CEC Continuing Education Center

DesignNews

Getting Hands-On With the M5Stack Core Platform

DAY 5: Exploring M5Stack Core Bluetooth Applications

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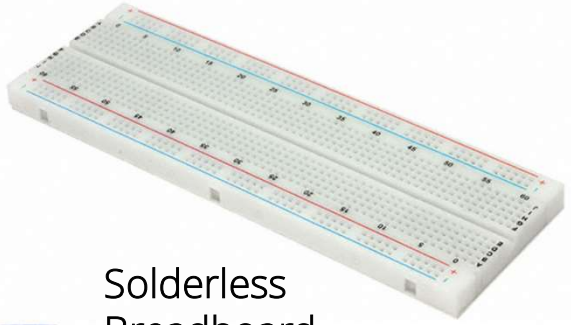
Dr. Don Wilcher

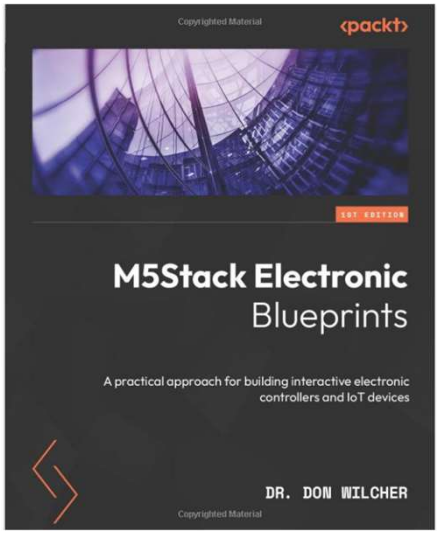
Visit ‘Lecturer Profile’ in your console for more details.

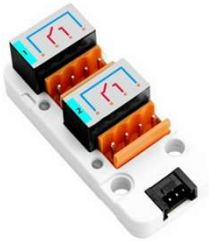
Course Kit and Materials

M5Go IoT Starter Kit V2.6



Solderless Breadboard





2 Channel SPST Relay Unit

Adafruit Parts Pal Kit

M5Stack Core2

Agenda:

- Origins of Bluetooth Technology
- Industrial Scientific Medical, Piconet, and Scatternet
- ESP32 with Bluetooth Introduction
- M5Stack Core2 Bluetooth Setup
- Build a Basic M5Stack Core2 Text Messaging Device
- Creating M5Stack Core2 Wireless Controller Device

M5Stack Core UIs

"An important note in designing and developing M5Stack Core UIs is simplicity. Simplicity is the design consideration consisting of using the important UI elements for communicating features and functions of your M5Stack Core device. (Wilcher, 2023, p. 24)."

Origins of Bluetooth Technology

- Bluetooth Technology dates back to the 1990s.
- The technological approach involves the collaborative efforts of several companies to create a wireless communication technology for short-range data exchange between devices.
- Ericsson, a Swedish telecommunication company, initiated the Bluetooth technology concept.
- Dr. Nils Rydbeck and Johan Ullman were instrumental in conceptualizing the technology in 1989.
- Dr. Rydbeck and Johan Ullman envisioned a way phones, computers, and accessories to wirelessly communicate over short distances.

Industrial Scientific Medical, Piconet, and Scatternet

- Bluetooth Technology uses the 2.4GHz band (2400 to 2483.5 MHz).
- This frequency band falls under the Industrial Scientific Medical (ISM) domain.
- The 2.4 GHz band is available world-world: a true standard for low-power wireless connectivity.
- The range for Bluetooth connectivity is approximately 30ft (10m).
- Bluetooth 5.3 specification supports a maximum distance of 240m (800ft).
- The Bluetooth 5.3 specification creates a piconet to connect other compatible wirelessly devices.

Question 1

What communications company initiated the Bluetooth technology concept?

a)Nortel
b)Motorola
c)Ericsson
d)none of the above

Industrial Scientific Medical, Piconet, and Scatternet

- The piconet establishes a master/slave or controller/controlled device approach for wirelessly data transmission.
- The controller device is responsible for managing the data transmissions of the controlled devices.
- Several piconets exchanging wireless data are known as a scatternet.
- The scatternet extends the range of Bluetooth through the bridging of nodes.

Industrial Scientific Medical, Piconet, and Scatternet

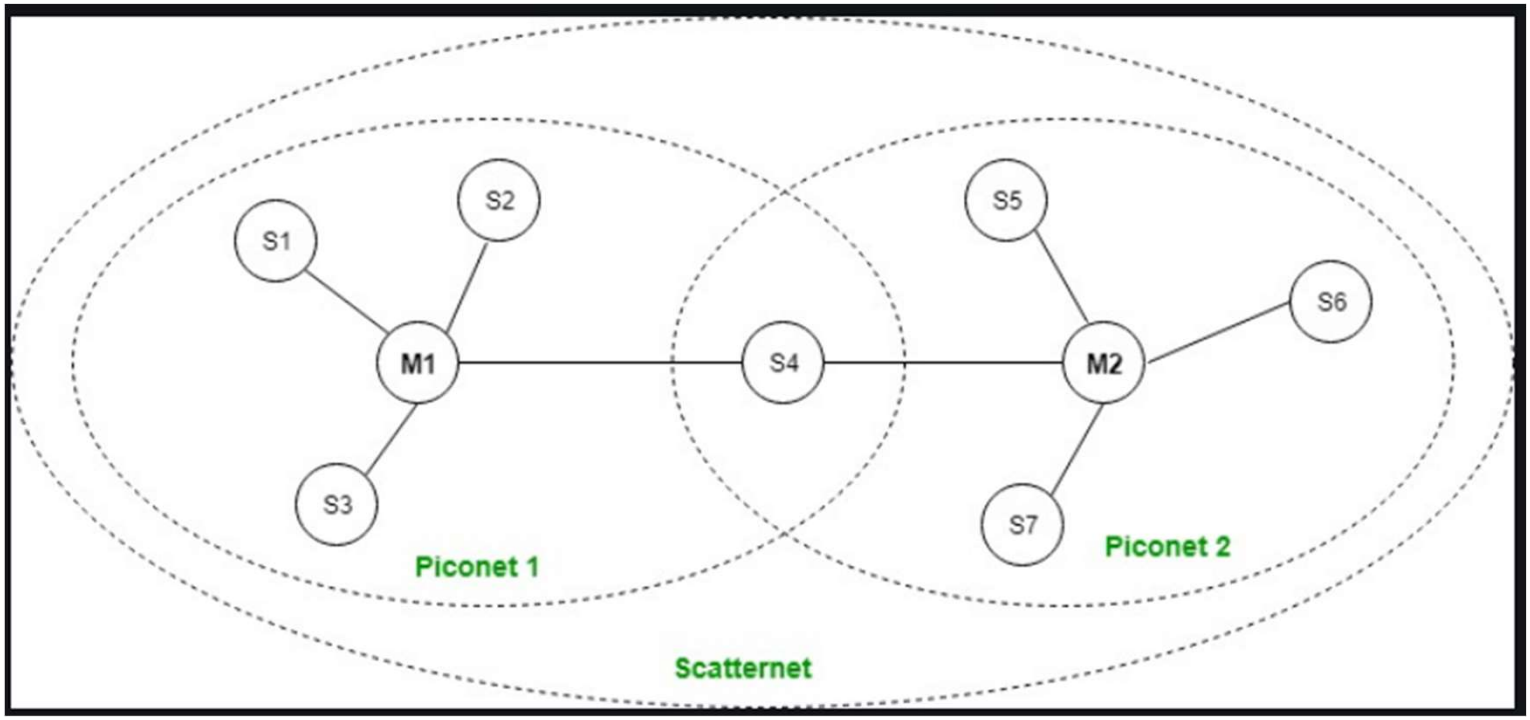


Image courtesy of geeksforgeeks/Bluetooth/

A Seminal Research Perspective on Communication Systems

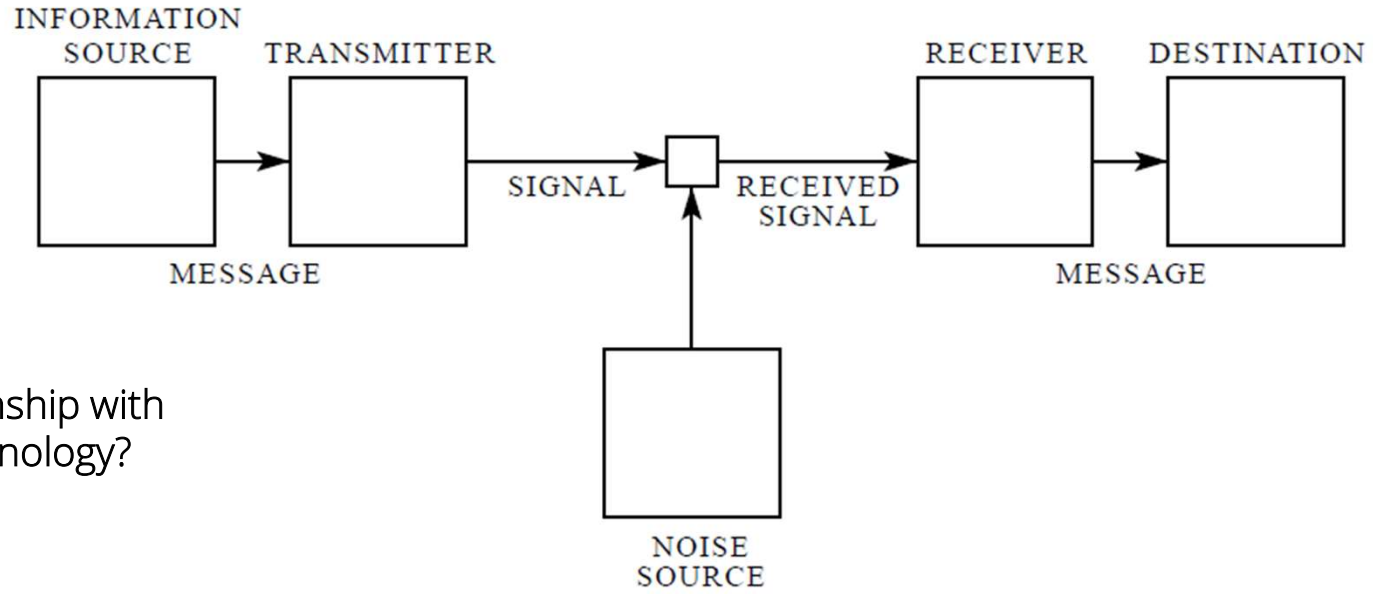


Fig. 1—Schematic diagram of a general communication system.

Is there a relationship with Bluetooth Technology?

Shannon, C.E. (1948). A mathematical theory of communication. *The Bell System Technical Journal*, *27*, 379- 656.

The ESP32 with Bluetooth Introduction

- The M5Stack Core2 uses an ESP32-DOWDQ6-V3 microcontroller incorporating a 240 MHz, dual-core microprocessor.
- The dual-core microprocessor provides efficiency in:
  a) computation
  b) managing input/output (I/O) of the microchip-using two central processing units (CPUs)
- This family of ESP32 microcontrollers has a Bluetooth chipset.
  a) link controller- handles the physical layer packets and all communication timing
  b) baseband – manages physical channels and uses other services in communication
     i. security
     ii. error correction

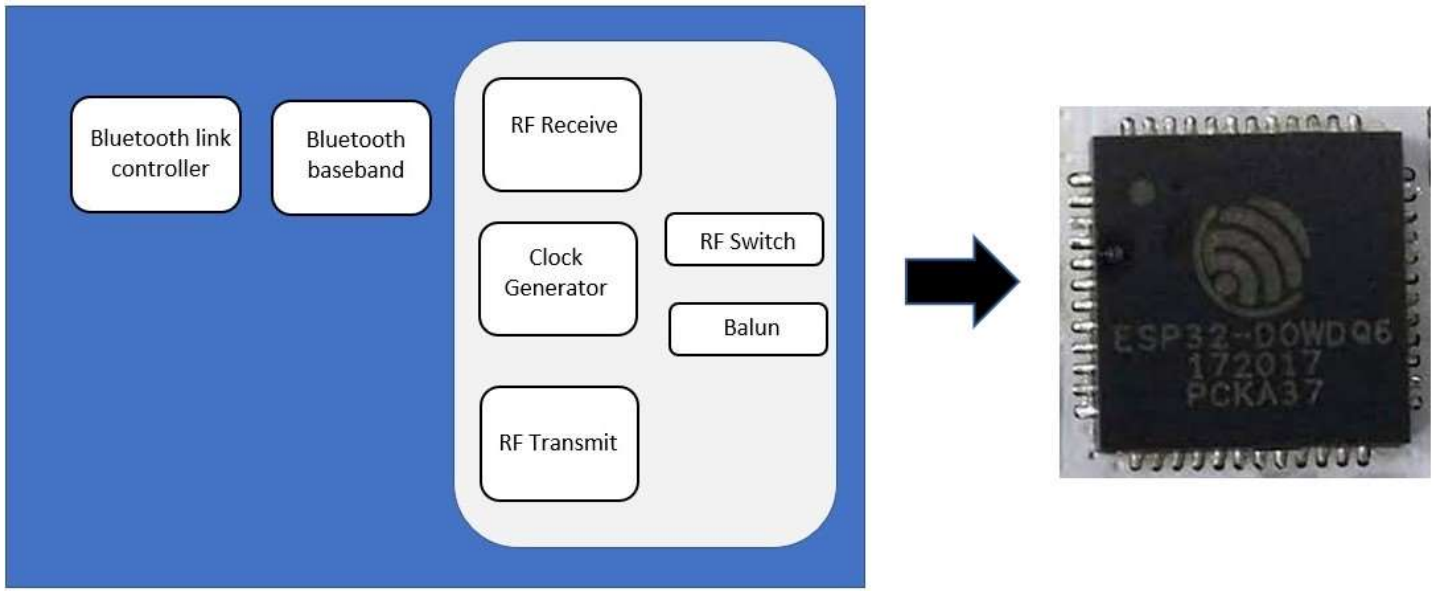
Question 2

What microcontroller is used in the M5Stack Core2?

a)ESP32-DOWDQ6-V3
b)ESP32-DOWDQ6-V2
c) ESP32-DOWDQ6-V1
d) none of the above

The ESP32 with Bluetooth Introduction

Images courtesy of the author



ESP32 Bluetooth chipset architecture

Wilcher, D. (2023, p. 201). *M5Stack Electronic Blueprints*. Packt.

The ESP32 with Bluetooth Introduction. . .

ESP32 Bluetooth chipset architecture definitions

- The clock generator- an electronic oscillator that produces a repetitive signal for synchronizing the Bluetooth link controller with the baseband.
- The RF Transmit circuit- allows a modulating signal with appropriate carrier wave and intelligence data to be sent to a designated or pair receiver.
- The RF Receive circuit – responsible for obtaining intelligence data from a demodulated designated or paired transmitter signal.
- The RF Switch is an electronic device that routes the received 2.4GHz signal from a designated or paired transmitter.

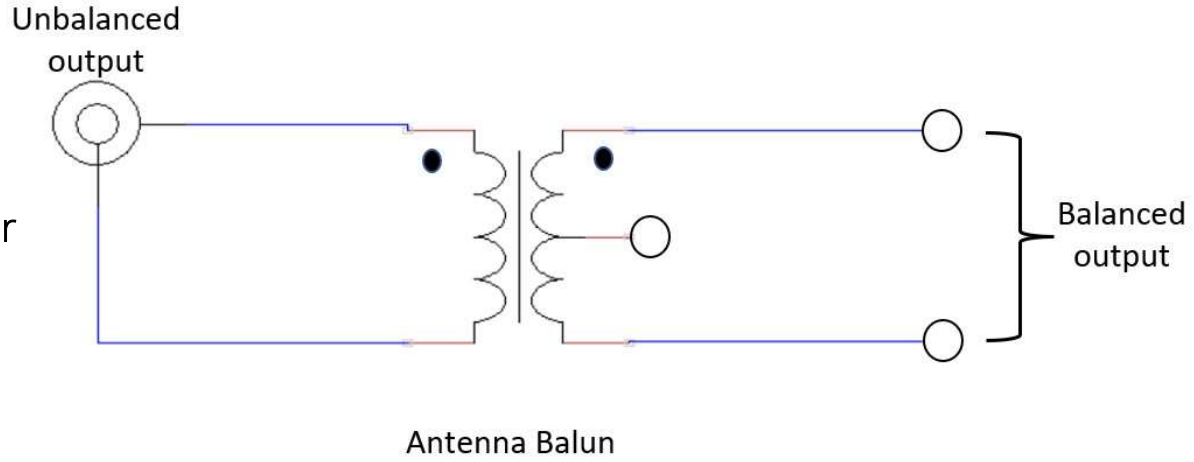
Wilcher, D. (2023, pp. 201- 202). *M5Stack Electronic Blueprints*. Packt.

The ESP32 with Bluetooth Introduction. . .

ESP32 Bluetooth chipset architecture definitions

The **balun** – an electrical device that converts an unbalance modulated received signal into a balanced or differential demodulated waveform.

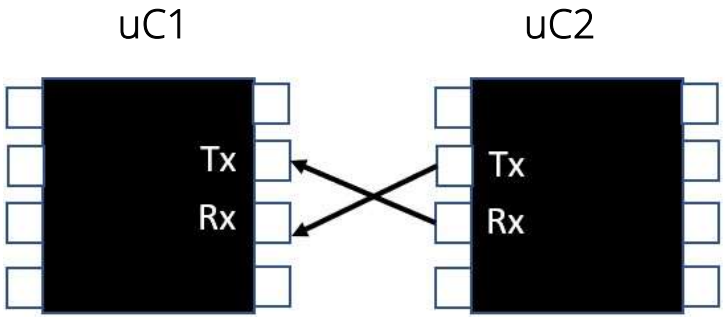
Image courtesy of the author



Wilcher, D. (2023, pp. 201- 202). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core2 Bluetooth Setup

BLE-UART Blockly Coding Blocks



Basic UART Communication method

Images courtesy of the author

Wilcher, D. (2023, p. 203). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core2 Bluetooth Setup. . .

UiFlow BLE IoT application device

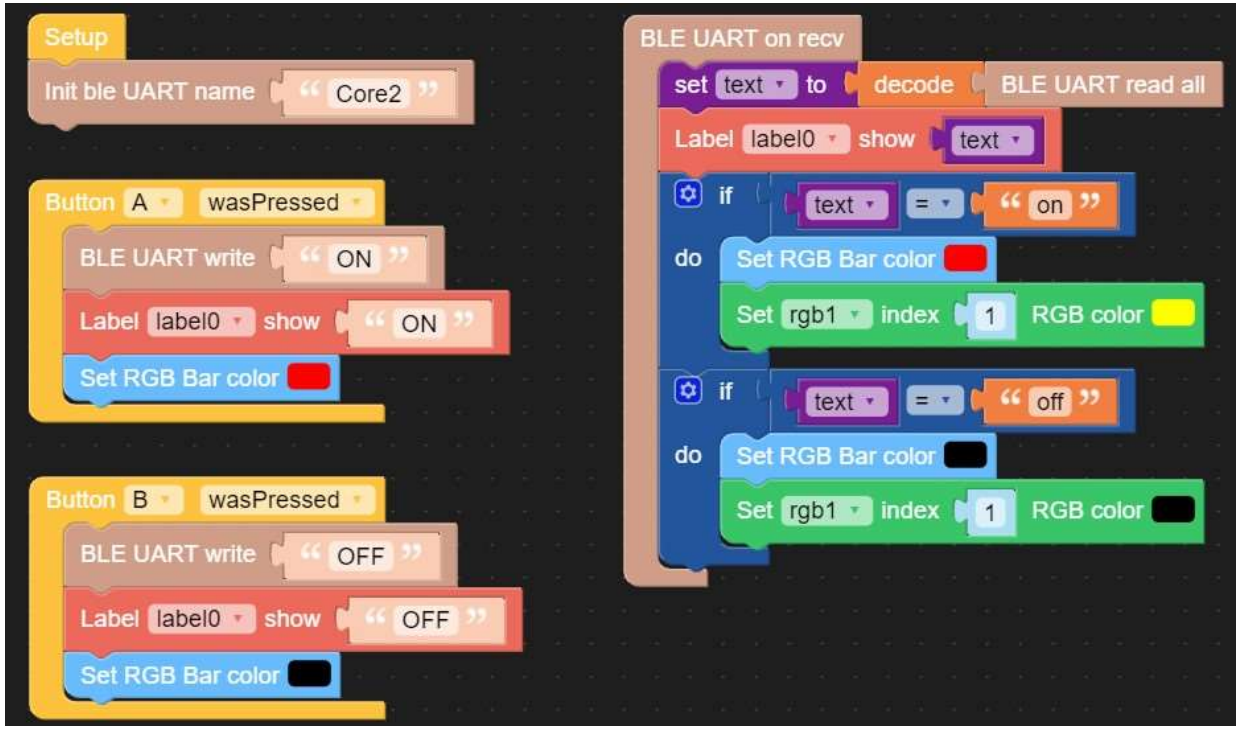


Image courtesy of the author

Wilcher, D. (2023, p. 203). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core2 Bluetooth Setup. . .

UiFlow coding process – BLE IoT application alignment

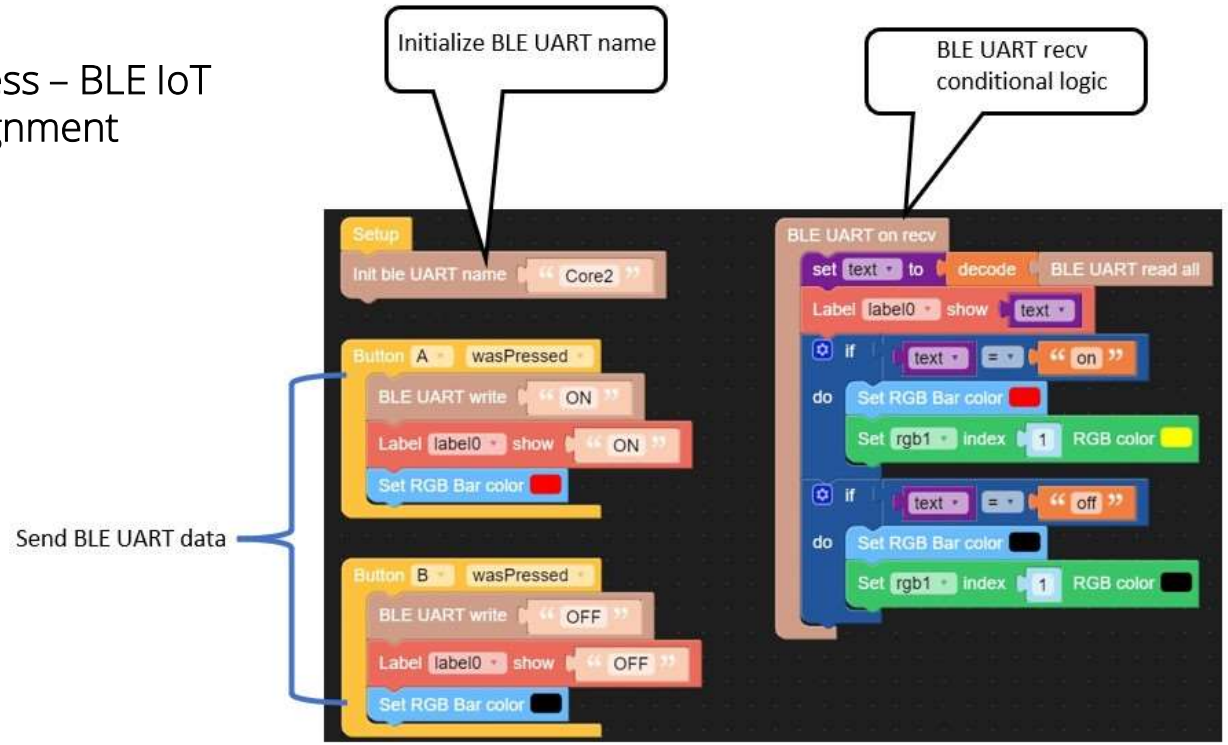


Image courtesy of the author

Wilcher, D. (2023, p. 206). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core2 Bluetooth Setup. . .

The Nordic Semiconductor nrF toolbox app to explore the M5Stack Core2 BLE UART

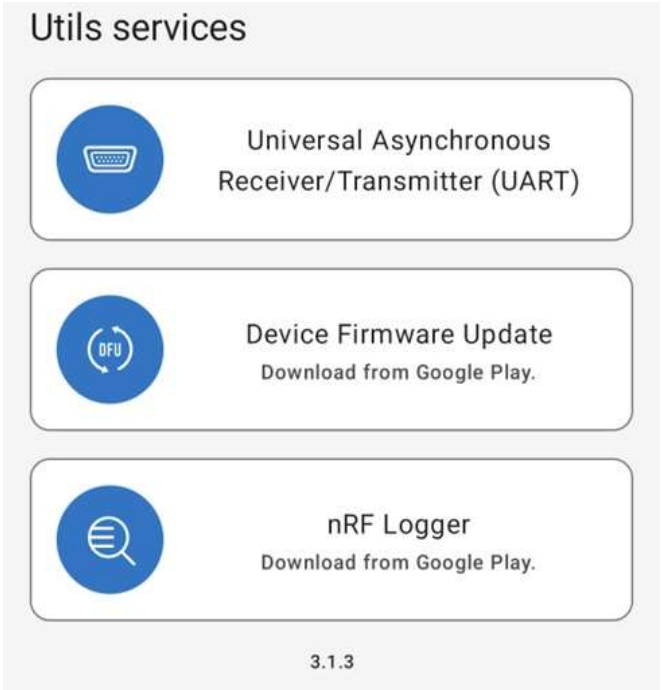
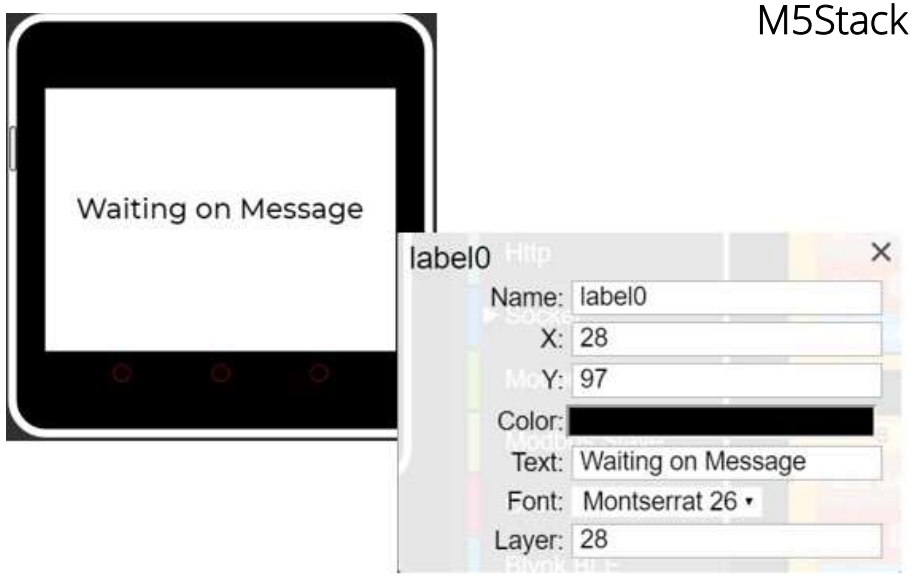


Image courtesy of the Nordic Semiconductor

Wilcher, D. (2023, p. 206). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core2 Bluetooth Setup. . .

M5Stack Core 2 UI l TFT LCD layout



Images courtesy of the author

Wilcher, D. (2023, p. 208). *M5Stack Electronic Blueprints*. Packt.

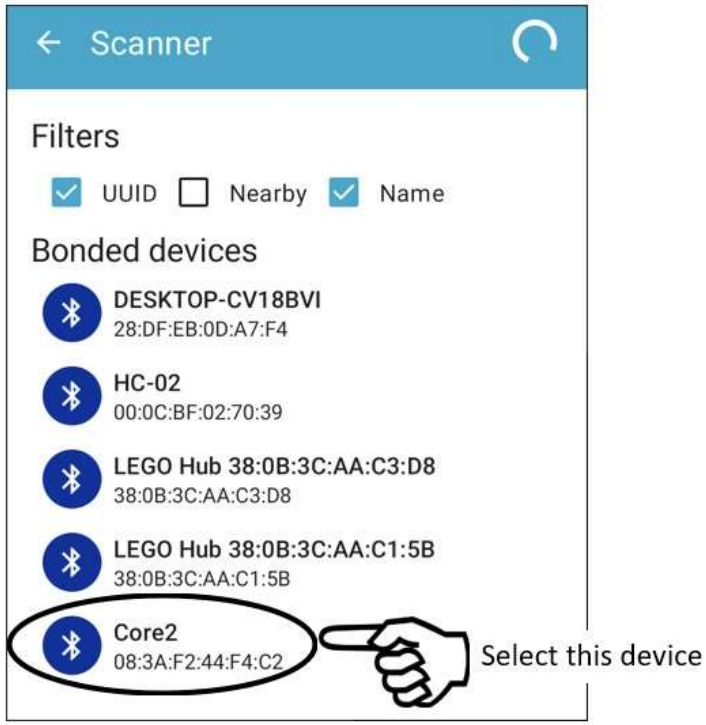
Question 3

UART stands for

a)Universal Asynchronous Rate Transmission
b)Universal Arbitrary Receiver Transmission
c)Universal Asynchronous Receiver Transmitter
d)none of the above

M5Stack Core2 Bluetooth Setup. . .

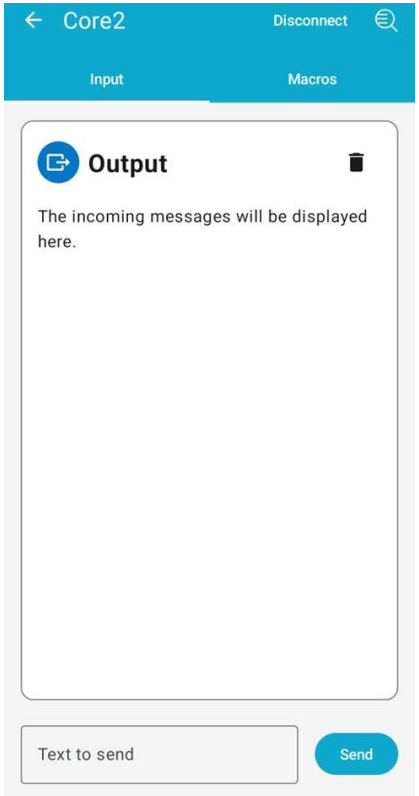
Scanning for M5Stack Core2 BLE Device using the Nordic UART Utility service profile app

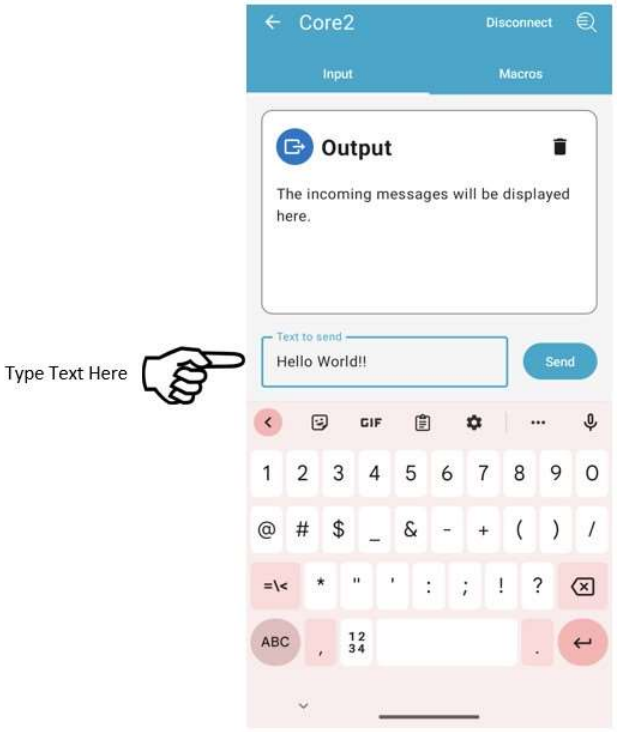


Images courtesy of the author

Wilcher, D. (2023, p. 206). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core2 Bluetooth Setup. . .



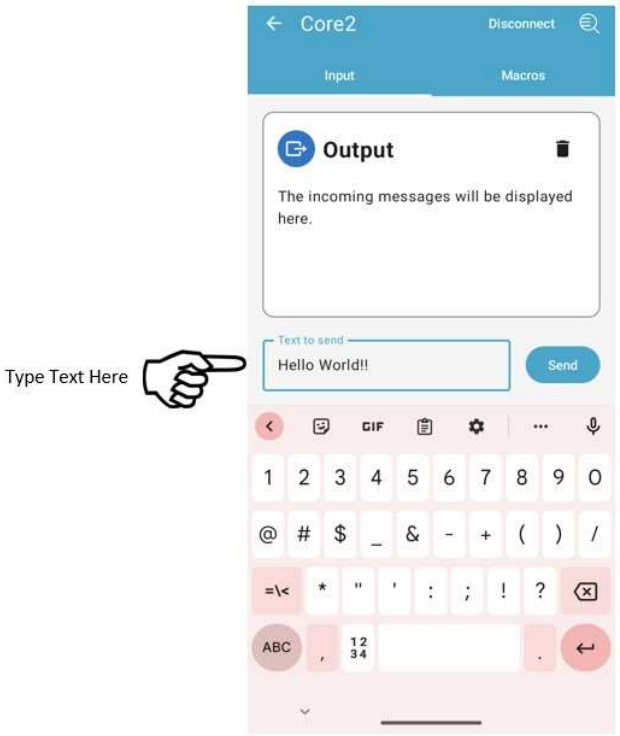


The Nordic nrF toolbox Output Window

Images courtesy of the author

Wilcher, D. (2023, pp. 210 - 211). *M5Stack Electronic Blueprints*. Packt.

M5Stack Core2 Bluetooth Setup. . .

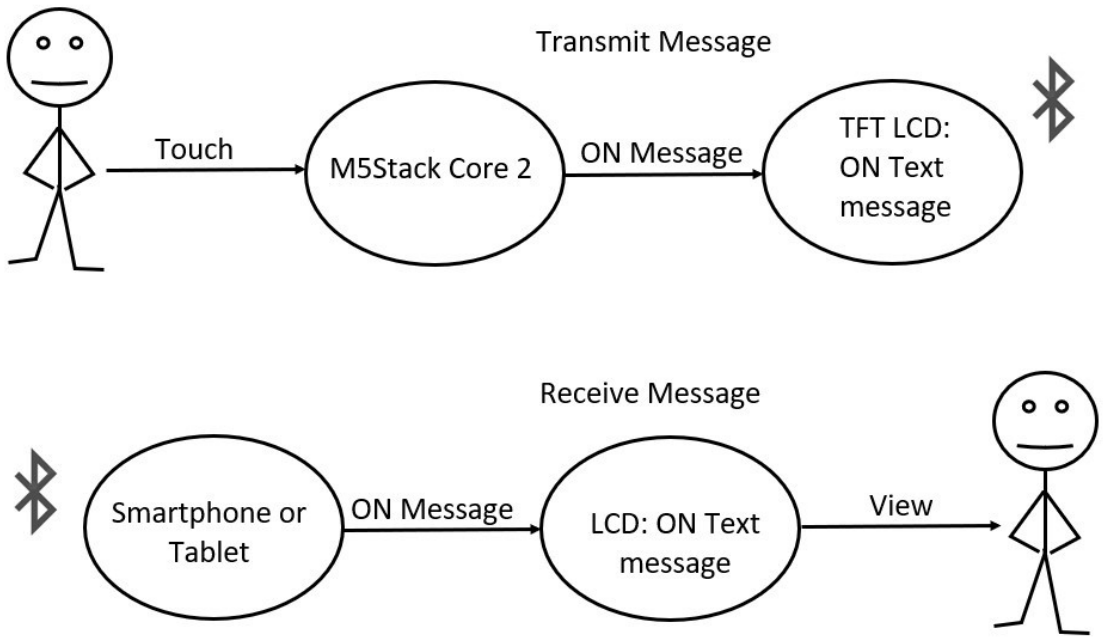


Displaying Hello World on the M5Stack Core 2

Images courtesy of the author

Wilcher, D. (2023, p. 211). *M5Stack Electronic Blueprints*. Packt.

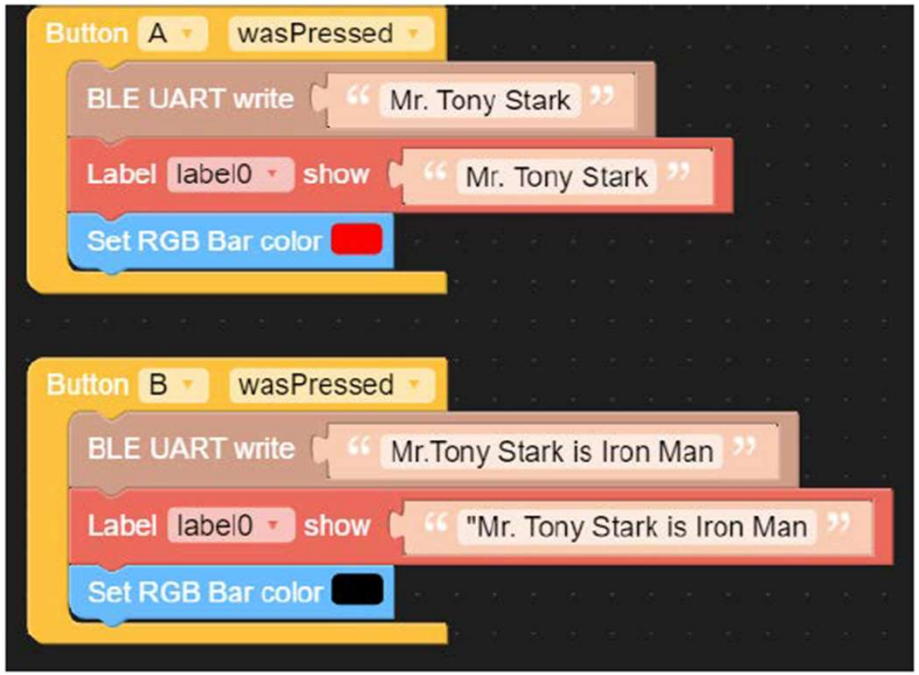
Build a Basic M5Stack Core 2 Text Messaging Device



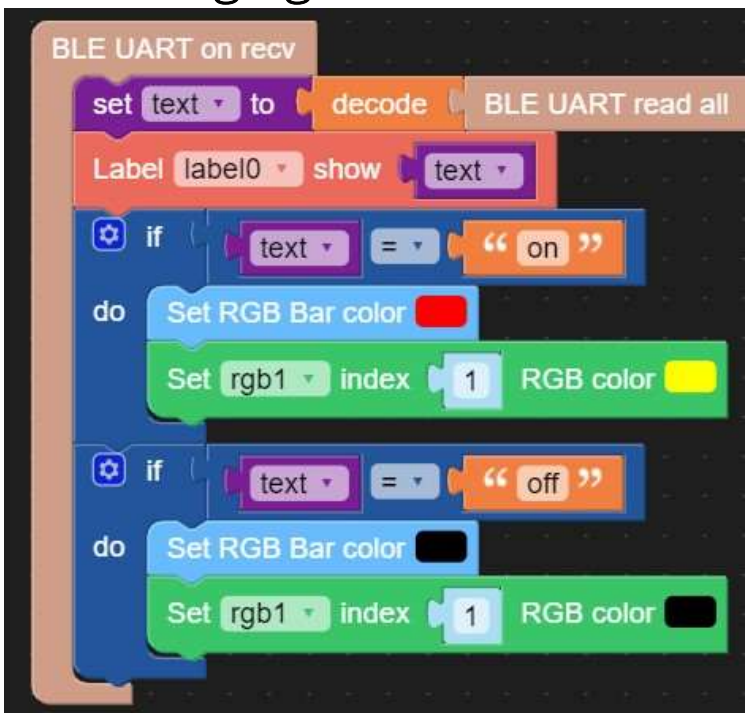
M5Stack Core2 Use Case – A Basic Messaging Device

Wilcher, D. (2023, p. 212). *M5Stack Electronic Blueprints*. Packt.

Build a Basic M5Stack Core 2 Text Messaging Device. . .



BLE UART on transmit programming structure

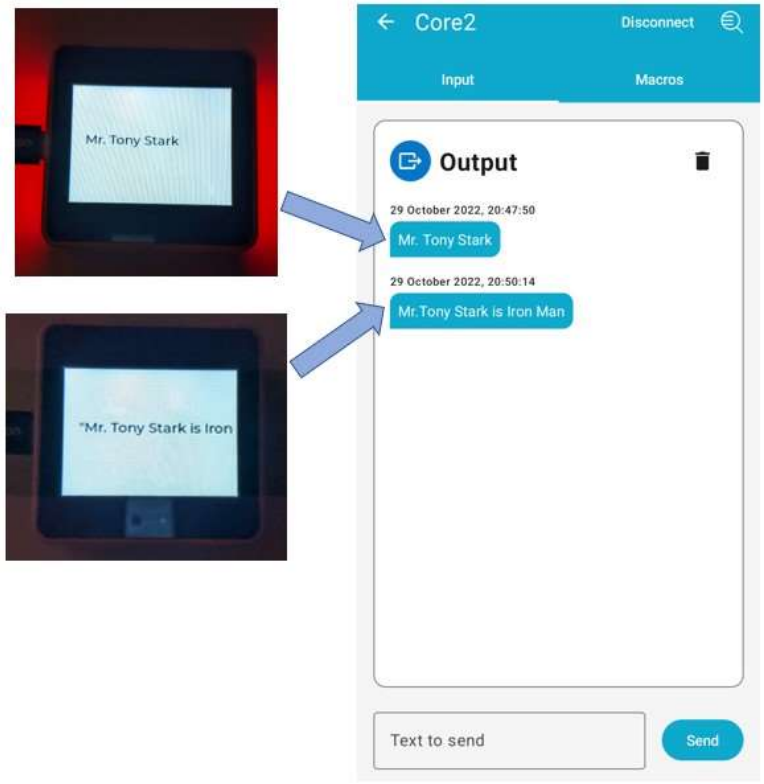


BLE UART on recv programming structure

Images courtesy of the author

Wilcher, D. (2023, pp. 213 -214). *M5Stack Electronic Blueprints*. Packt.

Build a Basic M5Stack Core 2 Text Messaging Device. . .



BLE UART transmitted string messages

Image courtesy of the author

Wilcher, D. (2023, p. 214). *M5Stack Electronic Blueprints*. Packt.

Creating a Basic M5Stack Core 2 Wireless Controller Device

M5Stack Core2 Use Case – Wireless Controller Device

BLE UART transmit:
ON message

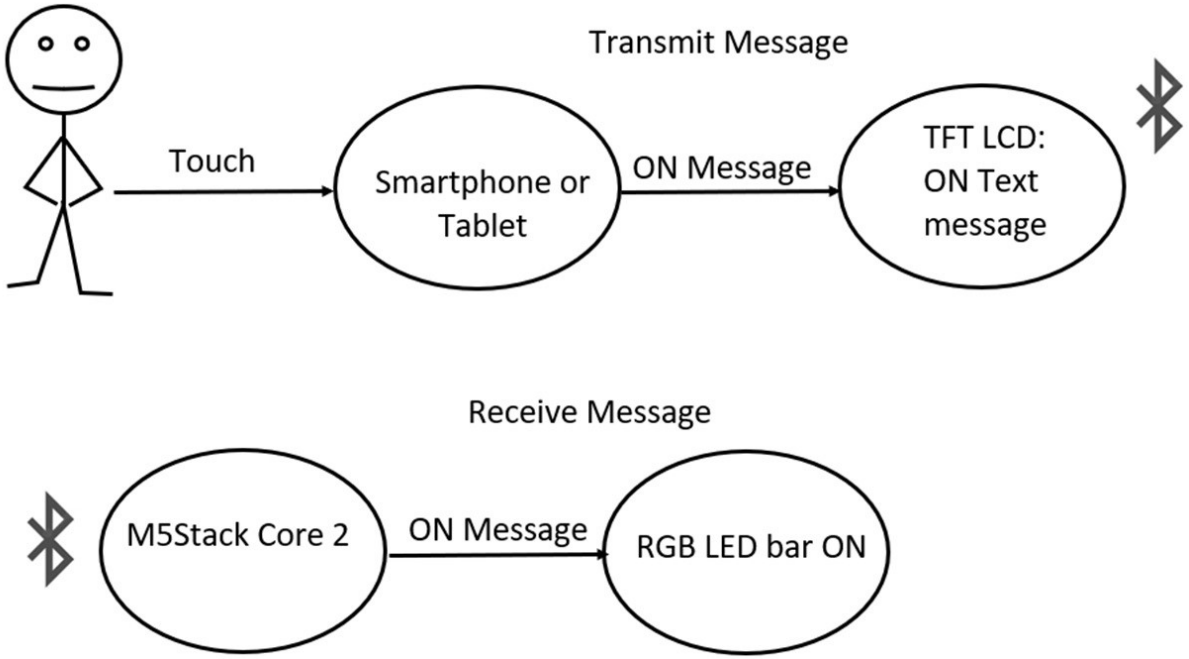


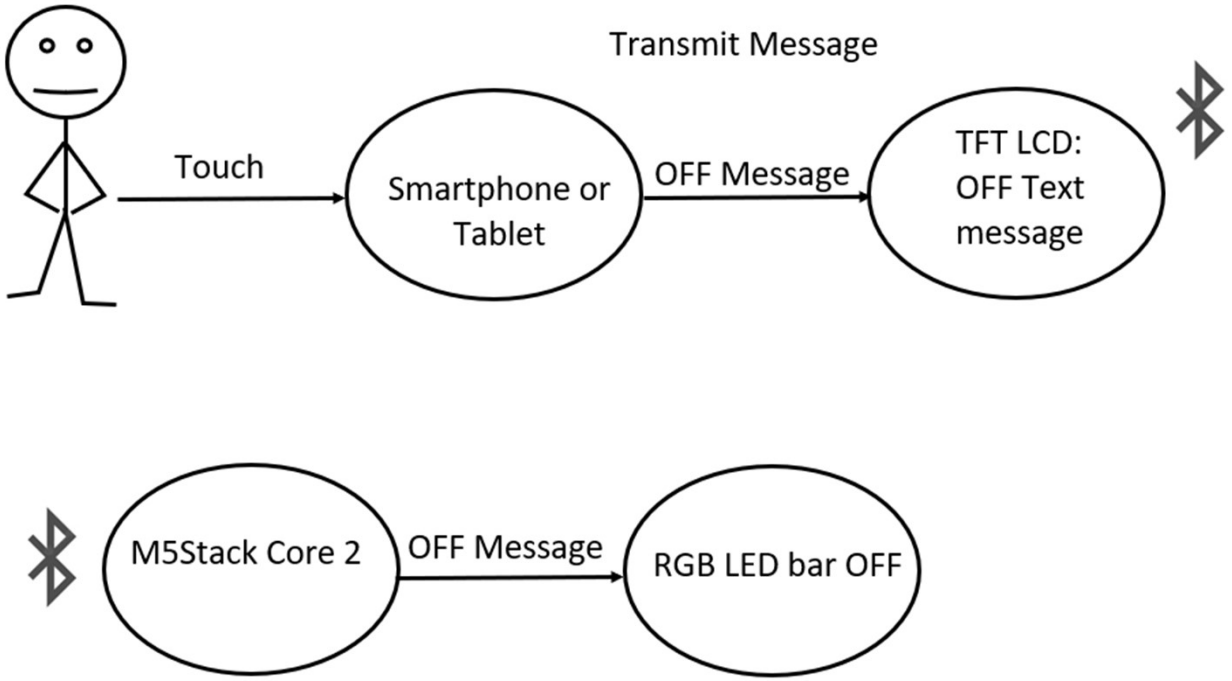
Image courtesy of the author

Wilcher, D. (2023, p. 215). *M5Stack Electronic Blueprints*. Packt.

Creating a Basic M5Stack Core 2 Wireless Controller Device. . .

M5Stack Core2 Use Case – Wireless Controller Device

BLE UART transmit:
OFF message



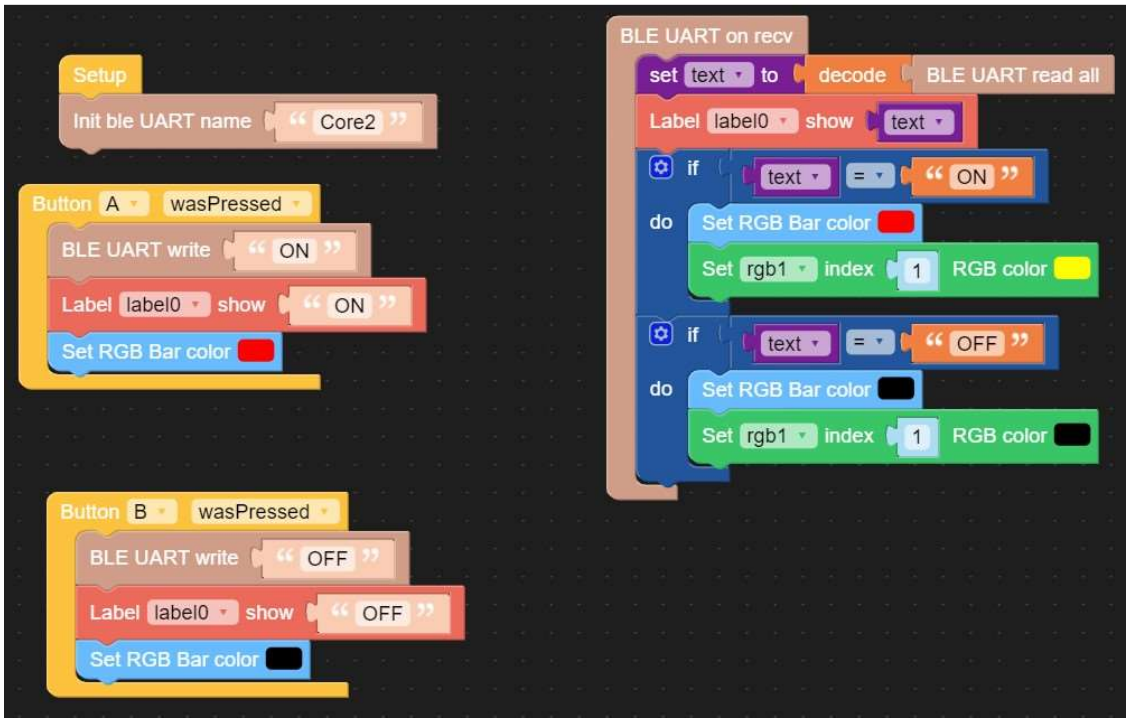
Wilcher, D. (2023, p. 216). *M5Stack Electronic Blueprints*. Packt.

Image courtesy of the author

Creating a Basic M5Stack Core 2 Wireless Controller Device. . .

M5Stack Core2 Use Case – Wireless Controller Device

BLE UART receiver-controller Blockly code blocks



Wilcher, D. (2023, p. 216). *M5Stack Electronic Blueprints*. Packt.

Image courtesy of the author

Question 4

Which Blockly code block is used to receive BLE data?

a) BLE UART on receiver
b) BLE UART on rcv
c) BLE UART on recv
d) none of the above

Creating a Basic M5Stack Core 2 Wireless Controller Device. . .

M5Stack Core2 Use Case – Wireless Controller Device

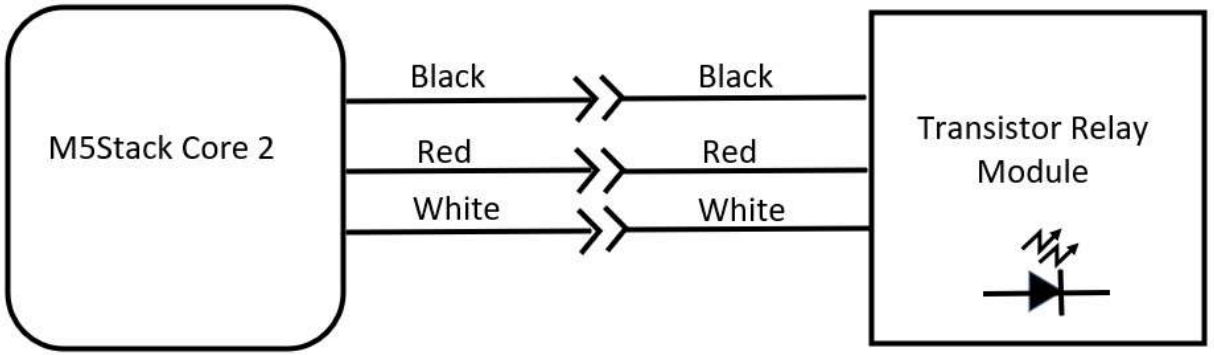
Text received red LED bar
ON-OFF Control Operation

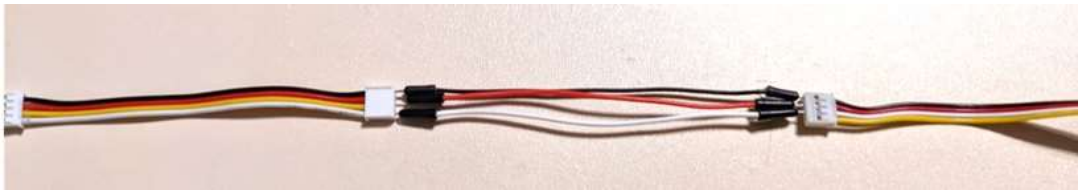
Wilcher, D. (2023, p. 216). *M5Stack Electronic Blueprints*. Packt.

Image courtesy of the author

Creating a Basic M5Stack Core 2 Wireless Controller Device. . .

Building a wire harness for operating a Transistor Relay Module



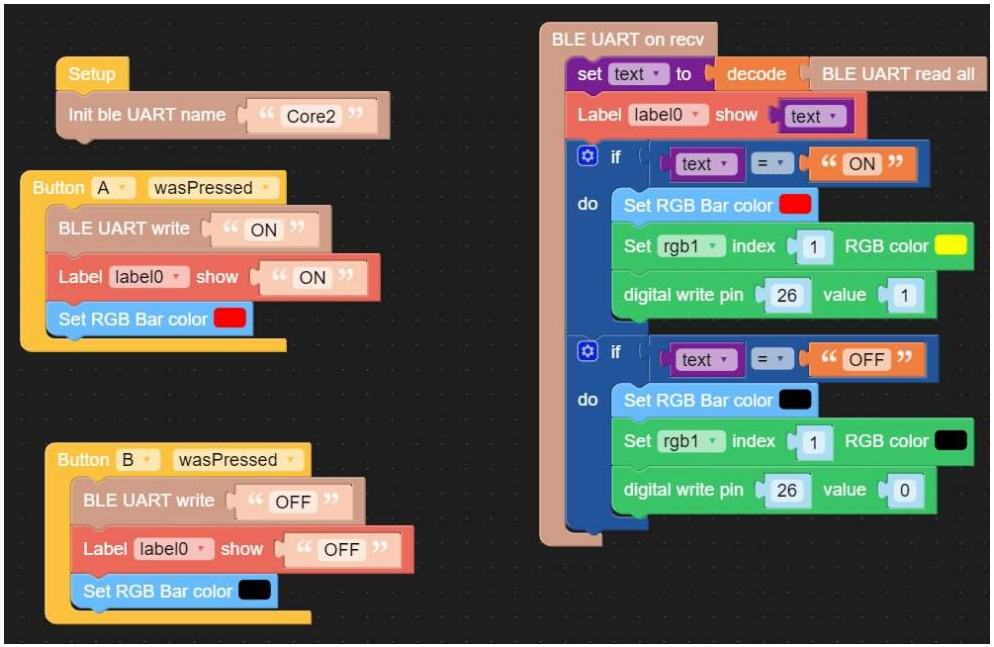


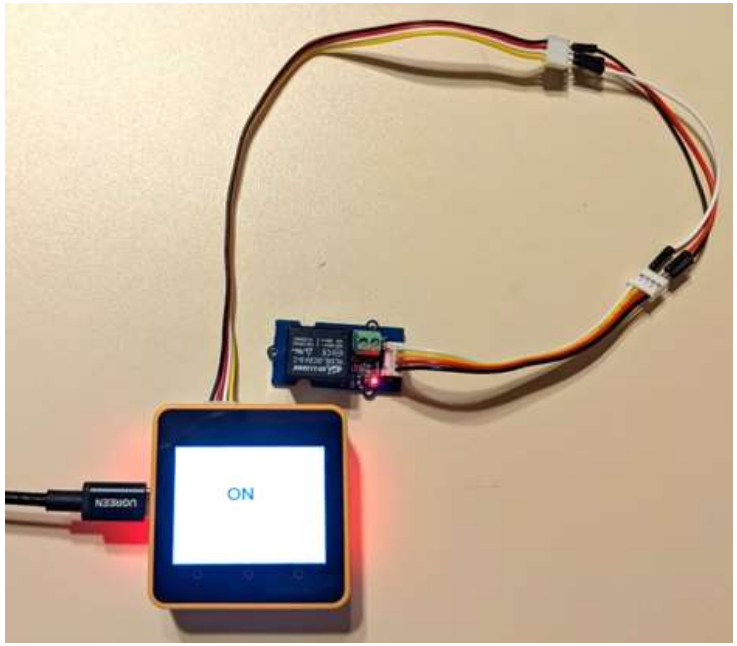
Wilcher, D. (2023, p. 219). *M5Stack Electronic Blueprints*. Packt.

Images courtesy of the author

Creating a Basic M5Stack Core 2 Wireless Controller Device. . .

UiFlow Blockly Code and the Control of the Transistor Relay Module-ON control



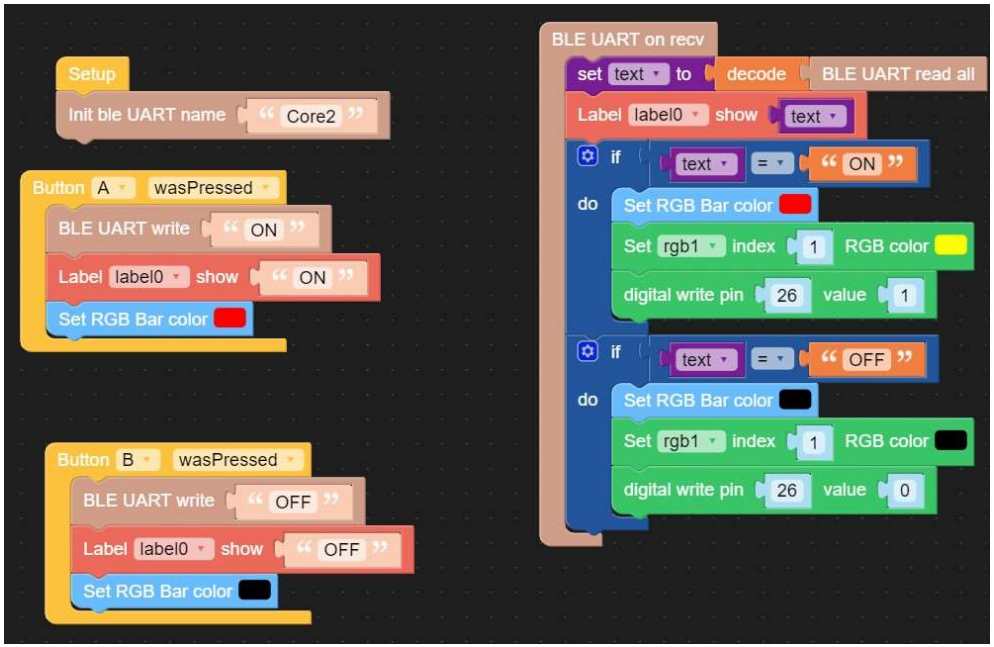


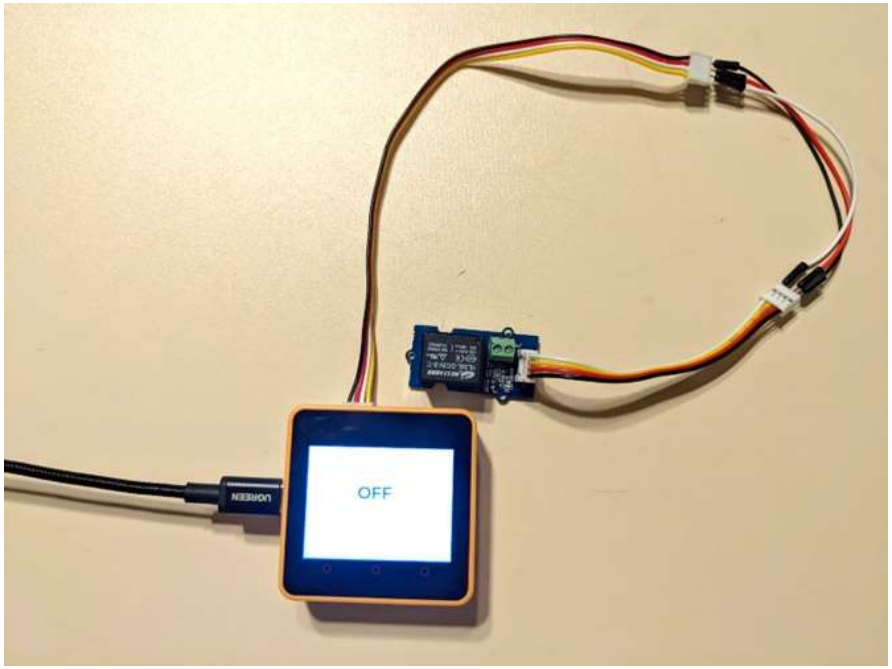
Wilcher, D. (2023, p. 220). *M5Stack Electronic Blueprints*. Packt.

Images courtesy of the author

Creating a Basic M5Stack Core 2 Wireless Controller Device. . .

UiFlow Blockly Code and the Control of the Transistor Relay Module-OFF control



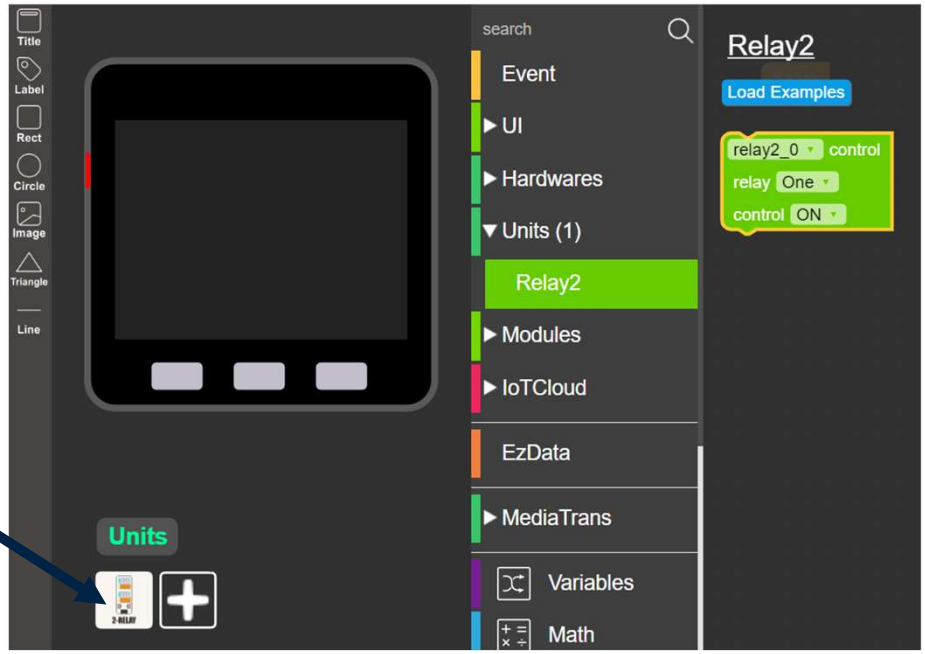


Wilcher, D. (2023, p. 221). *M5Stack Electronic Blueprints*. Packt.

Images courtesy of the author

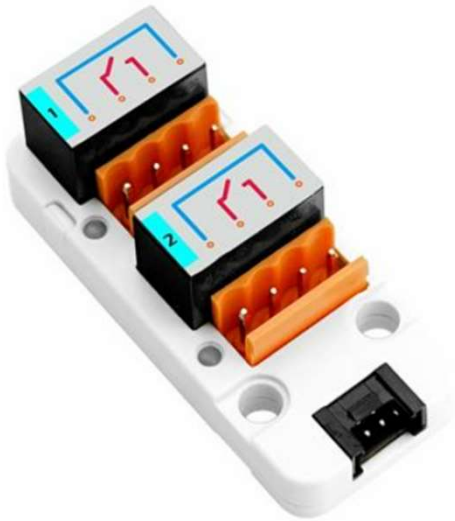
Creating a Basic M5Stack Core 2 Wireless Controller Device. . .

Using a 2-Channel SPST Relay Unit for Wireless Controller



Add 2 Channel SPST Relay Unit: Port A

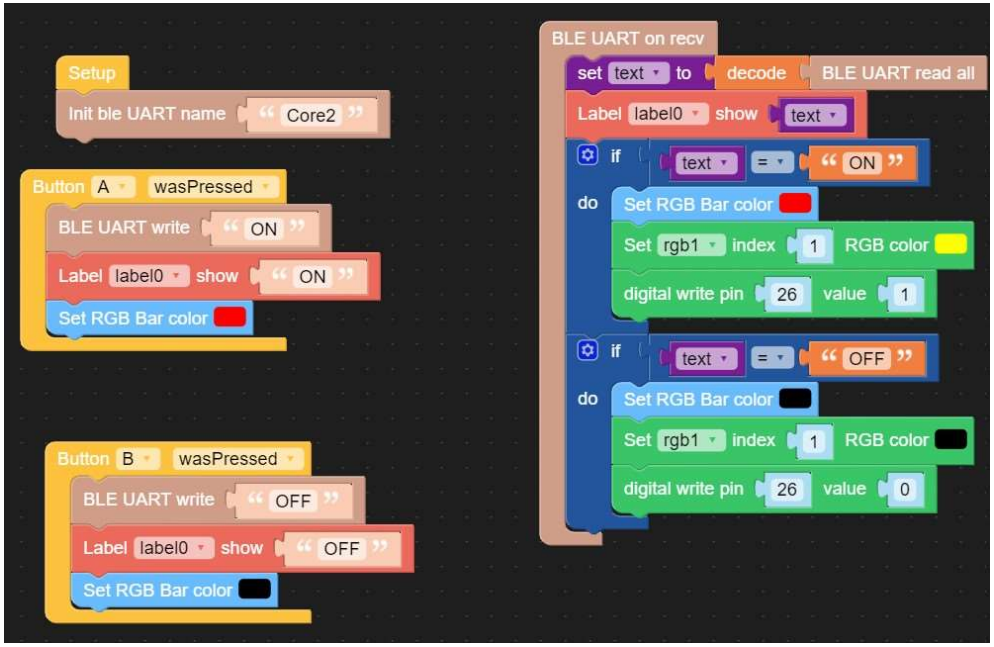
2 Channel SPST Relay Unit



Images courtesy of the author

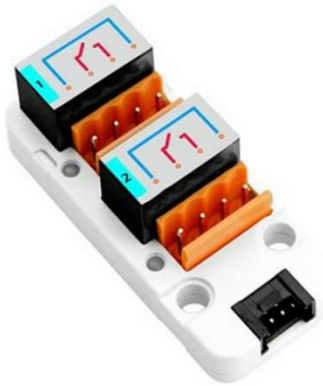
Creating a Basic M5Stack Core 2 Wireless Controller Device. . .

Modifying the BLE UART Code to operate 2 Channel SPST Relay Unit



Add these code blocks here

2 Channel SPST Relay Unit



Images courtesy of the author

Question 5

To attach the 2-Channel SPST Relay Unit, what port is used on the M5Stack Core 2?

a)Port A
b)Port B
c)Port C
d)none of the above

Thank you for attending

Please consider the resources below:

Bellucci, A., Aedo, I., & Diaz, P. (2017). ECCE toolkit: Prototyping ping sensor-based interaction. *Sensors, 17(3), 438.* https://doi.org/10.3390/s17030438

Bonfiglio, A., & DeRossi, D. (Eds.). (2011). Wearable monitoring systems. Springer. https://link.springer.com/book/10.1007/978-1-4419-7384-9

Shannon, C.E. (1948). A mathematical theory of communication. *The Bell System Technical Journal*, *27*, 379- 656. https://people.math.harvard.edu/~ctm/home/text/others/shannon/entropy/entropy.pdf

Wilcher, D. (2023). M5Stack electronic blueprints. Packt.

M5Stack Electronic Blueprints Code:

https://github.com/PacktPublishing/M5Stack-Electronic-Blueprints

M5Stack Core 2:
https://www.digikey.com/en/products/detail/m5stack-technology-co.,-ltd./K010-AWS/13562927?utm_adgroup=&utm_source=google&utm_medium=cpc&utm_campaign=PMax%20Product_Low%20ROAS%20Categories&utm_term=&utm_content=&gclid=Cj0KCQjwrMKmBhCJARIsAHuEAPQjYmAzEaS4_gO09ymPtRelznCQ_SkKXocWtUo_xwHbT0cw99HtFYEaAtpQEALw_wcB

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