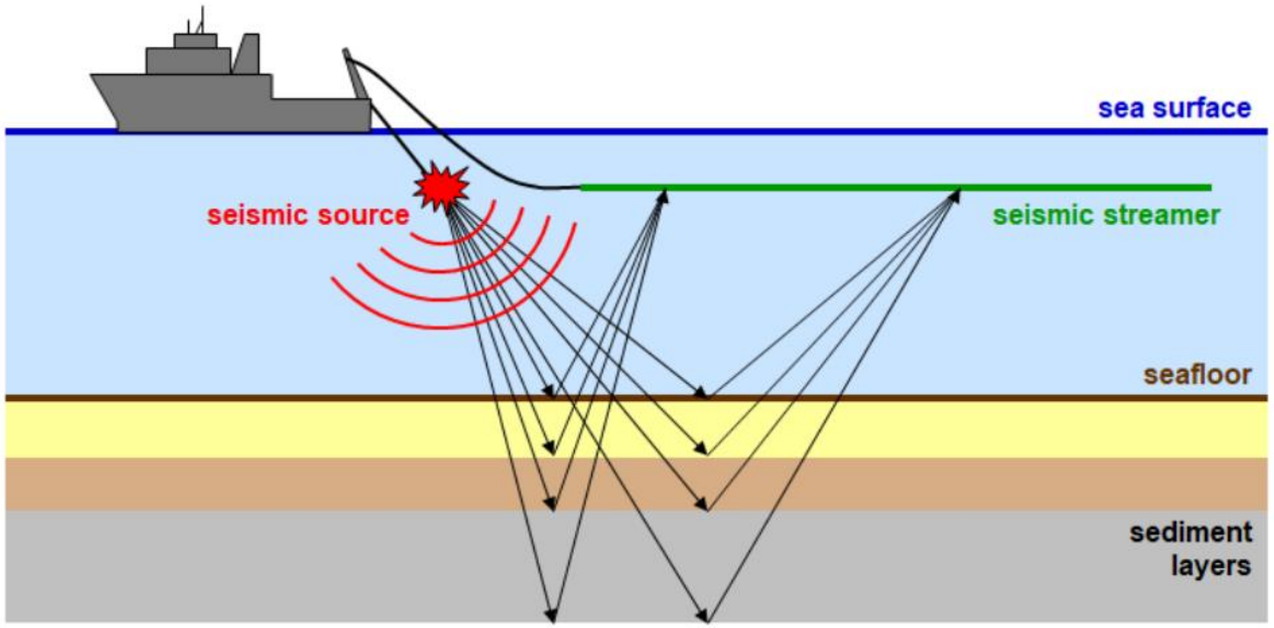
RESEARCH PROJECT HYDROPHONE

by Mowi & Adhit

PENGENALAN



Tujuan Proyek: “Data logger hydrophone”

Saran Komunikasi: SPI + Ethernet

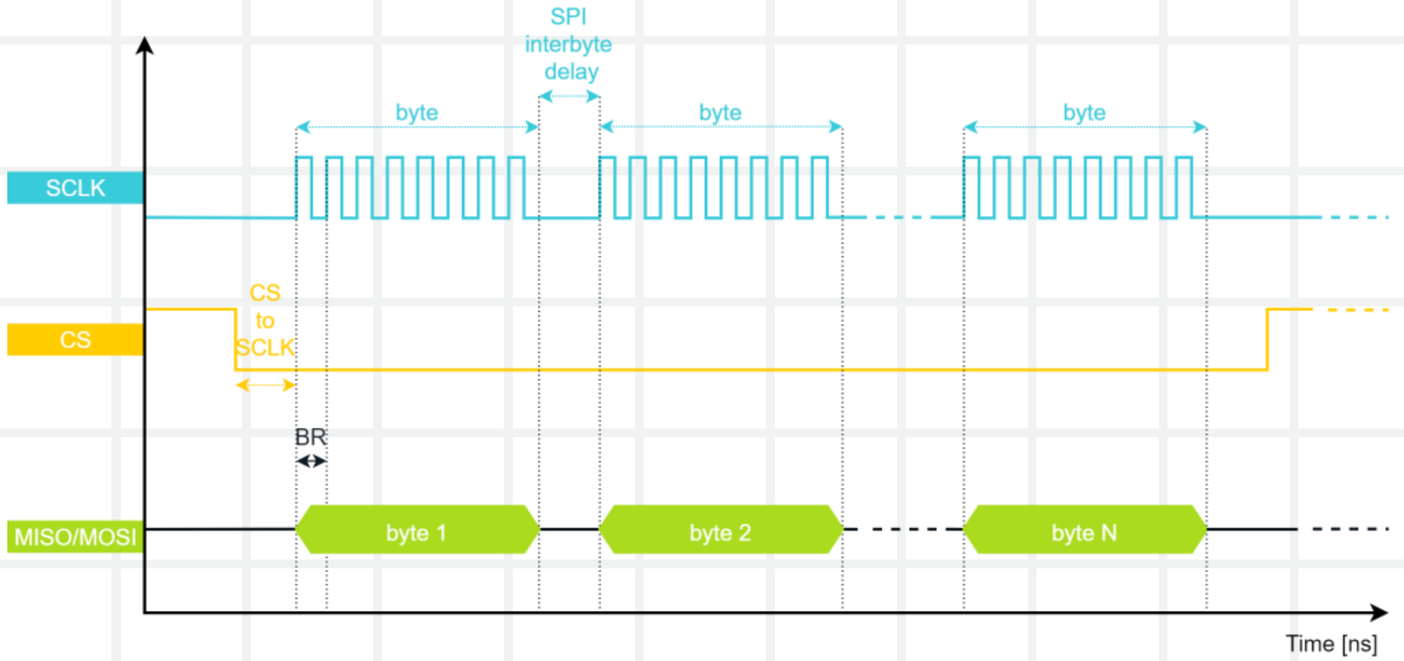
Kriteria Utama:

- Kecepatan transmisi tinggi.
- Akurasi data di lingkungan bising (laut).
- Jarak 100 meter tanpa degradasi sinyal.
- Arsitektur daisy chain.

PENGGUNAAN SPI + ETHERNET DAISY CHAIN

Keterbatasan SPI untuk jarak jauh:

1. Batas Jarak (Gangguan Noise/Skew Clock hingga 100m)
   - Penundaan propagasi mencapai 500 ns pada kabel 100m akibat kecepatan sinyal 5 ns/m, menyebabkan masalah sinkronisasi data-clock.
   - Arsitektur master-slave SPI rawan error pada jarak ini karena penundaan yang terakumulasi.

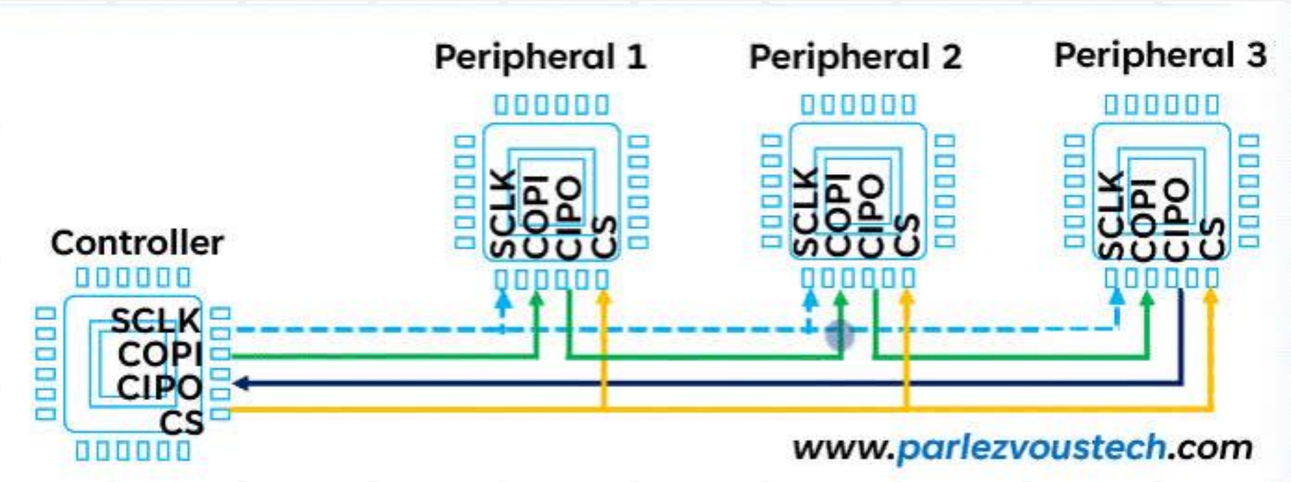


Sumber:
https://www.ti.com/lit/an/slyt441/slyt441.pdf
https://www.playembedded.org/blog/spi-101-a-beginners-guide/

PENGGUNAAN SPI + ETHERNET DAISY CHAIN

Keterbatasan SPI untuk jarak jauh:

2. Kompleksitas Sinkronisasi Daisy-Chain
   - SPI tersambung daisy-chain memerlukan timing siklus perintah yang presisi, dengan penundaan 1 siklus DIN-ke-DOUT per node.
   - Sinkronisasi hanya terjaga jika sinyal CS (Chip Select) tetap aktif (rendah) hingga semua node menerima data.

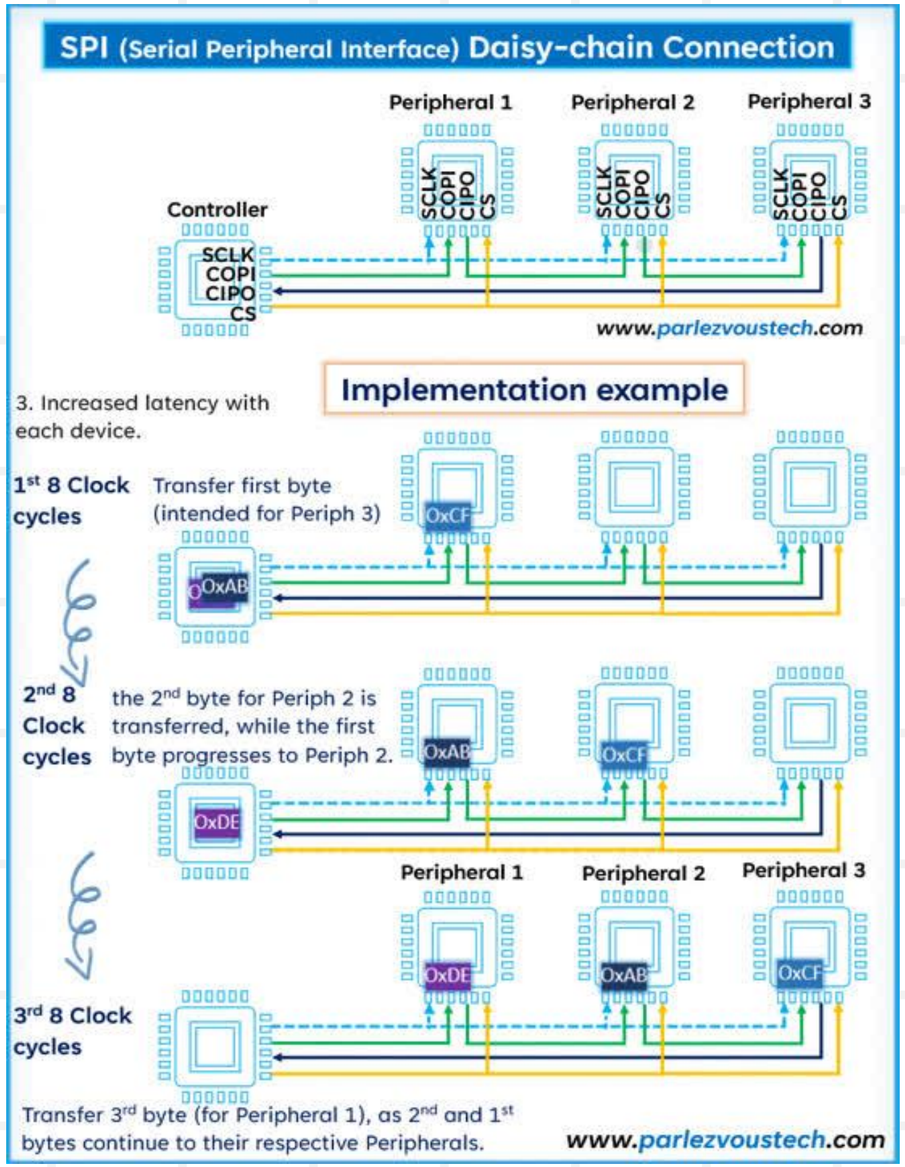


Sumber:
https://www.analog.com/en/resources/technical-articles/daisychaining-spi-devices.html
https://www.linkedin.com/pulse/discover-daisy-chain-spi-advantages-applications-samba-ndome-ccs7c/

PENGGUNAAN SPI + ETHERNET DAISY CHAIN

Keterbatasan SPI untuk jarak jauh:

3. Tantangan Kontrol CS (Chip Select)
   - Sistem multi-node tradisional membutuhkan jalur CS individual, meningkatkan kompleksitas hardware.
   - Daisy-chaining menyederhanakan CS menjadi satu sinyal, tetapi menimbulkan penundaan data bertingkat.



Sumber:
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https://www.linkedin.com/pulse/discover-daisy-chain-spi-advantages-applications-samba-ndome-ccs7c/

PENGGUNAAN SPI + ETHERNET DAISY CHAIN

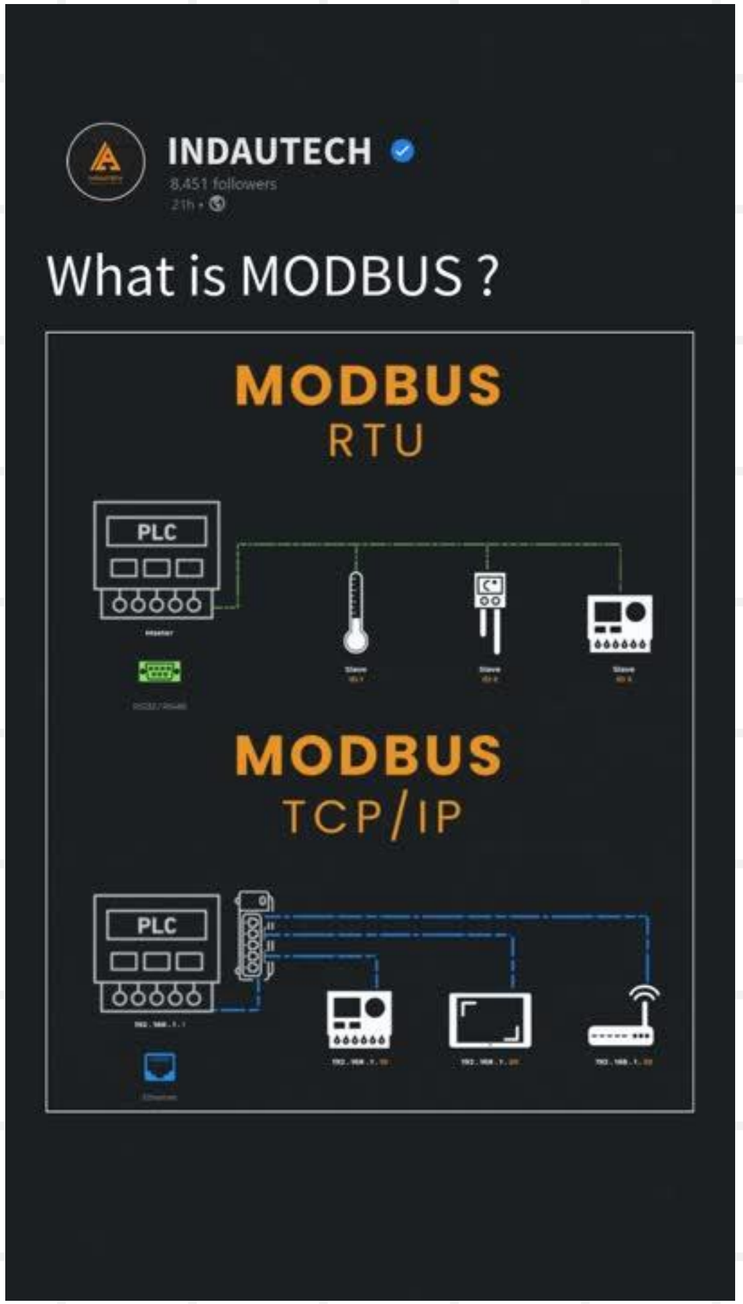
Perbandingan SPI Classic dengan Daisy Chain:

Criterion	SPI Classic	SPI Daisy Chain
Wiring complexity	High, requires one CS line per device	Reduced, a single CS line is enough
Device Management	Direct but becomes complex with multiple devices	Simplified, even with the addition of peripherals
Transmission speed	High, stable regardless of the number of devices	May decrease with increasing number of devices
System flexibility	Restrictive, limited by available GPIOs	High, facilitating modifications and extensions
Signal Integrity	Risk of interference with multiple connections	Improved in series configurations
Software implementation	Relatively simple for basic configurations	Requires precise device sequence management

Sumber:
https://www.linkedin.com/pulse/discover-daisy-chain-spi-advantages-applications-samba-ndome-ccs7c/

ModbusRTU vs TCP/IP

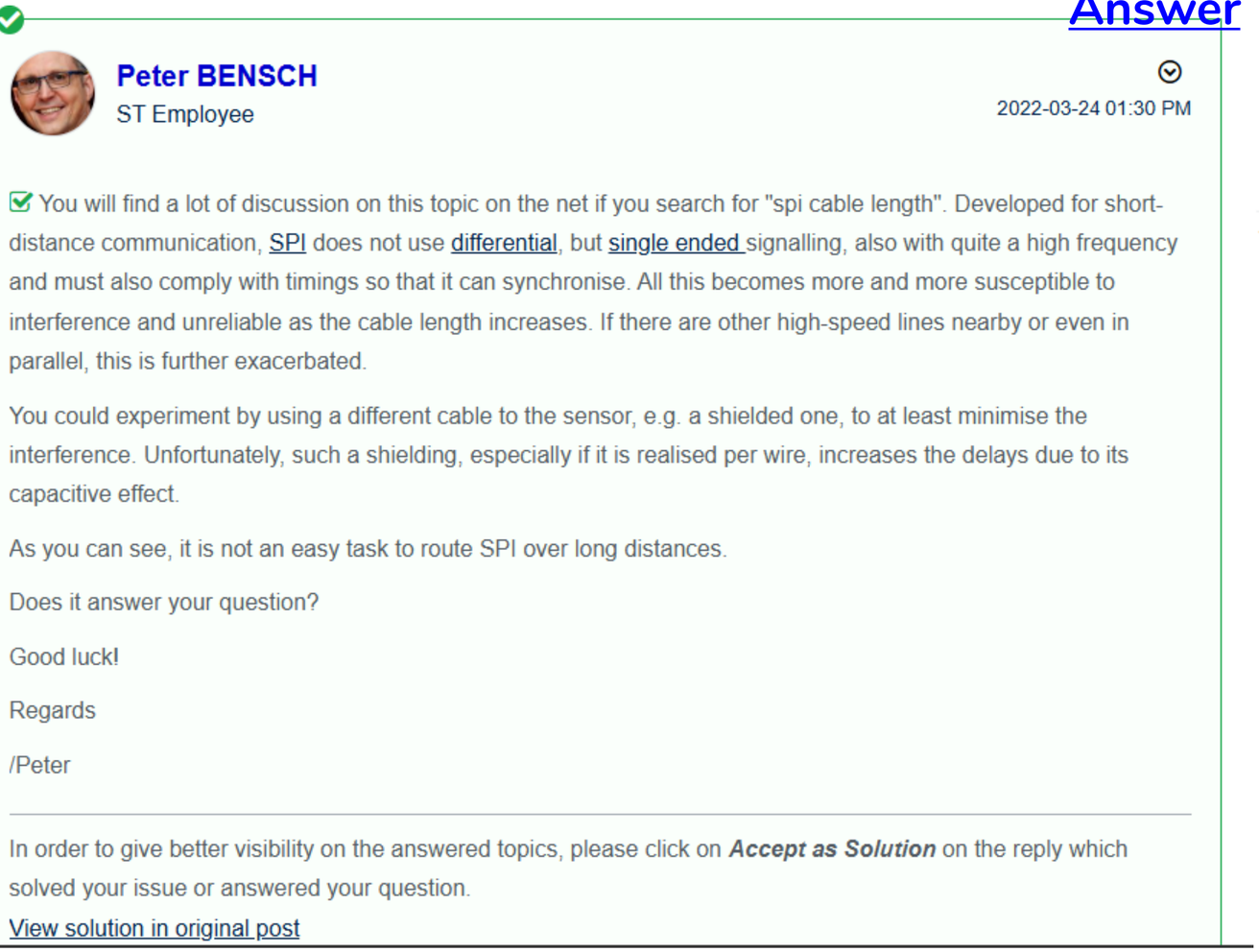
1. Modbus RTU:
   a. Menggunakan serial communication (RS-485 atau RS-232).
   b. Protokol lapisan fisik dan data link berbasis serial.
2. Modbus TCP/IP:
   a. Berjalan di atas Ethernet (TCP/IP stack: fisik, data link, jaringan, transport).
   b. Menggunakan kabel Ethernet dan perangkat jaringan seperti router/switch.



Sumber:
https://www.instagram.com/reel/DEIZAxMMeOz/?igsh=czV5NzN4M2Z0czhn

Karena jarak yang pendek bagaimana dengan expand menggunakan RS485? bukankah akhirnya sama saja menggunakan komunikasi RS485?

[Here is professional Answer]



Peter BENSCH
ST Employee

2022-03-24 01:30 PM

You will find a lot of discussion on this topic on the net if you search for "spi cable length". Developed for short-distance communication, SPI does not use differential, but single ended signalling, also with quite a high frequency and must also comply with timings so that it can synchronise. All this becomes more and more susceptible to interference and unreliable as the cable length increases. If there are other high-speed lines nearby or even in parallel, this is further exacerbated.

You could experiment by using a different cable to the sensor, e.g. a shielded one, to at least minimise the interference. Unfortunately, such a shielding, especially if it is realised per wire, increases the delays due to its capacitive effect.

As you can see, it is not an easy task to route SPI over long distances.

Does it answer your question?

Good luck!

Regards

/Peter

In order to give better visibility on the answered topics, please click on ***Accept as Solution*** on the reply which solved your issue or answered your question.

View solution in original post

It doesn't work when trying to extract data from a slave because of the turn-around time and the immediate possibility that data coming back will gradually become out-of-sync with the forward going clock signal over longer and longer distances. Thanks a lot :D this is what makes me think also since i haven't use or had bought the IC, the data could be not properly propagated for the uC to compute. Actually, what i'm currently building is a DAQ system so yeah, sensors are about acquiring data and its vital for me.
– Mheruian Feb 22, 2018 at 0:17

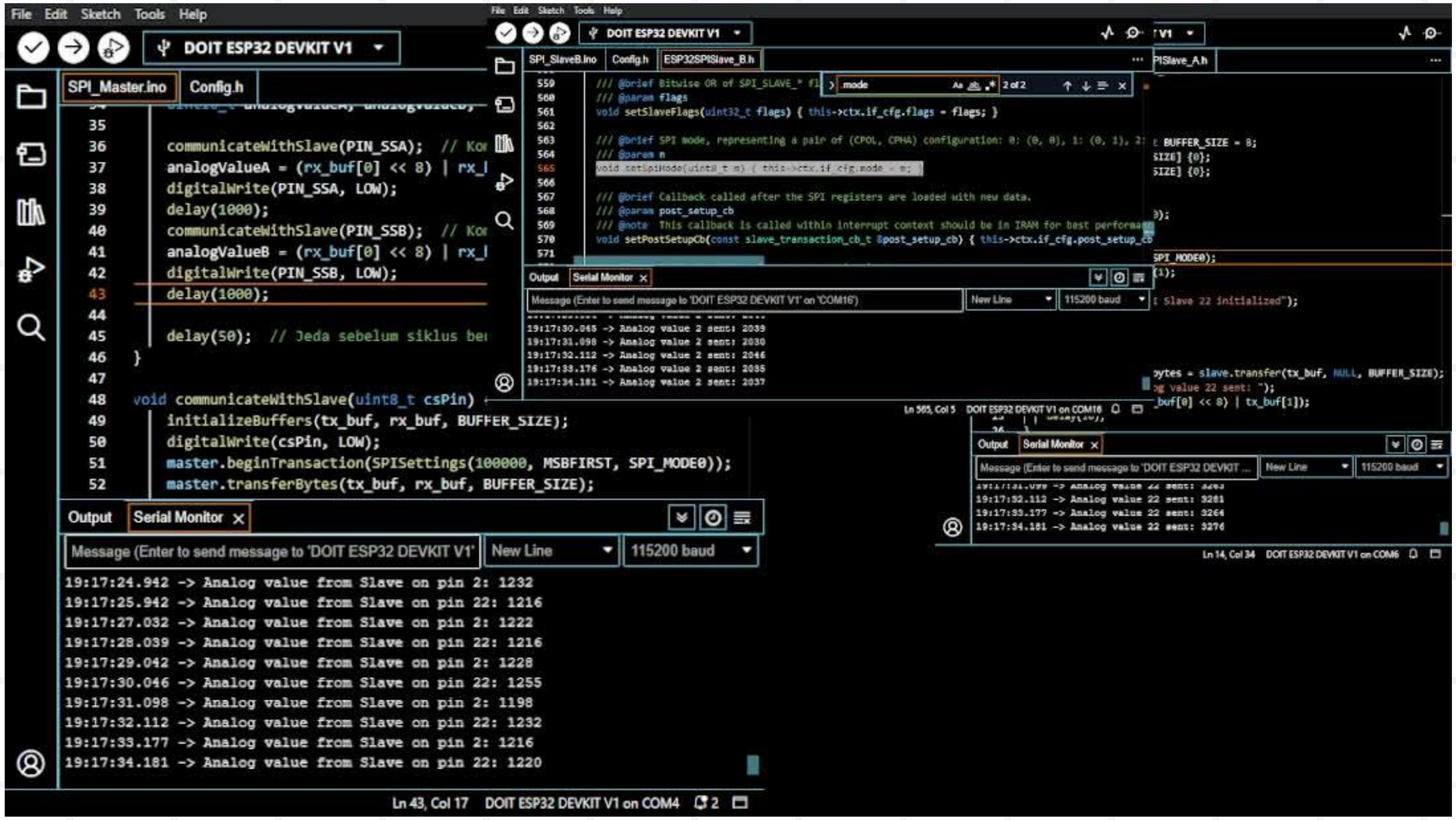
1 @Mheruian if you are happy with this answer please consider accepting it. If you need more clarification then ask. – Andy aka Feb 27, 2018 at 8:26

- Akan terdapat banyak noise
- Komunikasi hanya bisa satu arah jadinya master ke slave tidak bisa menerima data dari slave ke master
- STM32 Testimoni

Demo Komunikasi Antar Kontroller dengan SPI

Kesimpulan Demo:

- Data yang Diterima jadi random atau tidak stabil
- Kecepatan Transmisi data rendah



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Komunikasi hanya bisa satu arah jadinya master ke slave tidak bisa menerima data dari slave ke master

Analisis Solusi Alternatif

RS485 (Differential Signaling)

Kelebihan:

- Dirancang untuk jarak jauh (hingga 1200m pada 100 kbps).
- Tahan noise (sinyal diferensial).
- Mendukung topologi daisy chain.

Kecepatan Tinggi:

- IC modern (contoh: MAX3291) mencapai 50 Mbps pada 15m atau 25 Mbps pada 100m. (Internasional)
- Full-duplex (RS422) meningkatkan throughput.

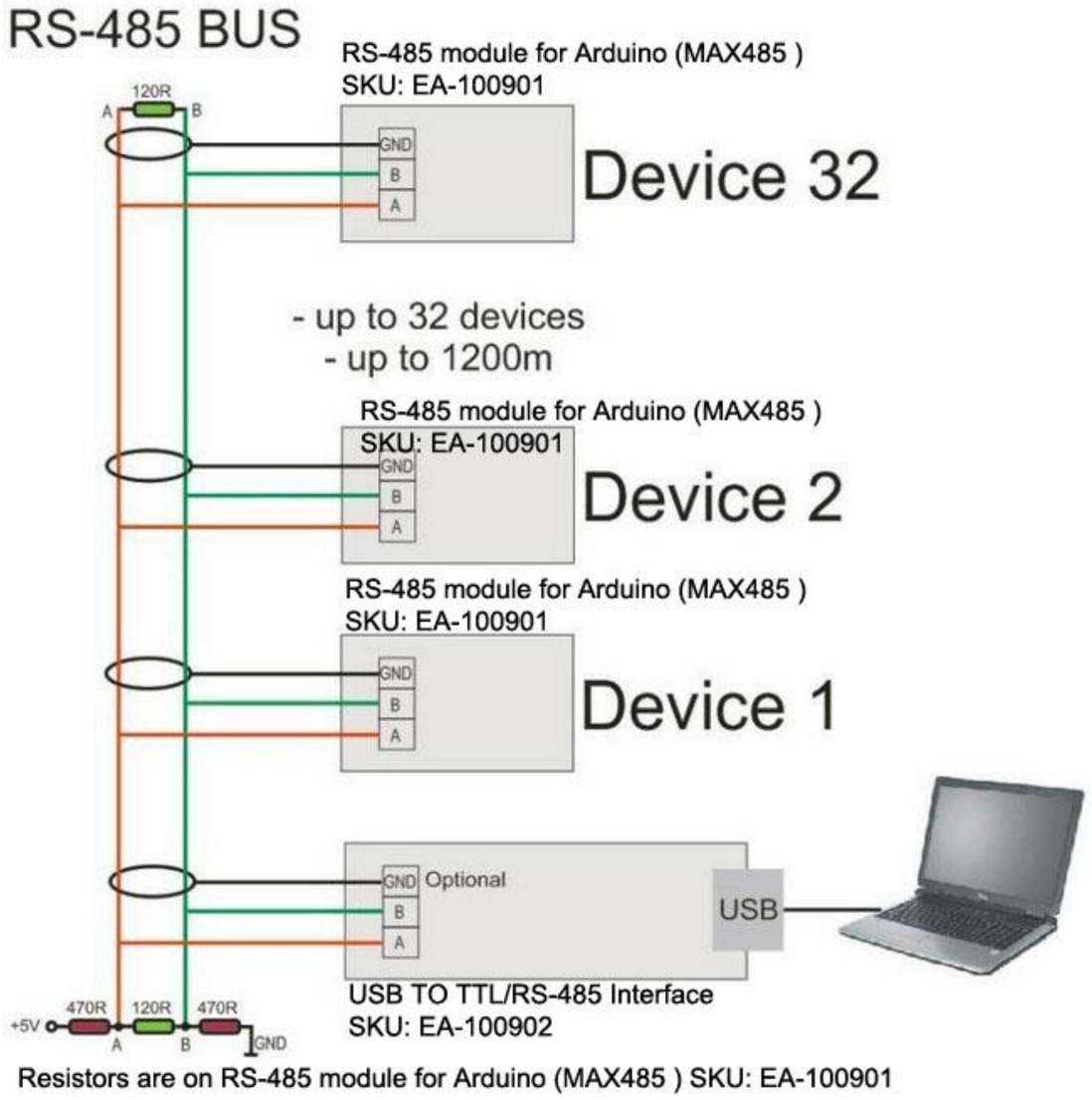
Optimasi Data:

- Kompresi data atau protokol efisien (misal: binning) untuk mengurangi beban transmisi

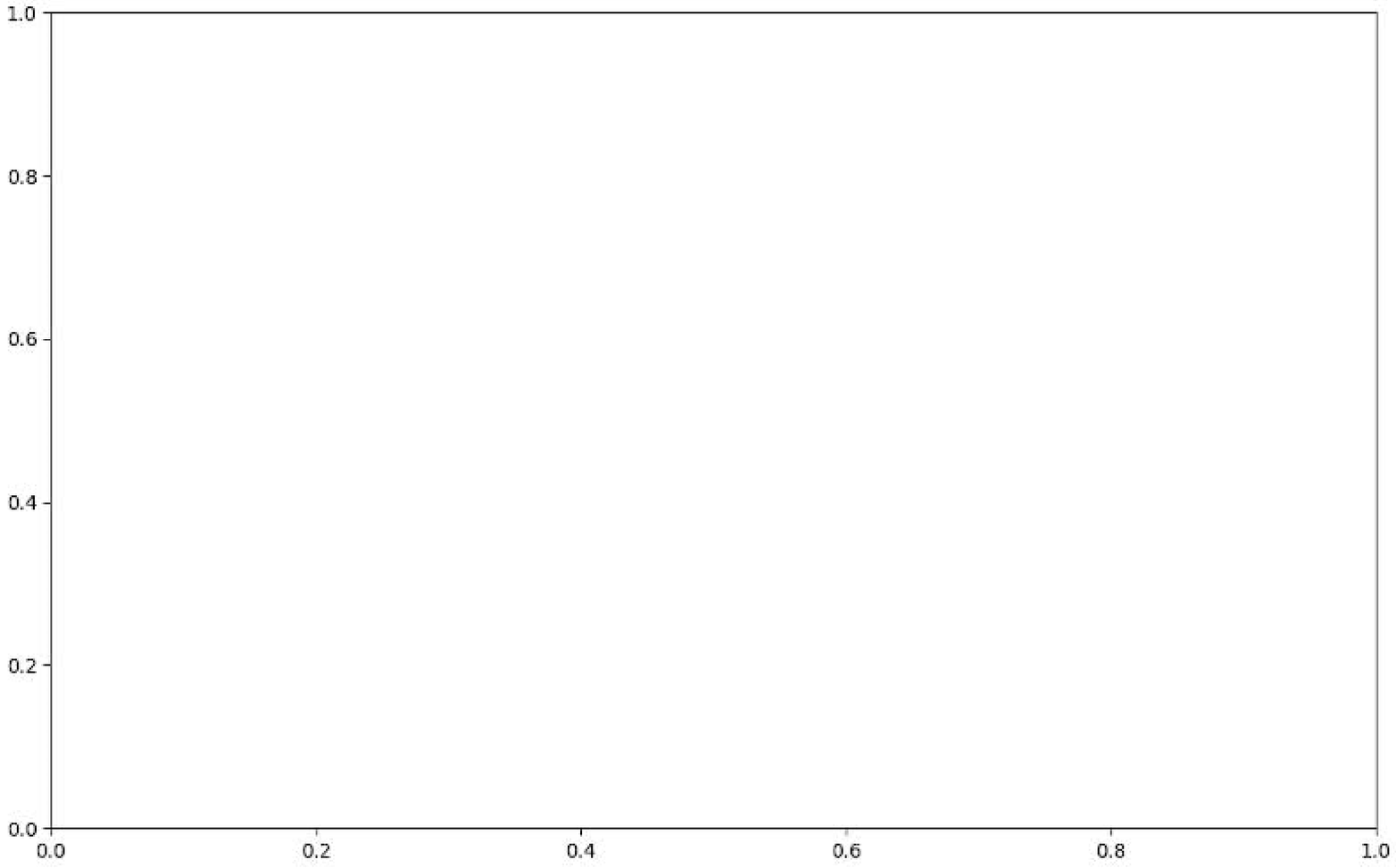
Sumber:


FIX_Respon_Cepat_RS485_Multi | Arduino IDE 2.3.4
File Edit Sketch Tools Help
ESP32 Dev Module
FIX_Respon_Cepat_RS485_Multi.ino
#define RX_PIN 16
#define TX_PIN 17
#define DE_RE_PIN 4
ModbusRTU mb;
uint16_t analogValues[4] = {0
unsigned long lastReadMillis
unsigned long sampleCount = 0
void setup() {
Serial.begin(115200);
Serial2.begin(115200, SERIA
pinMode(DE_RE_PIN, OUTPUT);
digitalWrite(DE_RE_PIN, LOW
mb.begin(&Serial2, DE_RE_PI
mb.slave(3); // Set Modbus
// Initialize Modbus holdi
for (int i = 0; i < 4; i++)
mb.addHreg(i); // Regist
Serial.printf("Register %
}
Output
Writing at 0x0003dd2a... (63 %)
Writing at 0x000430bb... (72 %)
Writing at 0x000485df... (81 %)
Writing at 0x00050e73... (90 %)
Writing at 0x00058e8d... (100 %)
Wrote 303680 bytes (167247 compress
Hash of data verified.
Leaving...
Hard resetting via RTS pin...
Ln 28, Col 13 ESP32 Dev Module on CO
Modbus Data Visualization
Slave 1
Slave Data
A0
A1
A2
A3
2.0
1.5
1.0
0.5
0
0
50
A0 Rate: 23.02 points/s
A1 Rate: 23.02 points/s
A2 Rate: 23.02 points/s
A3 Rate: 23.02 points/s
Total Rate: 92.09 points/s
VSCode [Administrator]
IDs here
ect COM port
hread
target=lambda: asyncio.run
ead
PORTS
powershell
Python: Test_Grafik_Blm_fix
Python: Test Gui
Python: Seismic_Plot_Default_...
Python: FIX_Respon_Cepat_RS4...
es: [2.181,
Spaces: 4 UTF-8 CRLF {} Python 3.11.2 64-bit

Arsitektur komunikasi Modbus RTU RS485



Resistors are on RS-485 module for Arduino (MAX485) SKU: EA-100901



Start

Stop

Reset Data Plot

Select Slave:

2

Select Range:

75