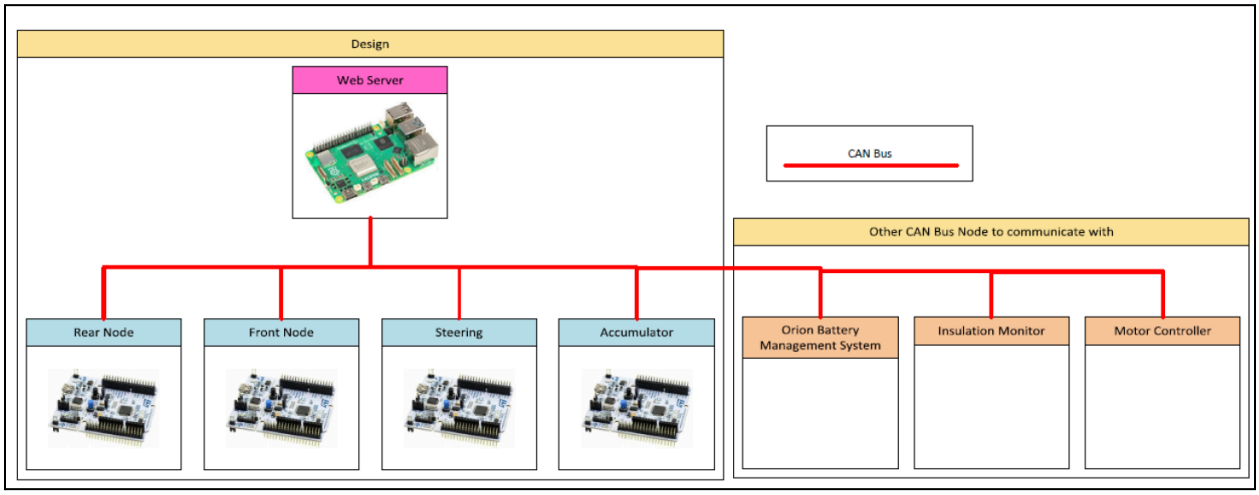
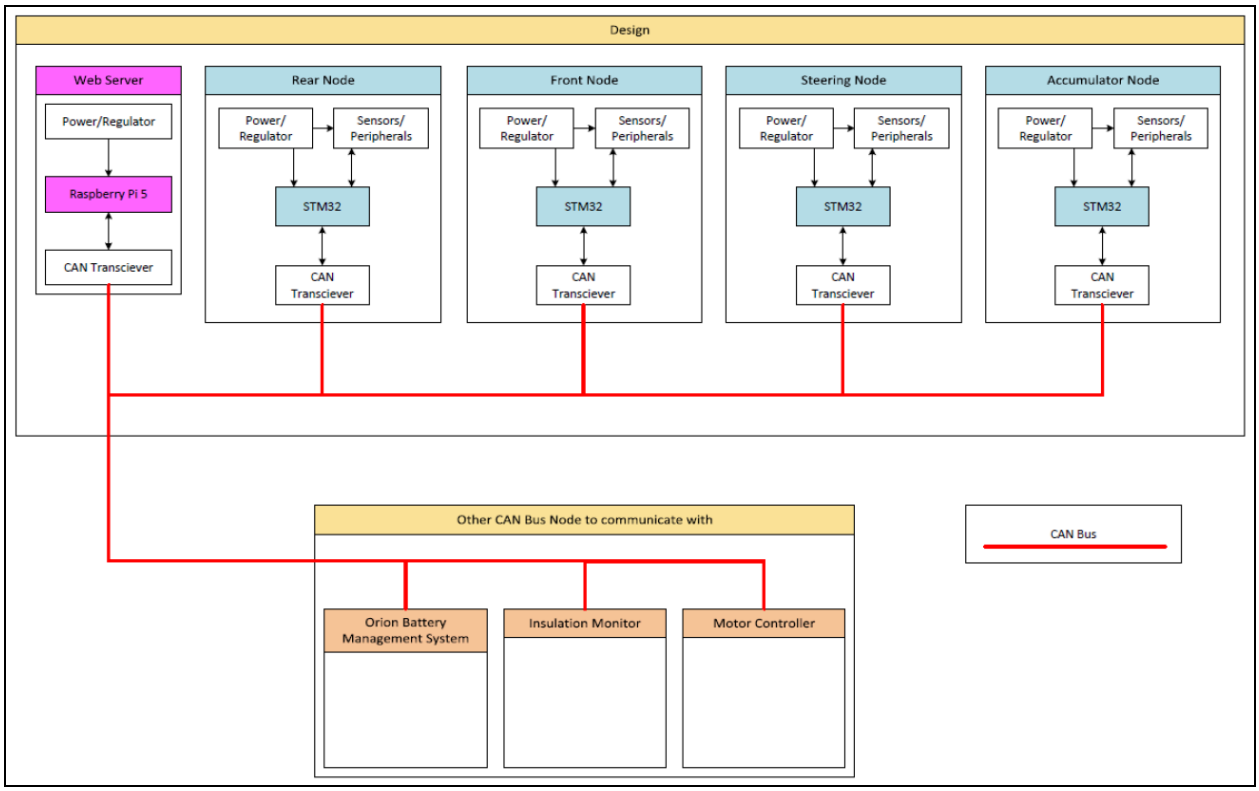
Week 1 - May 5, 2025

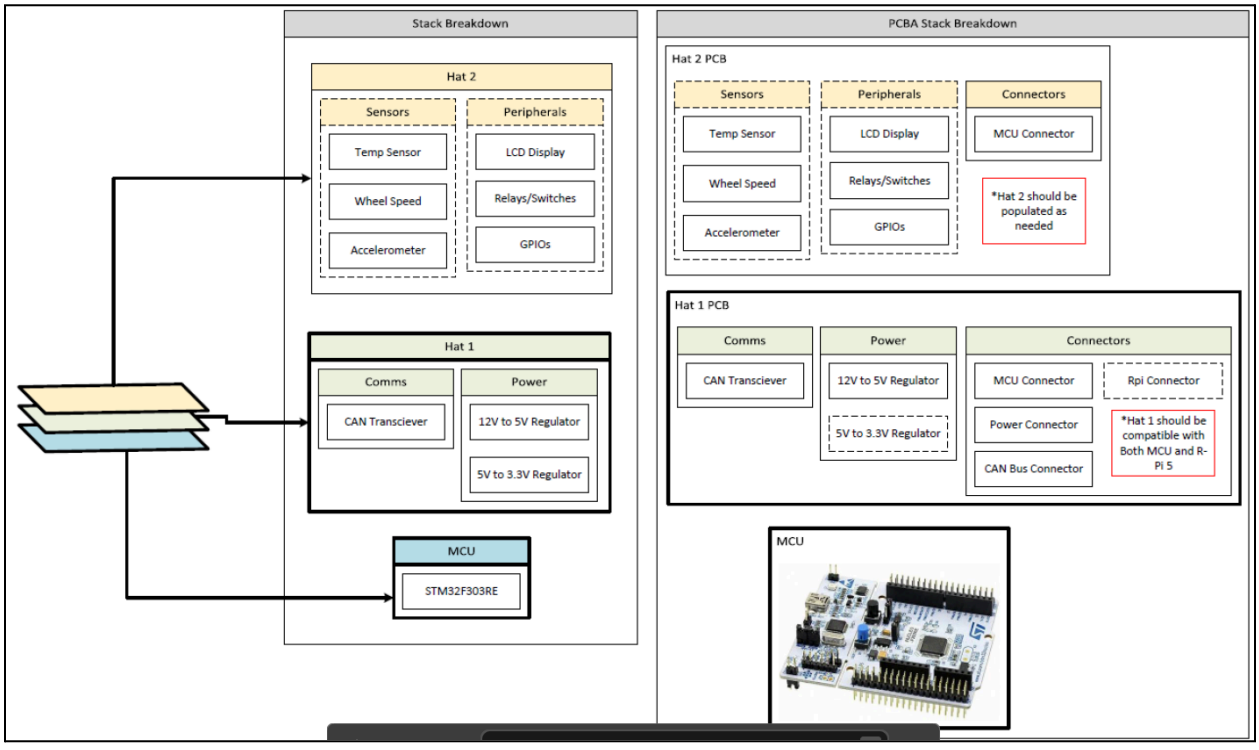
- [ ] Set-up Altium
    - [ ] Waiting for license
- [x] ~~Set-up IDE for Nucleo~~
    - [x] ~~STM32 CUBE IDE~~
- [ ] Read CAN Bus Documentation
    - [ ] In progress

Week 2 - May 12, 2025

- [ ] Set-up Altium
    - [ ] Still waiting for the license
- [ ] Read CAN Bus Documentation
    - [ ] In progress
- [ ] Design CAN Bus System
    - [x] ~~Top level - CAN Nodes~~
        - [ ] Need to design an address/ID
    - [x] ~~Boards/Hats Stack Design Proposal~~
    - [ ] Test Plan
        - [ ] Test Suite (Functions strictly for testing)
            - [ ] R-Pi Side
            - [ ] STM32 Side
        - [ ] Hardware verification
            - [ ] Oscilloscope verification of data structure (If possible)
    - [ ] Software
        - [ ] GPIO Setup in CUBE IDE
            - [ ] CAN
            - [ ] LEDs



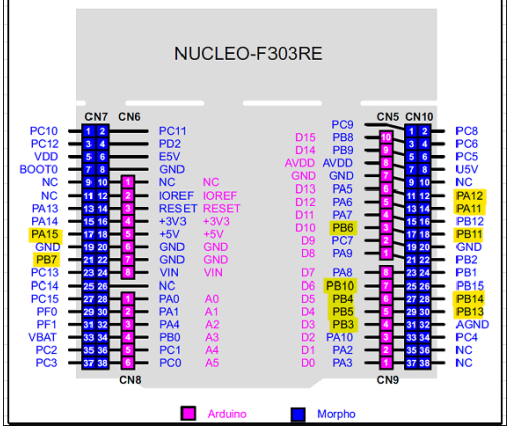

Design
Web Server
Power/Regulator
Raspberry Pi 5
CAN Transciever
Rear Node
Power/ Regulator
Sensors/ Peripherals
STM32
CAN Transciever
Front Node
Power/ Regulator
Sensors/ Peripherals
STM32
CAN Transciever
Steering Node
Power/ Regulator
Sensors/ Peripherals
STM32
CAN Transciever
Accumulator Node
Power/ Regulator
Sensors/ Peripherals
STM32
CAN Transciever
Other CAN Bus Node to communicate with
Orion Battery Management System
Insulation Monitor
Motor Controller
CAN Bus


Stack Breakdown
Hat 2
Sensors
Temp Sensor
Wheel Speed
Accelerometer
Peripherals
LCD Display
Relays/Switches
GPIOs
Hat 1
Comms
CAN Transciever
Power
12V to 5V Regulator
5V to 3.3V Regulator
MCU
STM32F303RE
PCBA Stack Breakdown
Hat 2 PCB
Sensors
Temp Sensor
Wheel Speed
Accelerometer
Peripherals
LCD Display
Relays/Switches
GPIOs
Connectors
MCU Connector
*Hat 2 should be populated as needed
Hat 1 PCB
Comms
CAN Transciever
Power
12V to 5V Regulator
5V to 3.3V Regulator
Connectors
MCU Connector
Rpi Connector
Power Connector
CAN Bus Connector
*Hat 1 should be compatible with Both MCU and R-Pi 5
MCU

Nucleo Fan out (for comms)

Nucleo Pin	Purpose	Nucleo Function	Verified and Confirmed
	CAN BUS		
PA.12	CAN Rx	CAN Rx	
PA.11	CAN TX	CAN TX	
	I2C		
PB.6	I2C SCL	I2C Serial Clock	
PB.7	I2C SDA	I2C Serial Data	
	SPI (user LED)		
PB.3	SCK	SPI Serial Clock	
PB.4	POCI	SPI MISO Data	
PB.5	PICO	SPI MOSI Data	
PA.15	CS	SPI Chip Select	
	COM PORTS (UART)		
PB.10	Serial Tx - HW	real UART Tx out	
PB.11	Serial Rx - HW	real UART Rx in	
PB.13	Serial RTS - HW (optional)	real UART RTS out	
PB.14	Serial CTS - HW (optional)	real UART CTS in	

Figure 16. NUCLEO-F303RE



Nucleo Fan out (for comms)

Nucleo Pin	Purpose	Nucleo Function	Verified and Confirmed
	CAN BUS		
PA.12	CAN Rx	CAN Rx	
PA.11	CAN TX	CAN TX	

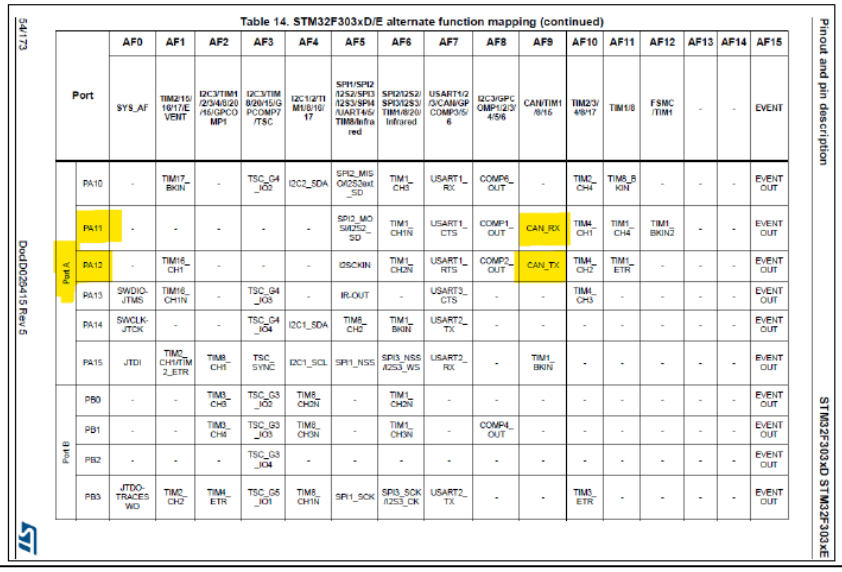


Table 14. STM32F303xD/E alternate function mapping (continued)

Port		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7	AF8	AF9	AF10	AF11	AF12	AF13	AF14	AF15
		SYS_AF	TIM2/15/16/17/EVENT	I2C3/TIM1/2/3/4/8/20/GPCOMP1	I2C3/TIM8/20/15/GPCOMP7/TSC	I2C1/2/TIM1/8/16/17	SPI1/SPI2/I2S2/SPI3/I2S3/SPI4/UART4/5/TIM8/Infrared	SPI2/I2S2/SPI3/I2S3/TIM1/8/20/Infrared	USART1/2/3/CAN/GPCOMP3/5/6	I2C3/GPCOMP1/2/3/4/5/6	CAN/TIM1/8/16	TIM2/3/4/8/17	TIM1/8	FSMC/TIM1	-	-	EVENT
Port A	PA10	-	TIM17_BKIN	-	TSC_G4_IO2	I2C2_SDA	SPI2_MISO/I2S2ext_SD	TIM1_CH3	USART1_RX	COMP6_OUT	-	TIM2_CH4	TIM8_BKIN	-	-	-	EVENT OUT
	PA11	-	-	-	-	-	SPI2_MOSI/I2S2_SD	TIM1_CH1N	USART1_CTS	COMP1_OUT	CAN_RX	TIM4_CH1	TIM1_CH4	TIM1_BKIN2	-	-	EVENT OUT
	PA12	-	TIM16_CH1	-	-	-	I2SCKIN	TIM1_CH2N	USART1_RTS	COMP2_OUT	CAN_TX	TIM4_CH2	TIM1_ETR	-	-	-	EVENT OUT
	PA13	SWDIO-JTMS	TIM16_CH1N	-	TSC_G4_IO3	-	IR-OUT	-	USART3_CTS	-	-	TIM4_CH3	-	-	-	-	EVENT OUT
	PA14	SWCLK-JTCK	-	-	TSC_G4_IO4	I2C1_SDA	TIM8_CH2	TIM1_BKIN	USART2_TX	-	-	-	-	-	-	-	EVENT OUT
	PA15	JTDI	TIM2_CH1/ETR/TIM2_ETR	TIM8_CH1	TSC_SYNC	I2C1_SCL	SPI1_NSS	SPI3_NSS/I2S3_WS	USART2_RX	-	TIM1_BKIN	-	-	-	-	-	EVENT OUT
Port B	PB0	-	-	TIM3_CH3	TSC_G3_IO2	TIM8_CH2N	-	TIM1_CH2N	-	-	-	-	-	-	-	-	EVENT OUT
	PB1	-	-	TIM3_CH4	TSC_G3_IO3	TIM8_CH3N	-	TIM1_CH3N	-	COMP4_OUT	-	-	-	-	-	-	EVENT OUT
	PB2	-	-	-	TSC_G3_IO4	-	-	-	-	-	-	-	-	-	-	-	EVENT OUT
	PB3	JTDO-TRACESWO	TIM2_CH2	TIM4_ETR	TSC_G5_IO1	TIM8_CH1N	SPI1_SCK	SPI3_SCK/I2S3_CK	USART2_TX	-	-	TIM3_ETR	-	-	-	-	EVENT OUT

Nucleo Fan out (for comms)

	I2C		
PB.6	I2C SCL	I2C Serial Clock	
PB.7	I2C SDA	I2C Serial Data	

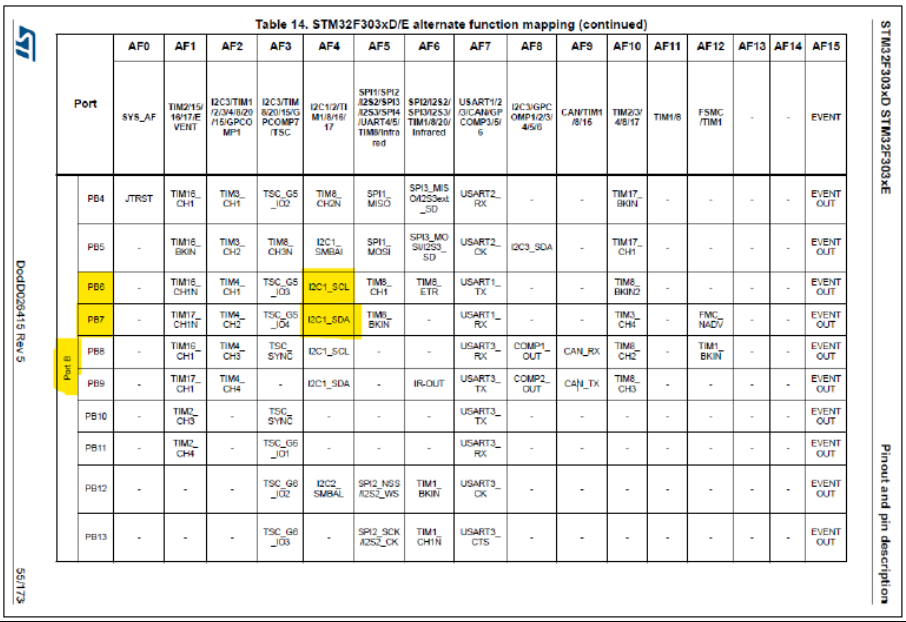


Table 14. STM32F303xD/E alternate function mapping (continued)

Port		AF0 SYS_AF	AF1 TIM2/15/16/17/EVENT	AF2 I2C3/TIM1/2/3/4/8/20/15/GPCOMP1	AF3 I2C3/TIM8/20/15/GPCOMP7/TSC	AF4 I2C1/2/TIM1/8/16/17	AF5 SPI1/SPI2/I2S2/SPI3/I2S3/SPI4/UART4/5/TIM8/Infrared	AF6 SPI2/I2S2/SPI3/I2S3/TIM1/8/20/Infrared	AF7 USART1/2/3/CAN/GPCOMP3/5/6	AF8 I2C3/GPCOMP1/2/3/4/5/6	AF9 CAN/TIM1/8/16	AF10 TIM2/3/4/8/17	AF11 TIM1/8	AF12 FSMC/TIM1	AF13 -	AF14 -	AF15 EVENT
Port B	PB4	JTRST	TIM16_CH1	TIM3_CH1	TSC_G5_IO2	TIM8_CH2N	SPI1_MISO	SPI3_MISO/I2S3ext_SD	USART2_RX	-	-	TIM17_BKIN	-	-	-	-	EVENT OUT
	PB5	-	TIM16_BKIN	TIM3_CH2	TIM8_CH3N	I2C1_SMBAI	SPI1_MOSI	SPI3_MOSI/I2S3_SD	USART2_CK	I2C3_SDA	-	TIM17_CH1	-	-	-	-	EVENT OUT
	PB6	-	TIM16_CH1N	TIM4_CH1	TSC_G5_IO3	I2C1_SCL	TIM8_CH1	TIM8_ETR	USART1_TX	-	-	TIM8_BKIN2	-	-	-	-	EVENT OUT
	PB7	-	TIM17_CH1N	TIM4_CH2	TSC_G5_IO4	I2C1_SDA	TIM8_BKIN	-	USART1_RX	-	-	TIM3_CH4	-	FMC_NADV	-	-	EVENT OUT
	PB8	-	TIM16_CH1	TIM4_CH3	TSC_SYNC	I2C1_SCL	-	-	USART3_RX	COMP1_OUT	CAN_RX	TIM8_CH2	-	TIM1_BKIN	-	-	EVENT OUT
	PB9	-	TIM17_CH1	TIM4_CH4	-	I2C1_SDA	-	IR-OUT	USART3_TX	COMP2_OUT	CAN_TX	TIM8_CH3	-	-	-	-	EVENT OUT
	PB10	-	TIM2_CH3	-	TSC_SYNC	-	-	-	USART3_TX	-	-	-	-	-	-	-	EVENT OUT
	PB11	-	TIM2_CH4	-	TSC_G6_IO1	-	-	-	USART3_RX	-	-	-	-	-	-	-	EVENT OUT
	PB12	-	-	-	TSC_G8_IO2	I2C2_SMBAI	SPI2_NSS/I2S2_WS	TIM1_BKIN	USART3_CK	-	-	-	-	-	-	-	EVENT OUT
	PB13	-	-	-	TSC_G8_IO3	-	SPI2_SCK/I2S2_CK	TIM1_CH1N	USART3_CTS	-	-	-	-	-	-	-	EVENT OUT

Nucleo Fan out (for comms)

	SPI (user LED)		
PB.3	SCK	SPI Serial Clock	
PB.4	POCI	SPI MISO Data	
PB.5	PICO	SPI MOSI Data	
PA.15	CS	SPI Chip Select	

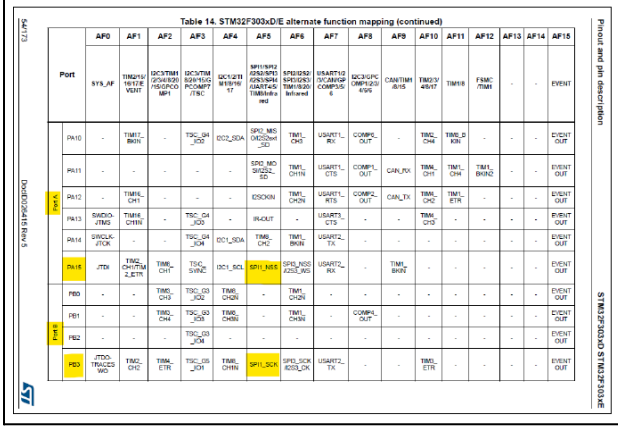


Table 14. STM32F303xD/E alternate function mapping (continued)

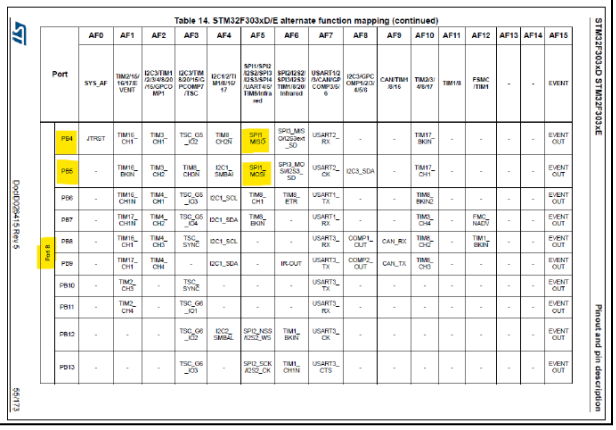


Table 14. STM32F303xD/E alternate function mapping (continued)

Nucleo Fan out (for comms)

	COM PORTS (UART)		
PB.10	Serial Tx - HW	real UART Tx out	
PB.11	Serial Rx - HW	real UART Rx in	
PB.13	Serial RTS - HW (optional)	real UART RTS out	
PB.14	Serial CTS - HW (optional)	real UART CTS in	

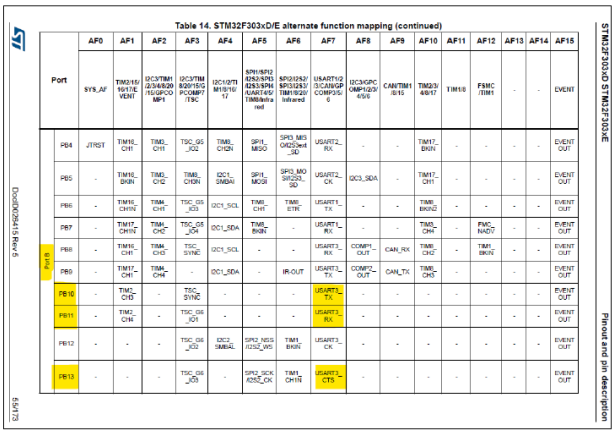
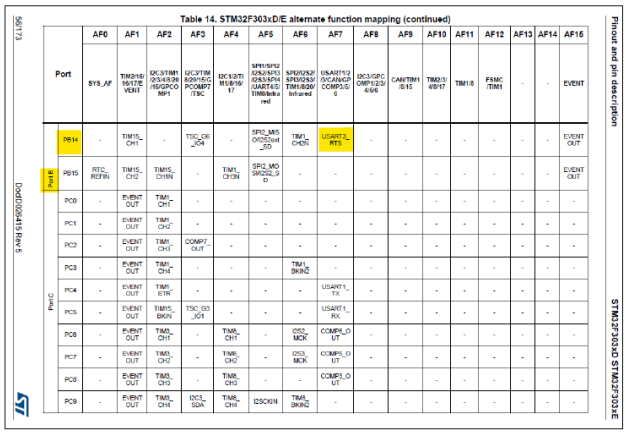


Table 14. STM32F303xD/E alternate function mapping (continued)

Port		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7	AF8	AF9	AF10	AF11	AF12	AF13	AF14	AF15
		SYS_AF	TIM2/15/16/17/EVENT	I2C3/TIM1/2/3/4/8/20/GPCOMP1/3/5/6/MP1	I2C3/TIM8/20/SPI2/3/PCOMP7/TSC	I2C1/2/TIM16/17	SPI1/SPI2/I2S2/SPI3/I2S3/SPI4/UART4/5/TIM8/Infrared	SPI2/I2S2/SPI3/I2S3/TIM1/8/20/Infrared	USART1/2/3/CAN/GPCOMP1/2/3/4/5/6	I2C3/GPCOMP1/2/3/4/5/6	CAN/TIM1/8/15	TIM2/3/4/8/17	TIM1/8	FSMC/TIM1	-	-	EVENT
Port B	PB4	JTRST	TIM16_CH1	TIM3_CH1	TSC_G5_IO2	TIM8_CH2N	SPI1_MISO	SPI3_MISO/I2S3ext_SD	USART2_RX	-	-	TIM17_BKIN	-	-	-	-	EVENT OUT
	PB5	-	TIM16_BKIN	TIM3_CH2	TIM8_CH3N	I2C1_SMBAI	SPI1_MOSI	SPI3_MOSI/I2S3_SD	USART2_CK	I2C3_SDA	-	TIM17_CH1	-	-	-	-	EVENT OUT
	PB6	-	TIM16_CH1N	TIM4_CH1	TSC_G5_IO3	I2C1_SCL	TIM8_CH1	TIM8_ETR	USART1_TX	-	-	TIM8_BKIN2	-	-	-	-	EVENT OUT
	PB7	-	TIM17_CH1N	TIM4_CH2	TSC_G5_IO4	I2C1_SDA	TIM8_BKIN	-	USART1_RX	-	-	TIM3_CH1	-	FMC_NADV	-	-	EVENT OUT
	PB8	-	TIM16_CH1	TIM4_CH3	TSC_SYNC	I2C1_SCL	-	-	USART3_RX	COMP1_OUT	CAN_RX	TIM8_CH2	-	TIM1_BKIN	-	-	EVENT OUT
	PB9	-	TIM17_CH1	TIM4_CH4	-	I2C1_SDA	-	IR-OUT	USART3_TX	COMP2_OUT	CAN_TX	TIM8_CH3	-	-	-	-	EVENT OUT
	PB10	-	TIM2_CH3	-	TSC_SYNC	-	-	-	USART3_TX	-	-	-	-	-	-	-	EVENT OUT
	PB11	-	TIM2_CH4	-	TSC_G6_IO1	-	-	-	USART3_RX	-	-	-	-	-	-	-	EVENT OUT
	PB12	-	-	-	TSC_G6_IO2	I2C2_SMBAI	SPI2_NSS/I2S2_WS	TIM1_BKIN	USART3_CK	-	-	-	-	-	-	-	EVENT OUT
	PB13	-	-	-	TSC_G6_IO3	-	SPI2_SCK/I2S2_CK	TIM1_CH1N	USART3_CTS	-	-	-	-	-	-	-	EVENT OUT



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Port		AF0	AF1	AF2	AF3	AF4	AF5	AF6	AF7	AF8	AF9	AF10	AF11	AF12	AF13	AF14	AF15
		SYS_AF	TIM2/15/16/17/EVENT	I2C3/TIM1/2/3/4/8/20/GPCOMP1/3/5/6/MP1	I2C3/TIM8/20/SPI2/3/PCOMP7/TSC	I2C1/2/TIM16/17	SPI1/SPI2/I2S2/SPI3/I2S3/SPI4/UART4/5/TIM8/Infrared	SPI2/I2S2/SPI3/I2S3/TIM1/8/20/Infrared	USART1/2/3/CAN/GPCOMP1/2/3/4/5/6	I2C3/GPCOMP1/2/3/4/5/6	CAN/TIM1/8/15	TIM2/3/4/8/17	TIM1/8	FSMC/TIM1	-	-	EVENT
Port B	PB14	-	TIM15_CH1	-	TSC_G6_IO4	-	SPI2_MISO/I2S2ext_SD	TIM1_CH2N	USART3_RTS	-	-	-	-	-	-	-	EVENT OUT
	PB15	RTC_REFIN	TIM15_CH2	TIM15_CH1N	-	TIM1_CH3N	SPI2_MOSI/I2S2_SD	-	-	-	-	-	-	-	-	-	EVENT OUT
Port C	PC0	-	EVENT OUT	TIM1_CH1	-	-	-	-	-	-	-	-	-	-	-	-	-
	PC1	-	EVENT OUT	TIM1_CH2	-	-	-	-	-	-	-	-	-	-	-	-	-
	PC2	-	EVENT OUT	TIM1_CH3	COMP7_OUT	-	-	-	-	-	-	-	-	-	-	-	-
	PC3	-	EVENT OUT	TIM1_CH4	-	-	-	TIM1_BKIN2	-	-	-	-	-	-	-	-	-
	PC4	-	EVENT OUT	TIM1_ETR	-	-	-	-	USART1_TX	-	-	-	-	-	-	-	-
	PC5	-	EVENT OUT	TIM15_BKIN	TSC_G3_IO1	-	-	-	USART1_RX	-	-	-	-	-	-	-	-
	PC6	-	EVENT OUT	TIM3_CH1	-	TIM8_CH1	-	I2S3_MCK	COMP6_OUT	-	-	-	-	-	-	-	-
	PC7	-	EVENT OUT	TIM3_CH2	-	TIM8_CH2	-	I2S3_MCK	COMP5_OUT	-	-	-	-	-	-	-	-
	PC8	-	EVENT OUT	TIM3_CH3	-	TIM8_CH3	-	-	COMP3_OUT	-	-	-	-	-	-	-	-
	PC9	-	EVENT OUT	TIM3_CH4	I2C3_SDA	TIM8_CH4	I2SCKIN	TIM8_BKIN2	-	-	-	-	-	-	-	-	-

Power/Regulator Circuit

- Protective Circuit
  - Fuse
  - TVS
- WEBENCH
  - 12 VDC → 5VDC
  - 5 VDC →3.3 VDC

Switching

- Relays/Optocoupler
- Debouncer
  - Pushbuttons
- Level Shifter
  - 3.3V to 5V

CAN Bus Test Plan: Software functionality

- R-Pi
  - WriteToCAN
  - ReadFromCAN
- STM32
  - WriteToCAN
  - ReadFromCAN

CAN Bus Test Plan: Software functionality

I. System ON
   I. R-Pi opens a terminal and shows logs/information
   II. Terminal prints the date & ip address of the device (maybe a welcome message)

II. R-Pi
   I. R-Pi WRITES to the CAN Bus
   II. STM32 READS from the CAN Bus
   III. IF READ is good, then FAST blink LEDs on STM32

III. STM32
   I. One-by-one, STM32 WRITES a message
   II. R-Pi READS from the CAN Bus
   III. IF READ is good, then R-pi prints on the terminal and logs the message

CAN Bus Test Plan

1. System ON
    1.1. R-Pi launches a script that opens a terminal that prints:
        1.1.1. Name of system
        1.1.2. Date
        1.1.3. IP Address
        1.1.4. Error handling during launch
    1.2. User input “Test CAN” through terminal or button which launches the test for the CAN Bus
2. R-Pi (Supervisor)
    2.1. “Ping” each node by sending commands (data) unique to each node
    2.2. Wait for the reply from the Node.
    2.3. Reply from the “pinged” node should also contain a unique command for the R-Pi to confirm the correct node was pinged and the node is operational.
    2.4. Cycle through each Node on a list until all nodes have been pinged:
        2.4.1. Front
        2.4.2. Rear
        2.4.3. Steering
        2.4.4. Accumulator
        2.4.5. BMS
        2.4.6. Insulation
        2.4.7. Motor Controller
    2.5. Each Ping should have a display message on the terminal.
3. STM32
    3.1. By default, STM32 should be able to handle the test ping without going into another state, as it is only waiting/listening for a command
    3.2. All nodes must listen to the R-Pi (Supervisor) and wait for their unique command to reply.
    3.3. Once pinged, the Green LED should start blinking, then send a message through the CAN Bus, back to the R-Pi

CAN Protocol Message Layout				
CAN ID (HEX)	Transmitter	Recipient	DLC	DATA
	R-pi	ALL	TBD	TBD
	Rear Node		TBD	TBD
	Front Node		TBD	TBD
	Steering		TBD	TBD
	Accumulator		TBD	TBD
	BMS		TBD	TBD
	Insulation Monitor		TBD	TBD
	Motor Controller		TBD	TBD

Week 3 - May 19, 2025