Microprocessors & Microcontrollers
: Arm Cortex M0+
(Using RP2040)

Lecture 3.3.1

UART Introduction, tx/rx data using SDK

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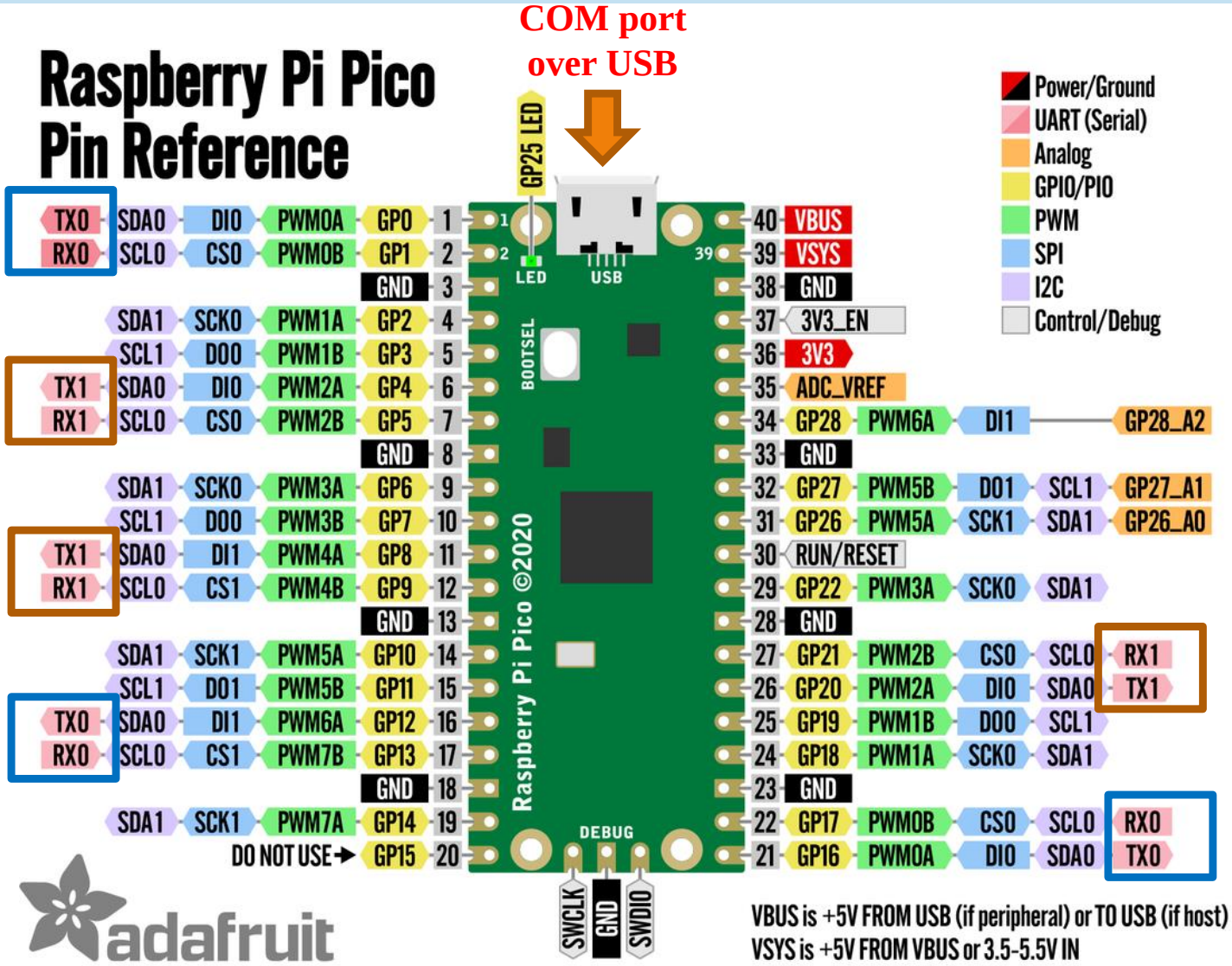
Lecture 3.3.1 Focus

- UARTs in RP2040
- UART Block and RS-232 Signal
- Demo of Interfacing UART 0
  - Without ISR (by polling)

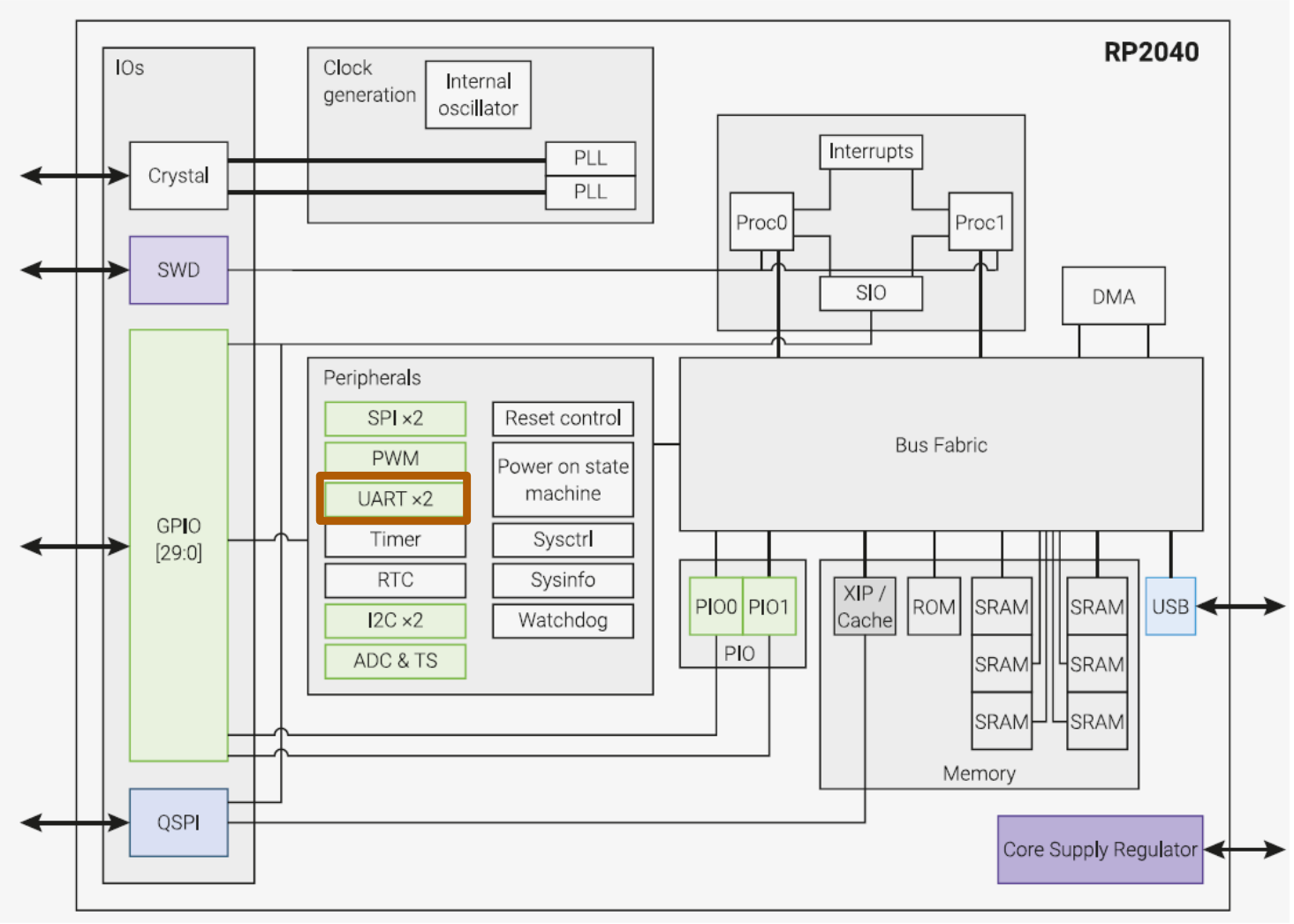
UART: Universal Asynchronous Receive Transmit

UARTs in RP2040

RP2040 Pin Out: UART 0 and 1



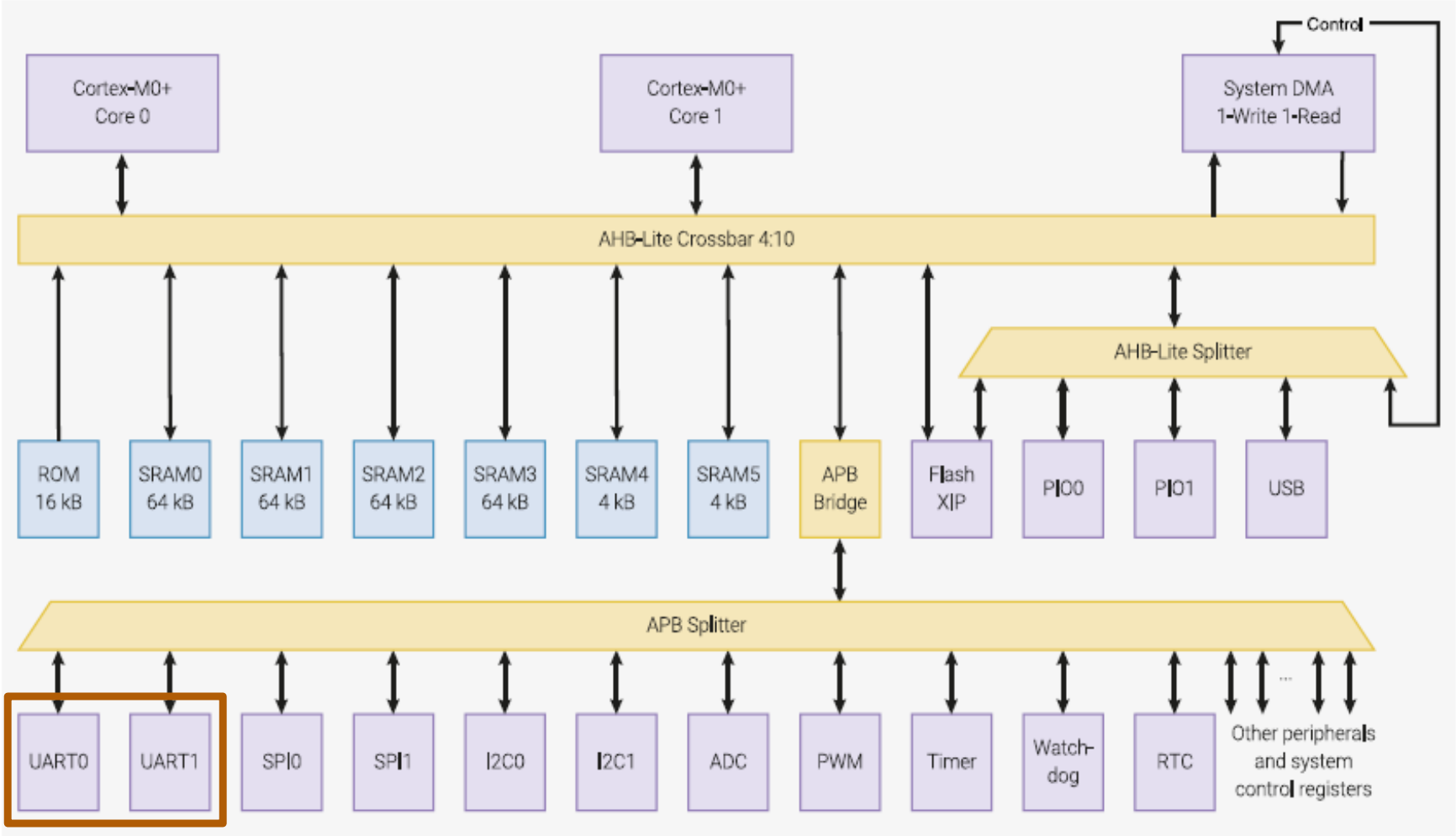
RP2040 System Block



COM port over USB

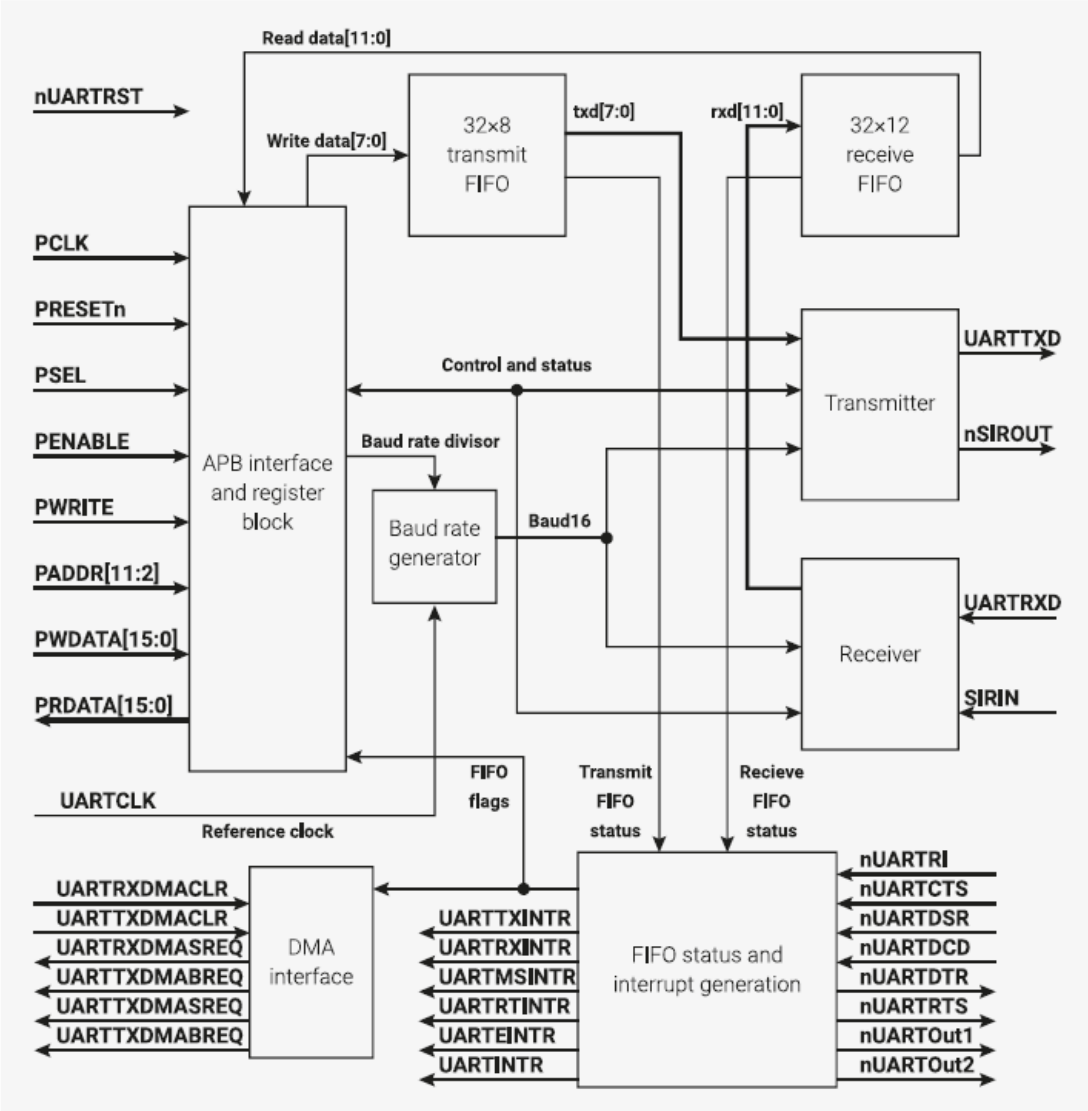
UART: Universal Asynchronous Receive Transmit

RP2040: Bus Fabric Overview



Ref 5: RP2040 Data sheet
Page: 16/647, Figure 4

RP2040: UART Block



Both TX and RX FIFO can be configured to be 1-byte deep

TX

RX

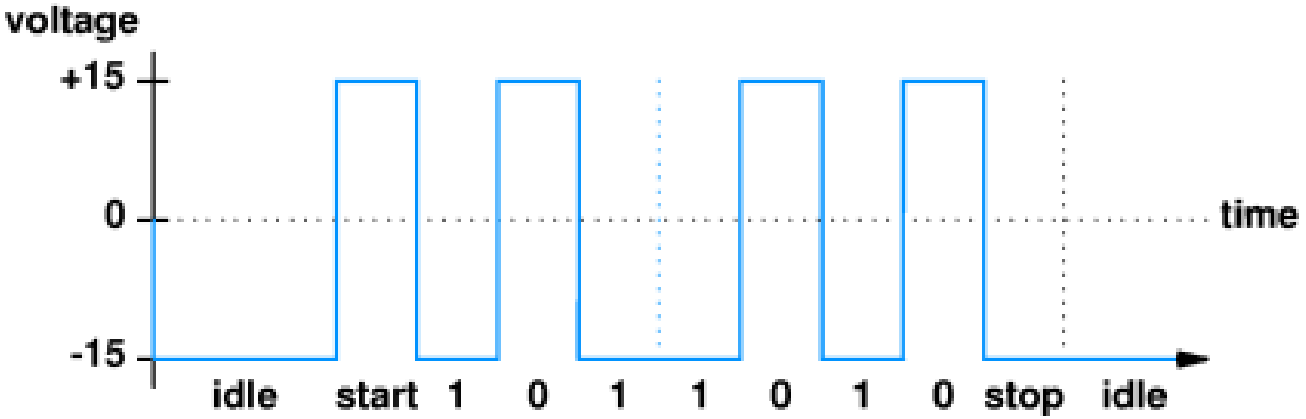
Ref 5: RP2040 Data sheet
Page: 438/647, Figure 59

UART: Overview

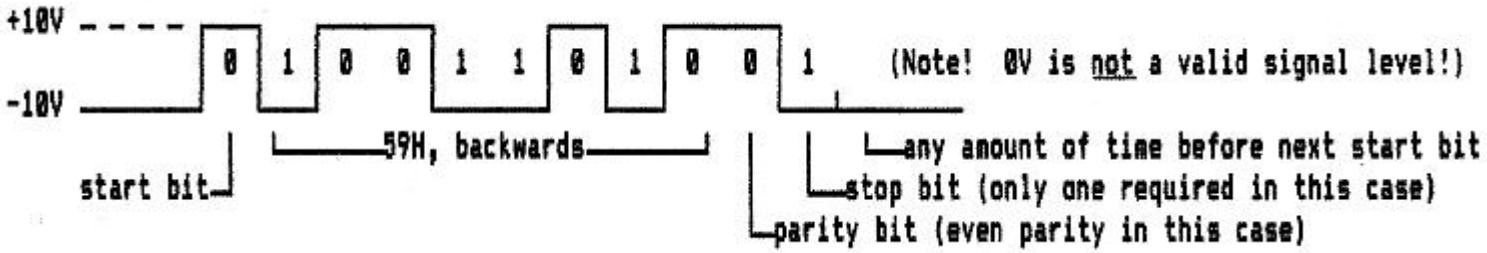
- The CPU reads and writes data and control/status information through the AMBA APB interface.
- The transmit and receive paths are buffered with internal FIFO memories enabling up to 32-bytes to be stored independently in both transmit and receive modes.
- **RxD: Serial-to-parallel** conversion on data received from a peripheral device
- **TxD: Parallel-to-serial** conversion on data transmitted to the peripheral device
- Supports a maximum baud rates of 921600 bps in UART mode.
- It also has programmable hardware flow control feature

UART: Serial: RS-232 Signal Format

Example 1:



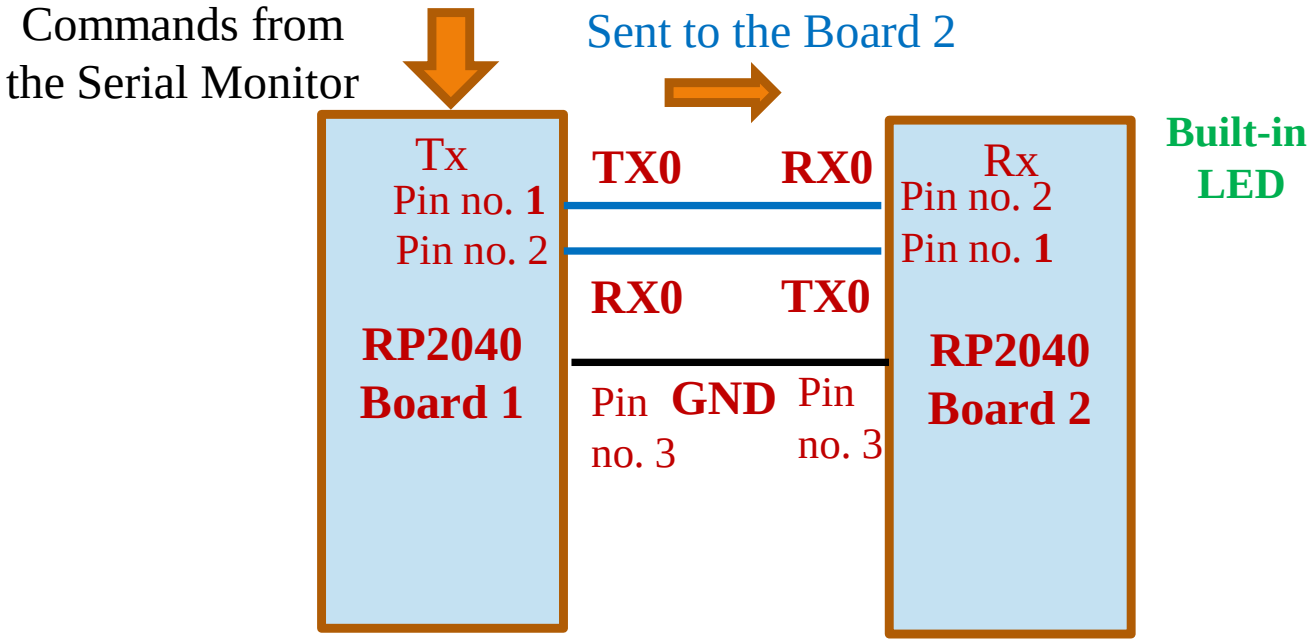
Example 2:



UART 0 Exercise

Exercise: Perform the same experiment by changing the program and connections between the boards, by using **UART 1**

Two Boards Configuration



The **Commands** are:
O or o: ON
F or f: OFF
1 to 9: Blink at the rate **100** to **900** milliseconds

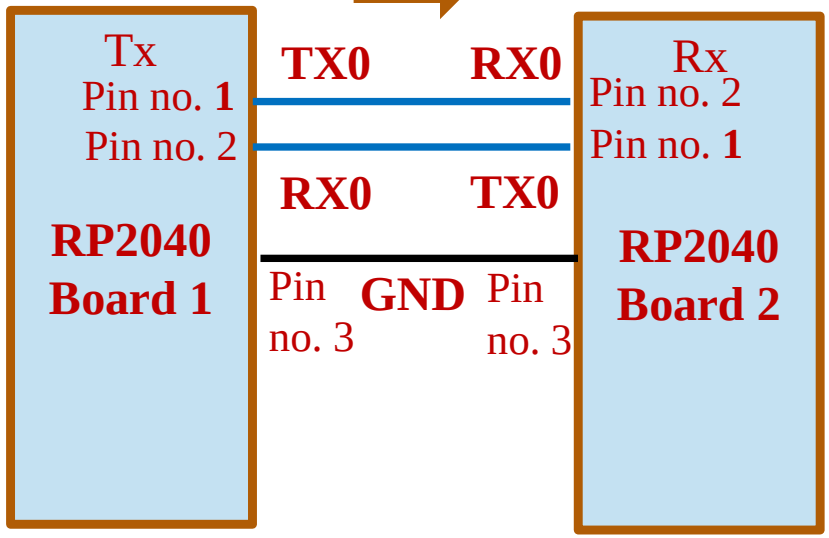
- Commands are received over USB serial port from the laptop by the Tx Board 1
- The command received is sent across to Rx Board 2 via UART 0
- Rx Board 2 receives the commands and controls its built-in LED.

Two Programs (Run on the Boards 1 and 2)

UART0 – Receives data by Polling (without ISR)

Commands from the Serial Monitor

Sent to the Board 2



Caution: Before giving commands make sure both boards are uploaded and connected together too.

The **Commands** are:
O or o: ON
F or f: OFF
1 to 9: Blink at the rate **100** to **900** milliseconds

File name:
prog_lec_3_3_1_uart_tx.ino

File name:
prog_lec_3_3_1_uart_rx.ino

- Interconnect the boards by connecting the UART 0 TX0 and RX0 pins as shown above
- Upload the programs on to the boards from the laptop
- From the Serial monitor of Board 1 (Tx) give the above commands to control the built-in LED on the Board 2 (Rx)

Demo of the Program

Demo: (without ISR)
prog_lec_3_3_1_uart_tx.ino (Tx board)
prog_lec_3_3_1_uart_rx.ino (Rx board)

Lecture 3.3.1: Summary

- UARTs in RP2040
- UART Block and RS-232 Signal
- Demo of Interfacing UART 0
  - Without ISR (by polling)

References - 1

Ref 0

RP2040 A microcontroller by Raspberry Pi

Getting started with Raspberry Pi Pico

C/C++ development with Raspberry Pi Pico and other RP2040-based microcontroller boards

Ref 1

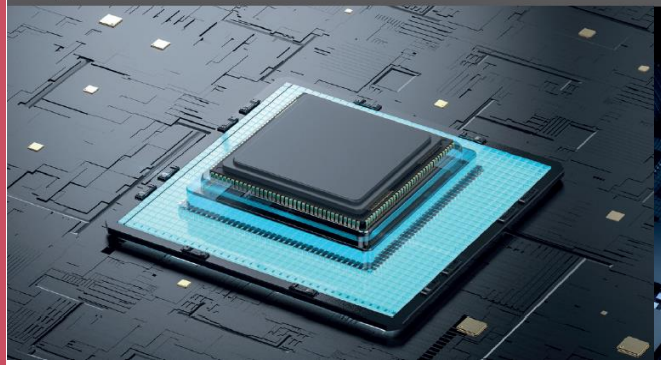
arm Education Media

Fundamentals of System-on-Chip Design on Arm Cortex-M Microcontrollers

TEXTBOOK

René Beuchat, Florian Depraz, Andrea Guerrieri, Sahand Kashani

SoC Design



Ref 2

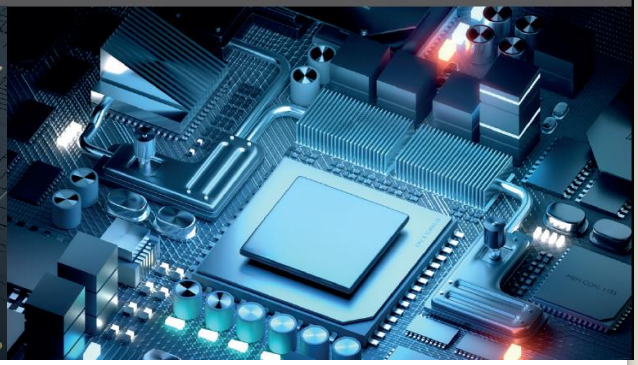
arm Education Media

Modern System-on-Chip Design on Arm

TEXTBOOK

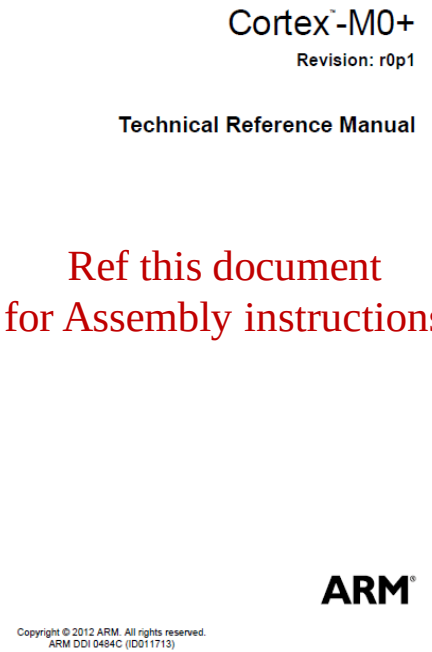
David J. Greaves

SoC Design



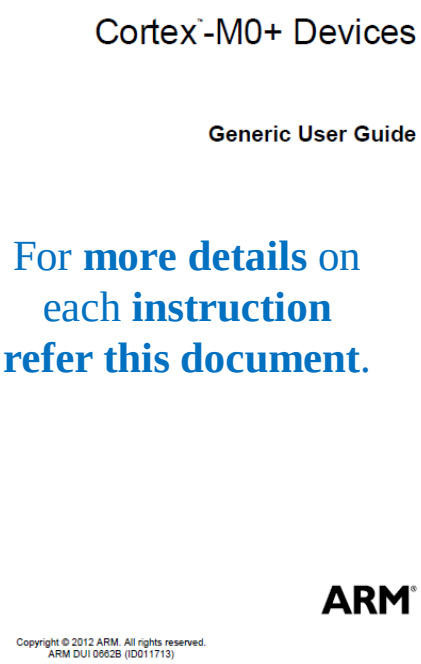
References - 2

Ref 3



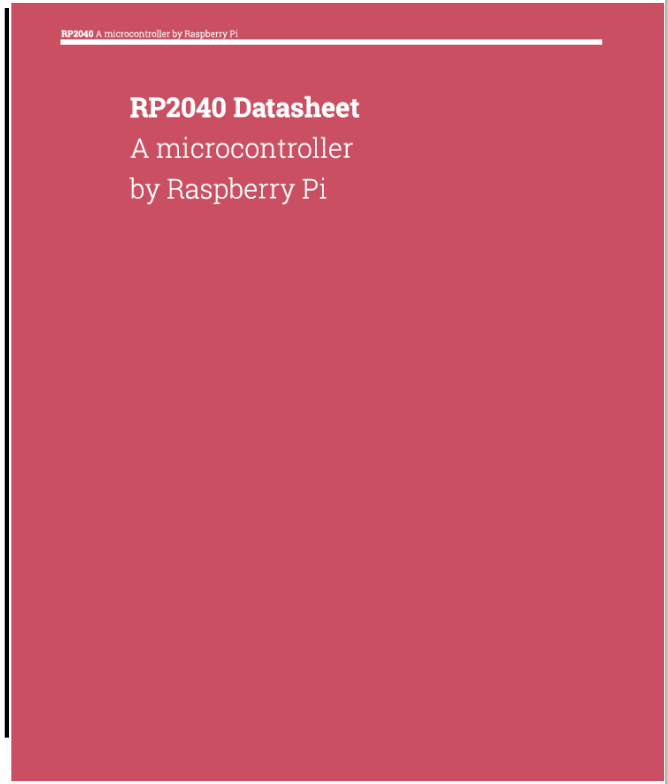
Ref this document
for Assembly instructions

Ref 4



For **more details** on
each **instruction**
refer this document.

Ref 5



Ref 6