THUNDERBALL H7 OEM

Industrial & Marine Rugged IP67
Calculator / IoT Gateway

Ultra-small form factor, Hard Real-Time & Robust platform for Industry, Marine, & Drones

STM32H7 Ecosystem

DATASHEET

Revision 1.03 – PCB REV02
Nov 2023

Revision History

Revision	Date	Comment
1.01	26/01/22	Initial Release
1.02	24/06/22	Change Links
1.03	29/11/23	Update for PCB REV02

Additional Resources

Please visit our developer tools webpage for QuickStart guides and other helpful resources:

Product Web Page: http://austral-eng.com/en/thunderball-h7-oem-industrial-marine-rugged-ip67-mission-calculator-iot-gateway/

Austral Electronics Software Support: https://github.com/austral-electronics/ThunderballH7

ST Software Support: https://www.st.com/en/evaluation-tools/nucleo-h743zi.html#tools-software

STM32 Bootloader (P263) : https://www.st.com/resource/en/application_note/an2606-stm32-microcontroller-system-memory-boot-mode-stmicroelectronics.pdf

STM32H743 Datasheet: STM32H743 datasheet

FM25L16B Datasheet :
https://www.infineon.com/dgdl/Infineon-FM25L16B_16-Kbit_(2_K_8)_Serial_(SPI)_F-RAM-DataSheet-v11_00-EN.pdf?fileId=8ac78c8c7d0d8da4017d0ec917394180

LAN9742AI Datasheet:
https://ww1.microchip.com/downloads/aemDocuments/documents/OTH/ProductDocuments/DataSheets/DS_LAN8742_00001989A.pdf

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1 KEY FEATURES

The **Thunderball H7 OEM is a high-performance microcontroller-based SWaP-C platform: Industrial with a wide temperature range, marinized IP67, miniaturized and very lightweight (Only 165g), very low power consumption, cost-effective.**

It integrates a powerful 32 bits ARM with DSP&FPU, many Industrial, Marine, and Transportation field buses, Galvanic isolation, Protections, Watchdog, RTC with GNSS Time synchronization, a huge possible storage for your datalogs (uSD card).

- **Field Interfaces with M12 & Binder 620 Connectors:**
  - **Ethernet:** HTTP/FTP server, Modbus TCP, Profinet, ETherNet/IP, BACnet, OPC-UA, MQTT, DDS, WebSocket, ZMQ, UDP, TCP, NMEA OneNet…
  - **CANbus**: NMEA2000, J1939, CANopen…
  - **5x Isolated Serials**:
    - 1x RS232 (4 Wires)
    - 4x RS485/Modbus RTU Half Duplex / RS422 Full Duplex / NMEA0183(-HS) / RS232 Rx Only…
  - **GNSS PPS Input** (Using RS232 CTS)
  - Options:
    - **FD-CAN** (8Mb/s)
    - **4x Isolated In/Out Synchro**

- **Cables:** Available on the shelf (Profinet & NMEA2000 standard cables)

- **Development interfaces:**
  - **JTAG/SWD**
  - **USB-C**: Bootload, uSD acces

2 BENEFITS

- **Make it fast and pro:** Build your next smart project operating in hostile environment choosing a **ready-to-use rugged platform** and the professional STM32 + Visual Code ecosystem.

- **Robust:** Minimizes the probability of failure and facilitates the design of safety-critical system:

    - Harsh environment design: Industrial high temperature components, galvanic isolation, vibration-proof conception, sealing, fan less…

    - Eliminates maintenance and instability Linux problems.

    - STM32H7 built-in safety features:
        - Dual Low latency watchdogs with very low reboot time.
        - Non-volatile memories with integrity checking (Dual bank FLASH, High endurance FRAM).
        - Memory protection unit (MPU) to enhance application security.

    - Compatible with **(pre-)certified safety-critical software solutions**:
        - X-CUBE-STL:
            - **Software** (*IEC 61508* SIL 2/3)
        - X-CUBE-CLASSB:
            - **Household Electrical Appliance** *(UL/CSA/IEC 60730-1 / 60335-1 Class B)*
        - SafeRTOS®:
            - **Software** *(IEC 61508-3 SIL 3)*
            - **Industrial** (*IEC 61508-1,-3,-4*)
            - **Automotive** *(ISO 26262 -2,-6,-8)*
            - **Medical** *(FDA 510(k), IEC 62304)*
            - **Aerospace** *(DO178C)*
        - EmbOS-Safe:
            - **Industrial** *(IEC 61508)*
            - **Medical** *(IEC 62304 Class C)*
            - **Automotive & Aerospace** *(MISRA-C:2012)*

- **Hard Real-Time**: Achieves performance unattainable with a Preempt RT Linux:
    - A bare-metal or RTOS architecture allows to obtain guarantee of latencies and execution.
    - Low boot time
    - Ultra-low interruptions latency (down to 48ns)
    - Easily reach a 1Khz frequency for your calculation, control or acquisition loops.

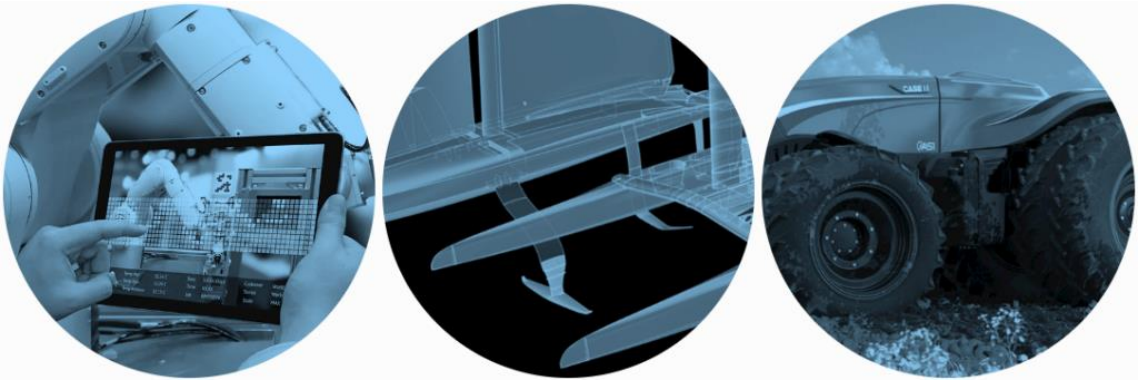
The **Thunderball H7 OEM** allows you to build your next smart project rapidly using a connected platform based on the powerful **STM32H743** ARM MCU running at **480Mhz**. It is the ideal solution for a hard real-time and robust systems with browser-based remote displays and operating in harsh environments. If a high level of integration is required, the bare electronic board can also be integrated into your system.

3 HARDWARE SPECIFICATIONS

	THUNDERBALL H7 OEM	On demand
CPU Core		
CPU	ARM Cortex-M7 (32 bits RISC)	
Frequency	480 MHz / 2424 CoreMark /1027 DMIPS	550Mhz / Dual Core
FPU	IEEE 754 (Double precision)	
Security	CRC on FLASH and SRAM	Crypto/hash Secure Update
Memory		
FLASH	2 MByte	1 MByte
SRAM	1 MByte	512 Kbyte
FRAM	16 KBit / 10^{14} writes / 151-year	8 MBit
SD-CARD	32GByte	Up to 1TB
Network		
LAN	100Mbps Ethernet	
I/O		
USB Device	1x USB2.0 (USB-C Connector)	
CANbus	1x CAN2.0/NMEA2000/J1939/CANopen (1Mbps)	FD-CAN
Serials	1x isolated RS232 4 Wires (230 Kbps) 4x isolated RS422/485/NMEA0183-HS/RS232_RX (1Mbps)	12Mbps
Synchro I/O	-	4x Isolated I/O (Pull-up, 1.7Mhz)
System		
RTC	RTC with PCB mounted battery	Wake-up
LED	1x White LED Panel	
Watchdog	Configurable Watchdog	
Analog	12V, Temperature	
Debug	JTAG/SWD	
Bootload	JTAG/SWD, USB-C, Serial	Ethernet OTA Update
Electrical		
Supply voltage	8 to 18V	
Power Consumption	2.3W typically	
Mechanical		
Dimensions	110x84x28 mm (Enclosure) / 88x57x12 (Board)	OEM board
Protection	IP67	
Enclosure	Nylon PA12	Aluminum
Cooling	Passive	
Weight	165g	31g (OEM board)
Compliance		
EMC	EN 301 489-1 / -17, EN 55032 / EN 55024 Class B	
Safety	EC 60950-1:2005, EN 62311:2008, UL 2500V, CSA, VDE, DIN EN60747-5-2 (VDE 0884 Part2): 2003-01	
ROHS	Directive 2015/863/EU	
Reliability		
MTTF	> 200 000 hours	
Warranty	2 Years	
Operation Temperature	-20 to +85°C	
Relative Humidity	10% to 90% (operation) 5% to 95% (storage)	

Build your product reference at http://austral-eng.com/en/thunderball-h7-oem-industrial-marine-rugged-ip67-mission-calculator-iot-gateway/

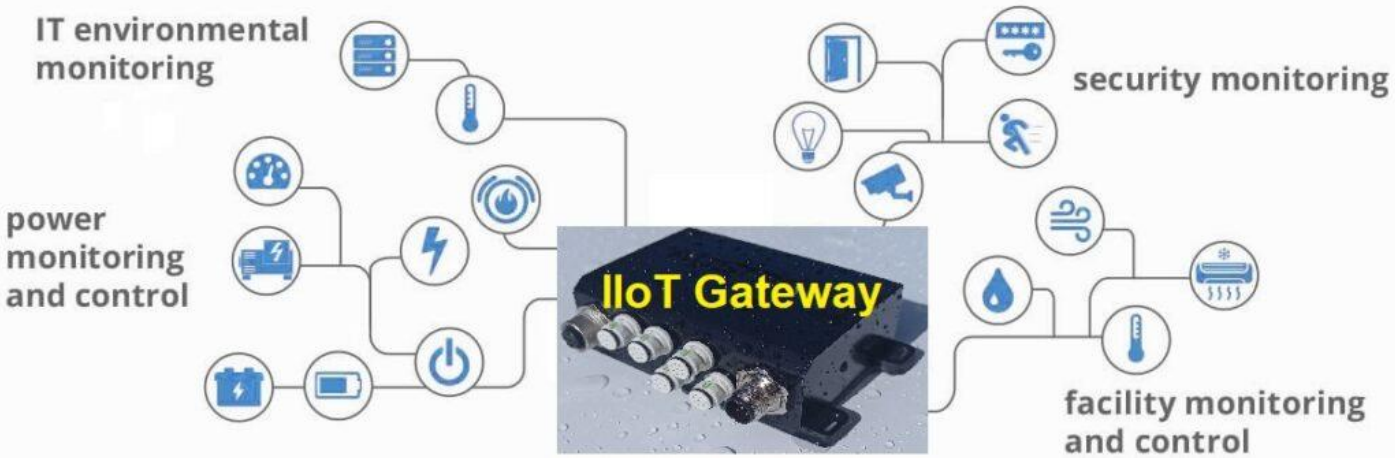
4 APPLICATIONS & EXAMPLES OF USE



The **Thunderball H7 OEM** is designed for **SWaP-sensitive, robust and real-time applications using remote HMI**. It will be embedded into a third-party system in a harsh environment, like wearable edge computing, boats, vehicles, drones, machines, outdoor and underground platforms… and for a wide range of use cases:

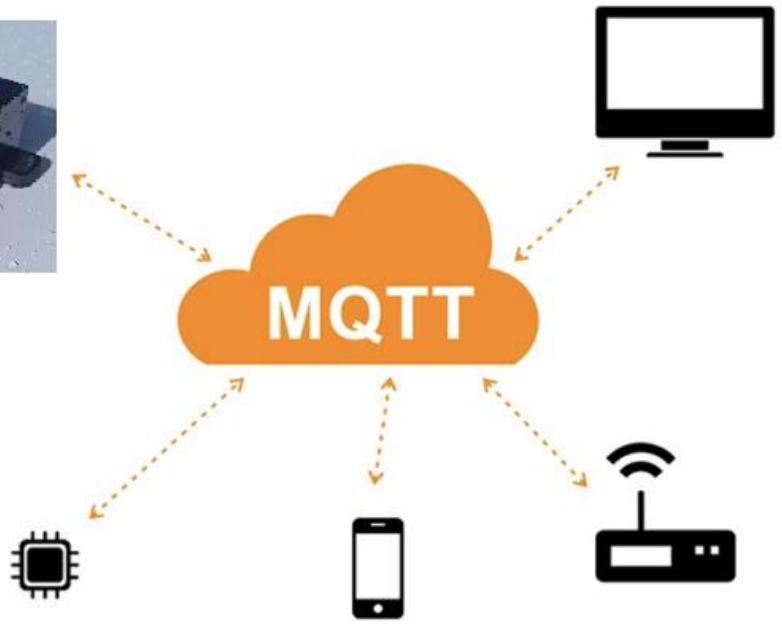
- **Interfacing:** sensors, actuators, PLCs, mission computer…
- **Datalog:** Data collection, Black box…
- **Dashboard**: HTML5 dashboard on all browsers and Industrial or marine Multifunction Displays.
- **IoT gateway:** Marine IoT, IIoT, Cloud IoT…
- **Marine:** Autopilot, Attitude control, Foiler Flight Control System, Wind calculation…
- **Drones / Robotics:** ROS2 Client node, Command control, Guidance…
- **Overall Equipment Effectiveness (OEE)**: Fleet management, Asset tracking, Machine monitoring, Energy Management, Security systems…
- **Automation:** Building, boat and transportation automation, Climate control…

Sector : Marine, Industry 4.0, Drones, Robotics, Off-Highway Vehicles, Smart Farming …

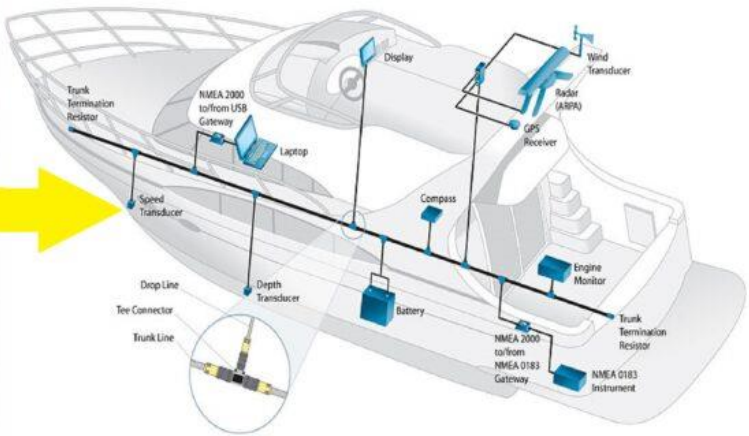


INTERFACE / DATA COLLECTION / CLOUD IOT : *Connect and log your sensors and actuators using a rugged waterproof and Ready-to-Use IIoT / micro-ROS / CANBus / Modbus Gateway*

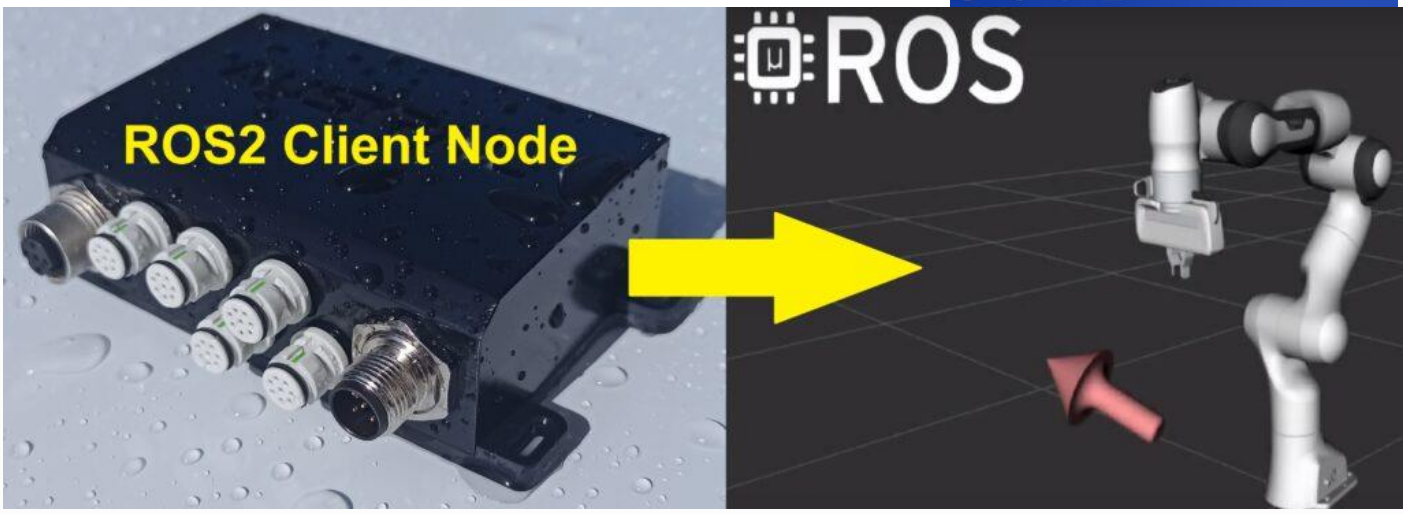
SUPERVISE: *Design advanced Web UI Dashboard with Mongoose for STM32*



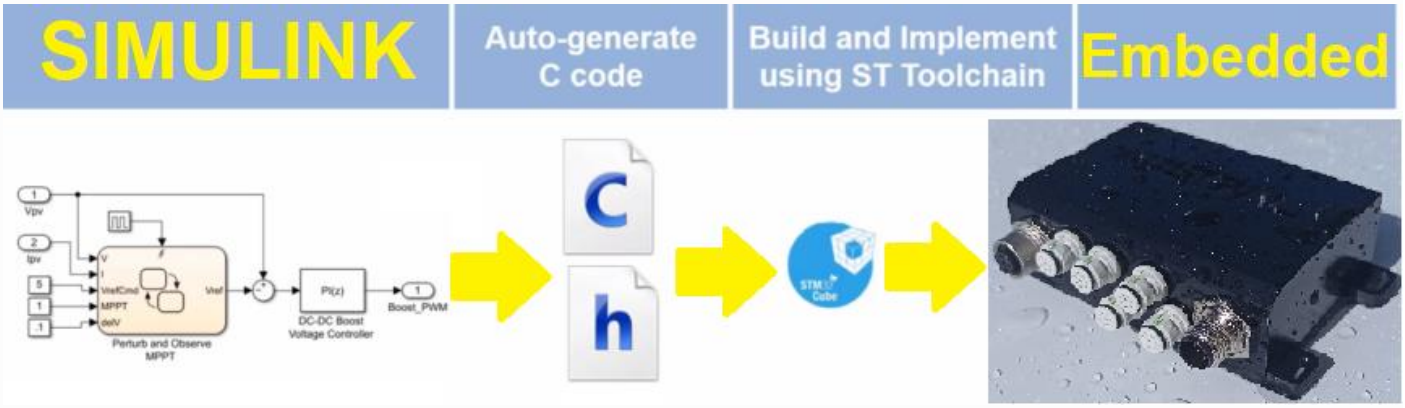
IIOT SYSTEM: *Create a rugged MQTT Client node*



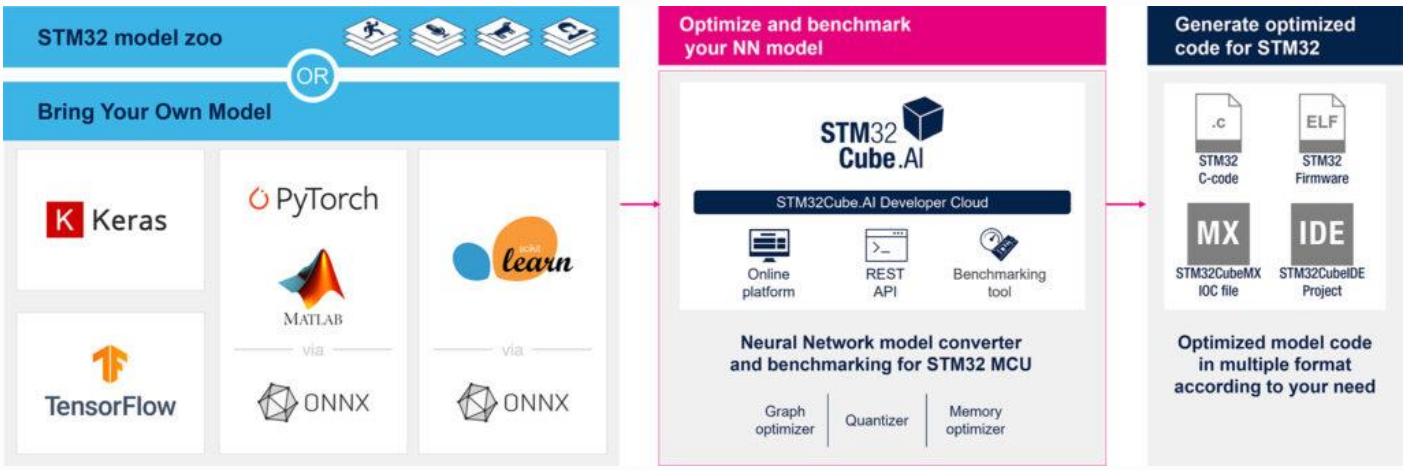
MARINE / VEHICULES / FARMING: *Build an NMEA2000/J1939 Gateway*



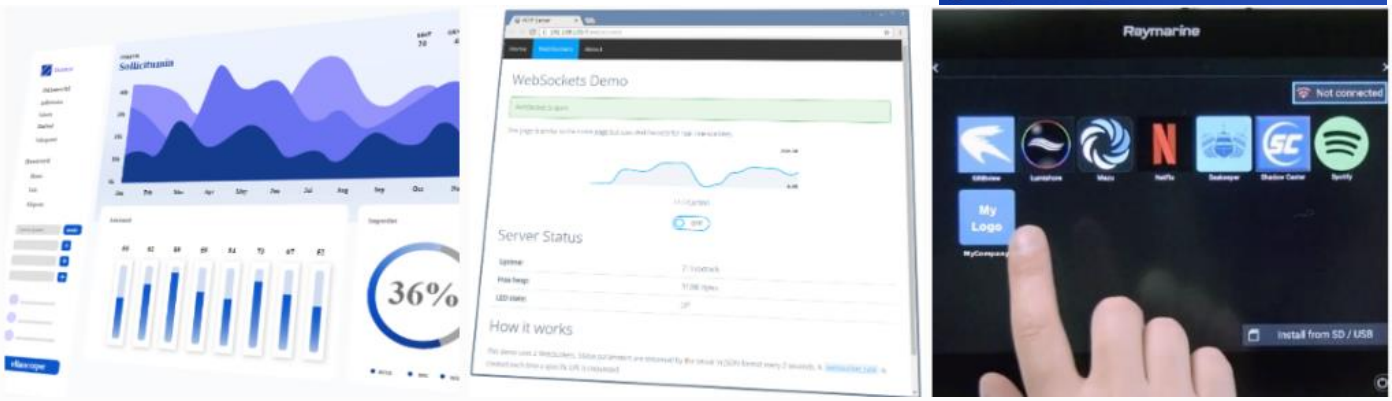
ROBOTICS: *Build a rugged ROS2 Client Nodes with micro-ROS for STM32*



SIGNAL PROCESSING / CONTROL SYSTEM: *Port your MATLAB algorithms to a rugged embedded platform with SIMULINK Code Generation for STM32*



ARTIFICIAL INTELLIGENCE: *Generate optimized code for STM32 with STM32cube.AI*



OVERALL EQUIPMENT EFFECTIVINESS : *User friendly remote dashboards with Mongoose or FreeRTOS+Websocket on Phone, Tablet, PC, Marine HTML5 MFD*

5 SOFTWARE SUPPORT & SERVICES

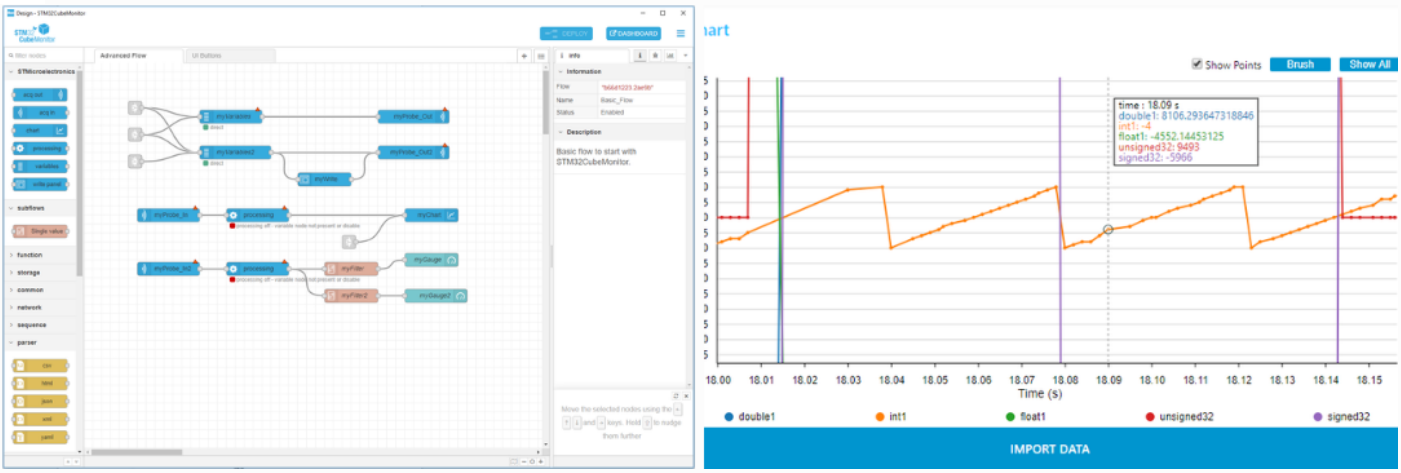
We provide with the product an SDK that allows you to save a few weeks of training, experimentation and research in the forums.

AUSTRAL Electronics in partnership with **LINATSEA** can also accompany you in your software development: Zephyr RTOS, OTA update, Micro-ROS, Protocol integration (NMEA2000, J1939…), IoT (Cloud, MQTT..), Web page (Websocket, Mongoose web UI, PyScript, WebAssembly…).

6 SOFTWARE DEVELOPMENT KIT

Github Access : https://github.com/austral-electronics/ThunderballH7

- **Development tools:** Visual Code, GCC, make, Git, STM32CubeMx, FreeRTOS, LwIP, ST-LINK/V2…
- **Template:** CubeMx code generation for the configuration of peripherals, very simple Web UI, Serials, Bootload, CANbus …
- **Tutorial:** Dev tools, CubeMX pinout & configuration, USB Bootload…



STM32CubeMonitor : *Create in minutes a dashboard to monitor your variables at run-time*

7 REAL TIME OPERATING SYSTEM COMPATIBLITY

Visit the RTOS zoo

- **Industrial & IIoT: FreeRTOS**, **Zephyr** *(OTA update, POSIX)* , **Mbed-os** *(OTA update, JavaScript)*
- **Cloud IoT: AWS FreeRTOS** *(OTA update)*, **Microsoft Azure RTOS**
- **Safety Critical: SafeRTOS**, **X-CUBE-STL**, X-CUBE-CLASSB, EmbOS-Safe, QP™ RTEFs
- **Generic:** OpenRTOS, ChibiOS/RT, RT-Thread, NuttX, PX5

8 USEFULL SOFTWARE LINKS

- **ST Support**:
  - STM32 SDK WIKI
  - STM32 Embedded Software
  - Embedded Software from ST partners (RTOS, Protocols…)

- **Advanced Debugging Tools:**
  - **Debug Node-Red Dashboard**: STM32CubeMonitor
  - **SWD+UART OTA Update**: vcon
  - **Trace & Performance Optimizer:** TraceAnalyser

- **Remote Web UI**:
  - **Simple HTML Page**: LwIP, Websocket tutorial, Simple chart, Ajax tutorial
  - **Advanced Web UI REST:** Mongoose Dashboard Live Preview (admin/admin) Mongoose Github Mongoose User Guide
  - **UI in any Languages executed in the browser:** Pyscript, Pyodide, WebAssembly
  - **Marine HTML5 MFD (Multi-Function Display) discovery**: LwIP & zeroconf

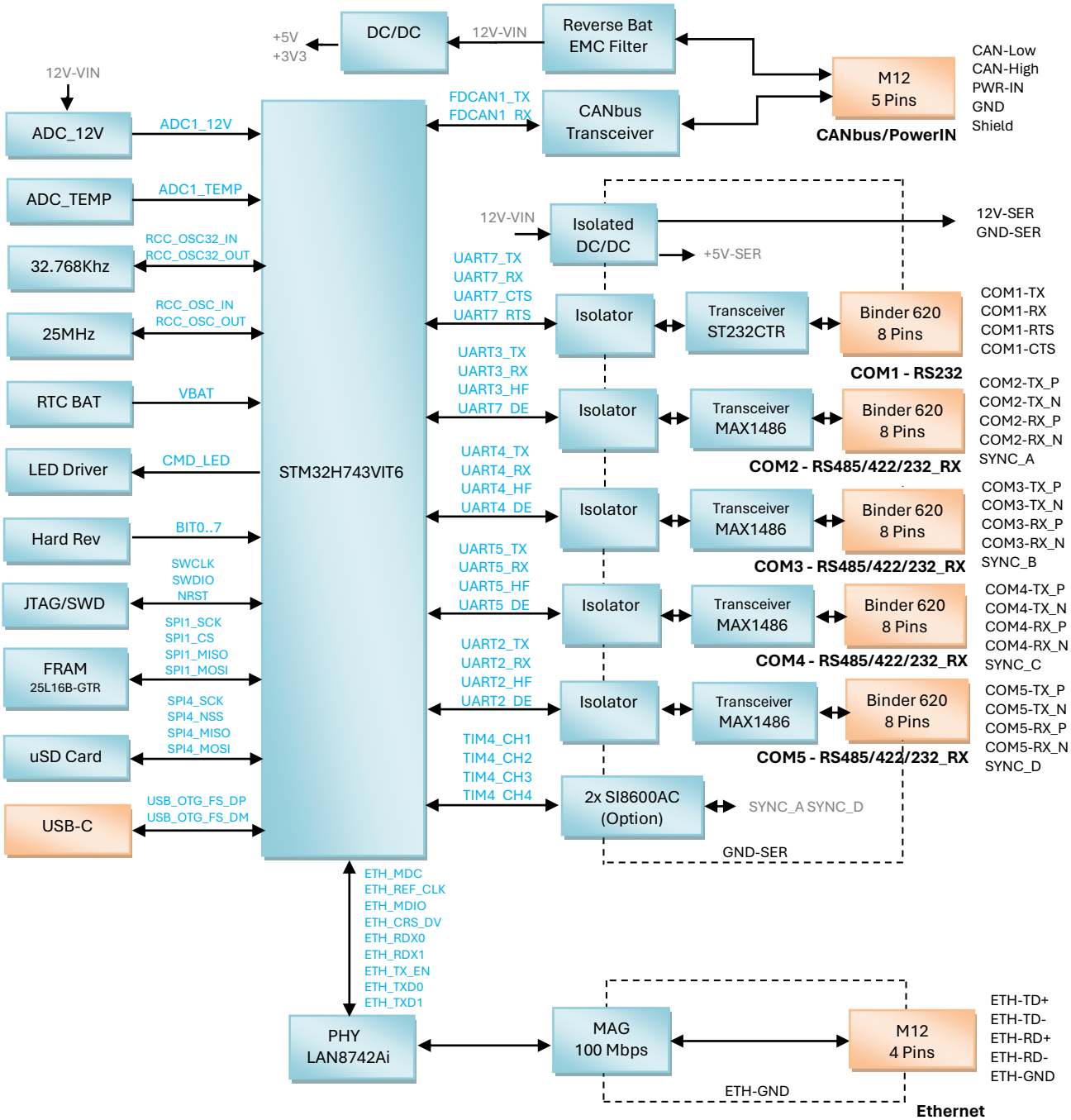
- **Robotics & Automation:**
  - **ROS2 nodes:** micro-ROS
  - **State Machine:** Boost-SML
  - **Industrial Protocols:** MODBUS, CANopen, Profinet device, Protobuf, MQTT, DDS, Backnet, OPC-UA

- **Model based Automatic Code Generation:**
  - **Simulink**: Simulink for STM32
  - **Safety Critical:** QM™ Model-Based Design Tool
  - **AI:** STM32Cube.AI, AI Model Zoo

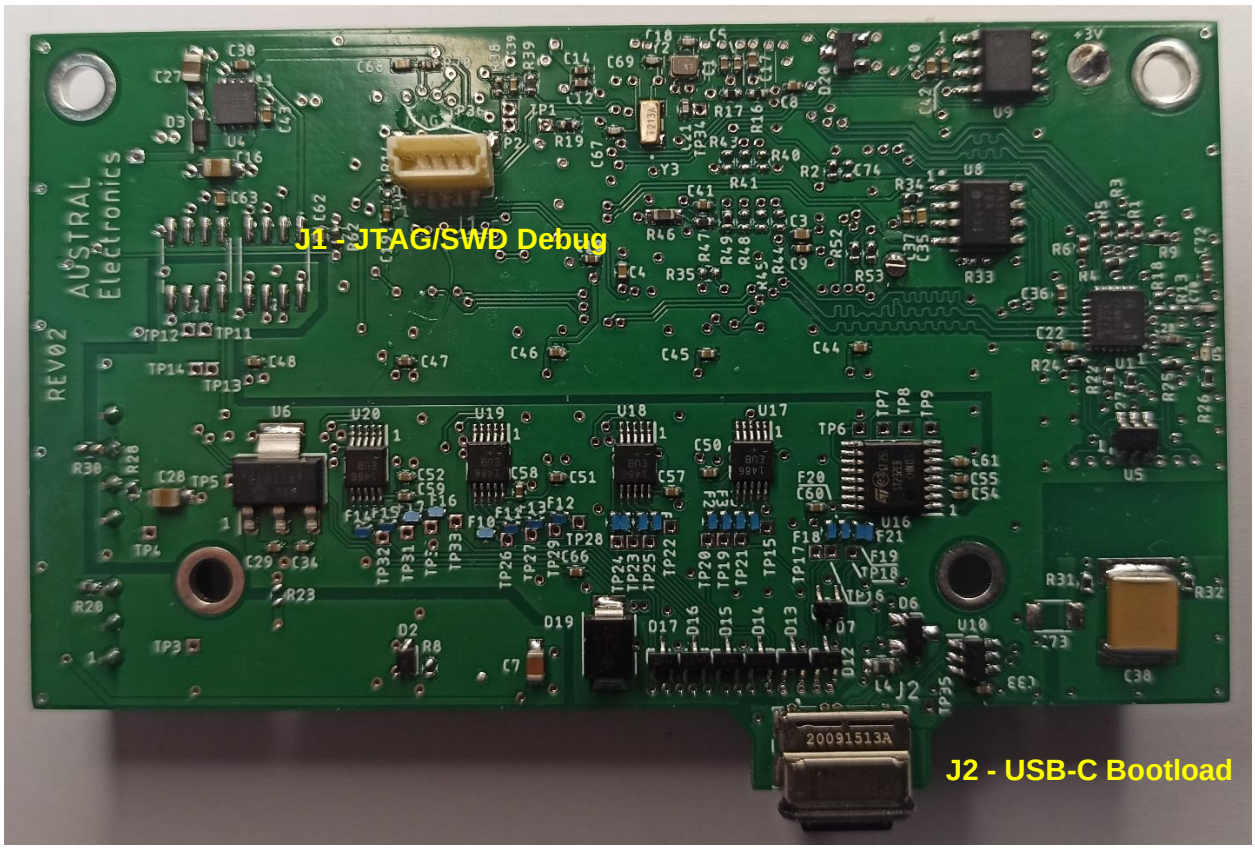
- **Other Languages:** Micro-Python, Rust, JavaScript (mbed-os)

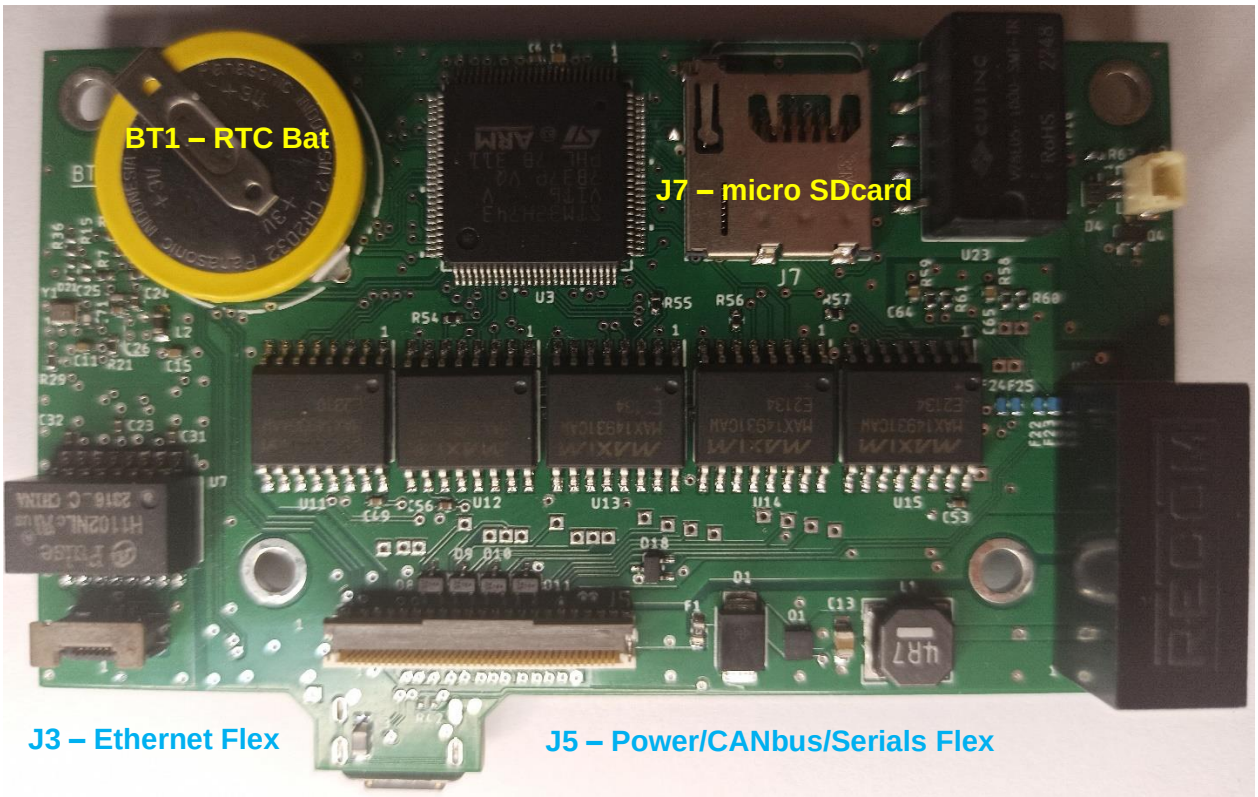
9 BOARD HARDWARE

9.1 Bloc Diagram

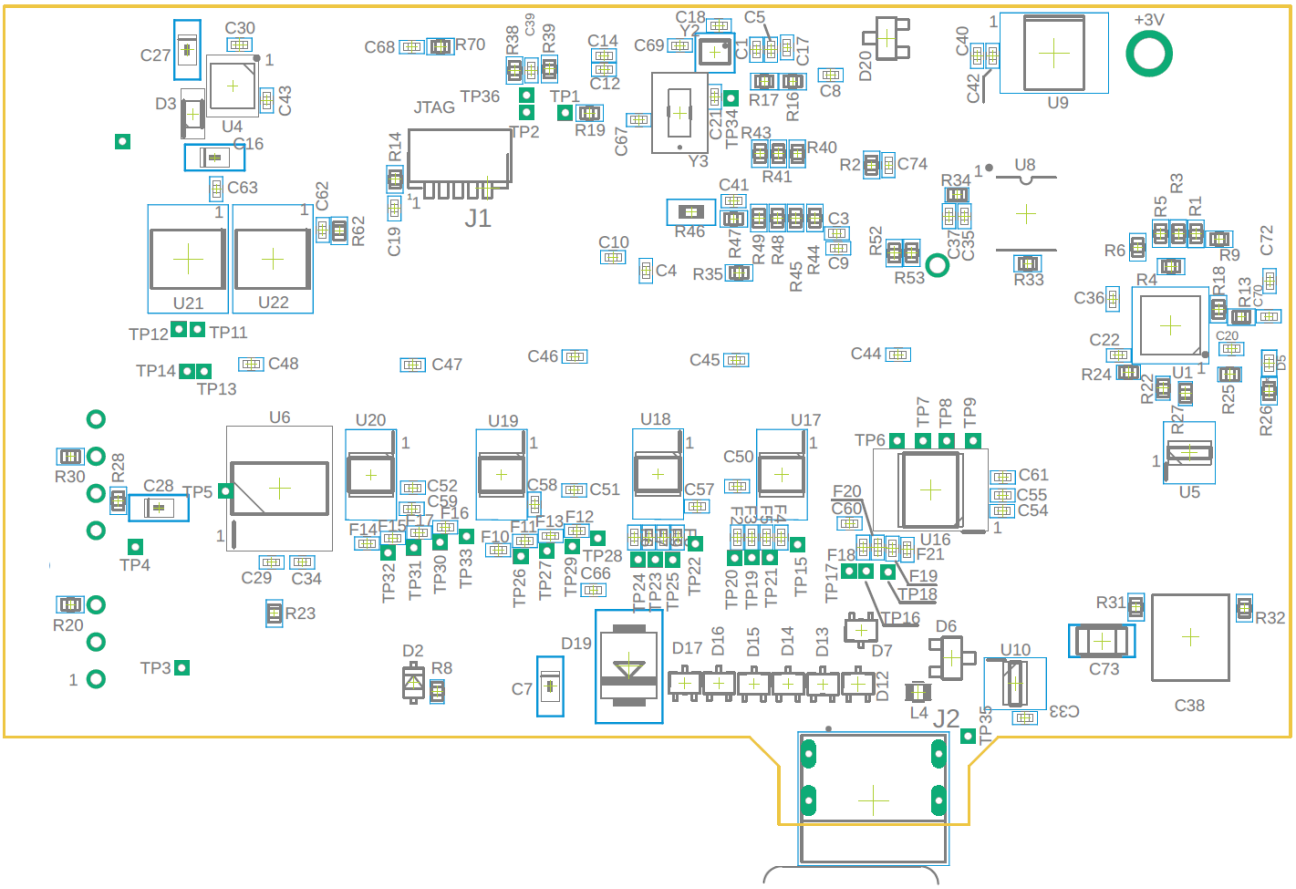


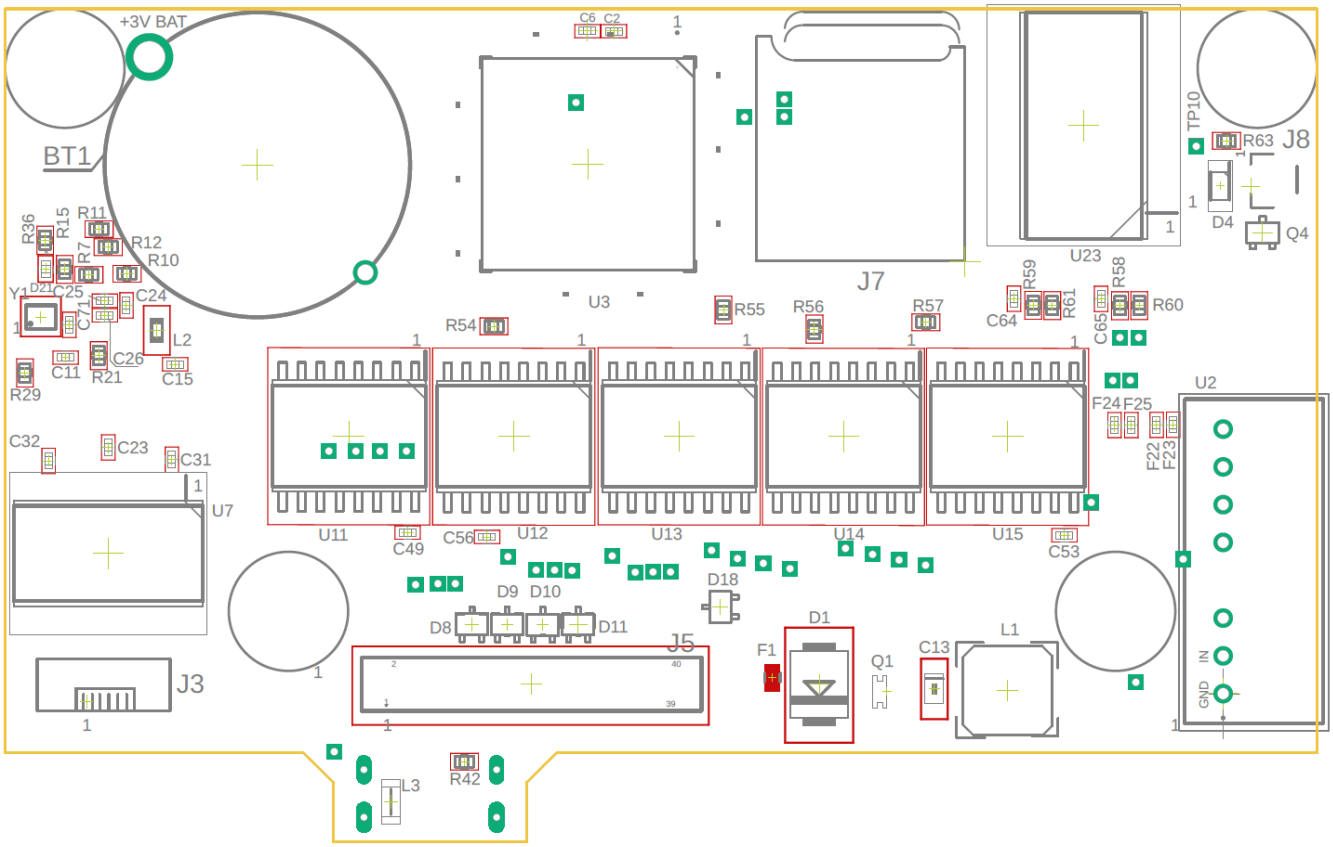
9.2 Main Board





9.3 PCB IMPLANTATION





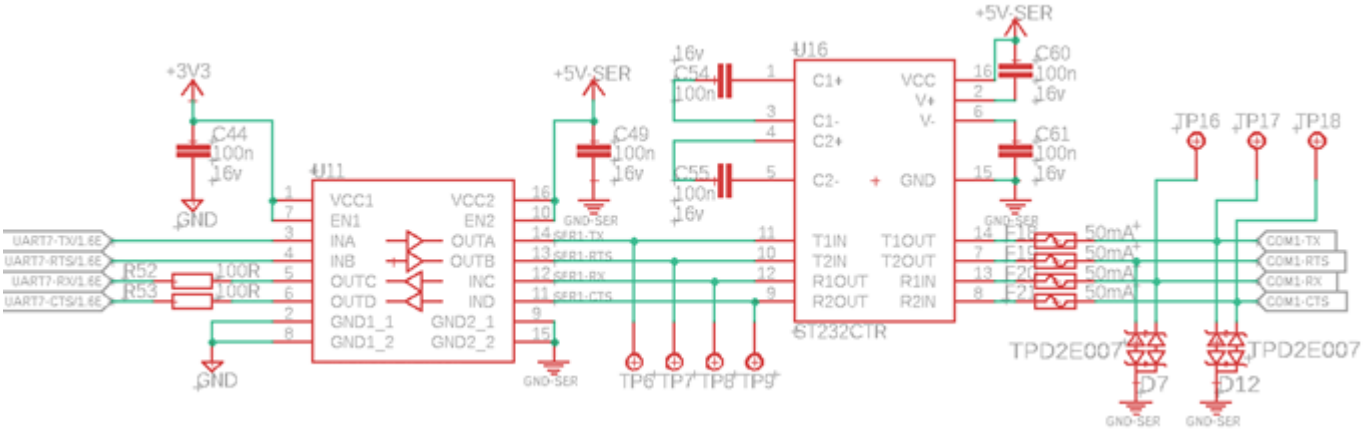
9.4 TEST POINTS

TEST	POTENTIAL	RELATIVE TO	NOTE
TP1	BOOT0	GND	STM32: Jump to Bootloader after reset
TP2	USART8_RX	GND	Free to use
TP3	+12V-VIN	GND	After F1 (Fuse), Q1 (Reverse Voltage), L1 (EMC) U2 and U23 +VIN
TP4	+12V-SER	GND-SER	After U2 (12V Isolated DC/DC)
TP5	+5V-SER	GND-SER	After U6 (5V regulator from +12V-SER)
TP6	SER1-TX	GND-SER	between Isolator & Driver
TP7	SER1-RTS	GND-SER	between Isolator & Driver
TP8	SER1-RX	GND-SER	between Isolator & Driver
TP9	SER1-CTS	GND-SER	between Isolator & Driver
TP10	+5V	GND	After 2 diodes D3, D4 connected to a 5V regulator U23 and +5V-USB
TP11	SYNC_B	GND-SER	Option
TP12	SYNC_A	GND-SER	Option
TP13	SYNC_D	GND-SER	Option
TP14	SYNC_C	GND-SER	Option
TP15	COM2-TX_P	GND-SER	
TP16	COM1-RX	GND-SER	
TP17	COM1-TX	GND-SER	
TP18	COM1-CTS	GND-SER	
TP19	COM2-RX_N	GND-SER	
TP20	COM2-RX_P	GND-SER	
TP21	COM2-TX_N	GND-SER	
TP22	COM3-TX_P	GND-SER	
TP23	COM3-RX_N	GND-SER	
TP24	COM3-RX_P	GND-SER	
TP25	COM3-TX_N	GND-SER	
TP26	COM4-RX_P	GND-SER	
TP27	COM4-RX_N	GND-SER	
TP28	COM4-TX_P	GND-SER	
TP29	COM4-TX_N	GND-SER	
TP30	COM5-TX_N	GND-SER	
TP31	COM5-RX_N	GND-SER	
TP32	COM5-RX_P	GND-SER	
TP33	COM5-TX_P	GND-SER	
TP34	NRST	GND	STM32: Reset/
TP35	+5V-USB	GND	
TP36	USART8_TX	GND	Free to use
BT1	+3V-BAT	GND	RTC Battery
C30	+3V3	GND	Near U4 3V3 Regulator

9.5 FUSES

Designator	Qty	Manufacturer	Mfg Part	Description / Value
F1	1	BOURNS	SF-0603S300-2	FUSE BOARD MNT 3A 32VDC 0603 (Warning : Slow Blow Type)
F2 to F25	24	KYOCERA AVX	F0402G0R05FNTR	FUSE BOARD MOUNT 50MA 32VDC 0402

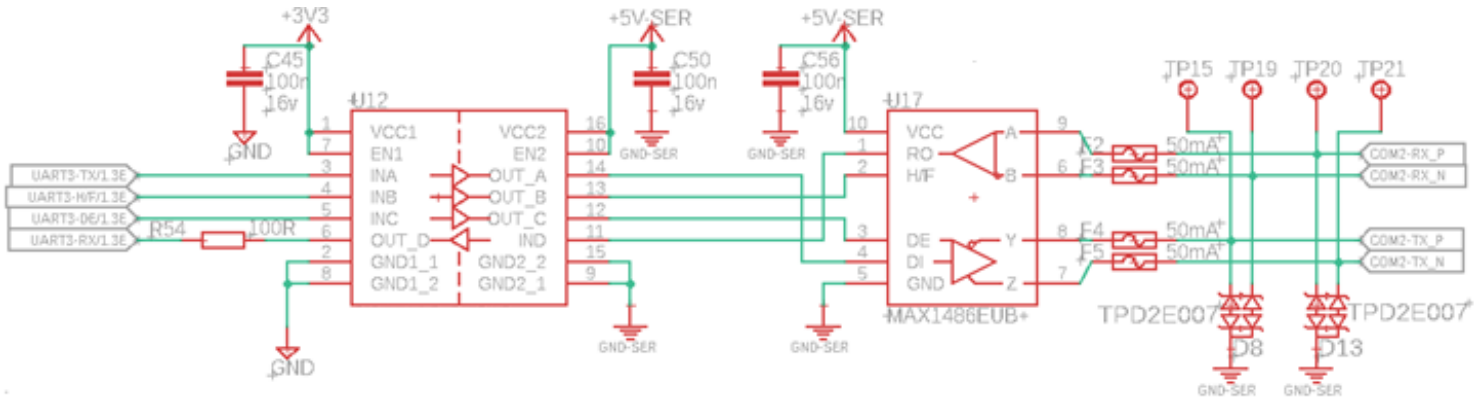
9.6 4 wires RS232 (COM 1)



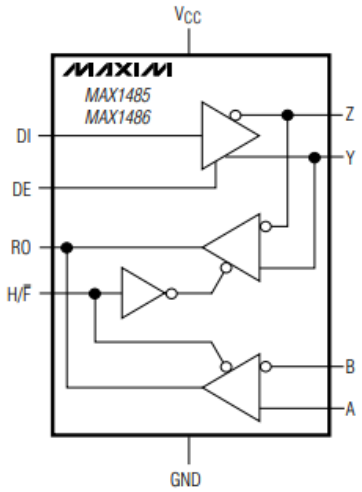
RS232 Schematic

Note: COM1_CTS can be used for PPS input

9.7 4 Wires Software-Selectable RS485 /RS422 / RX232_RX (COM 2 to 5)



RS485/422 Schematic



TRANSMITTING			
INPUTS		OUTPUTS	
DE	DI	Z	Y
1	1	0	1
1	0	1	0
0	X	High-Z	High-Z

RECEIVING				
INPUTS			OUTPUT	
H/$\overline{F}$	DE	A-B	Y-Z	RO
0	X	≥ 0.2V	X	1
0	X	≤ -0.2V	X	0
1	0	X	≥ 0.2V	1
1	0	X	≤ -0.2V	0

X = Don't care

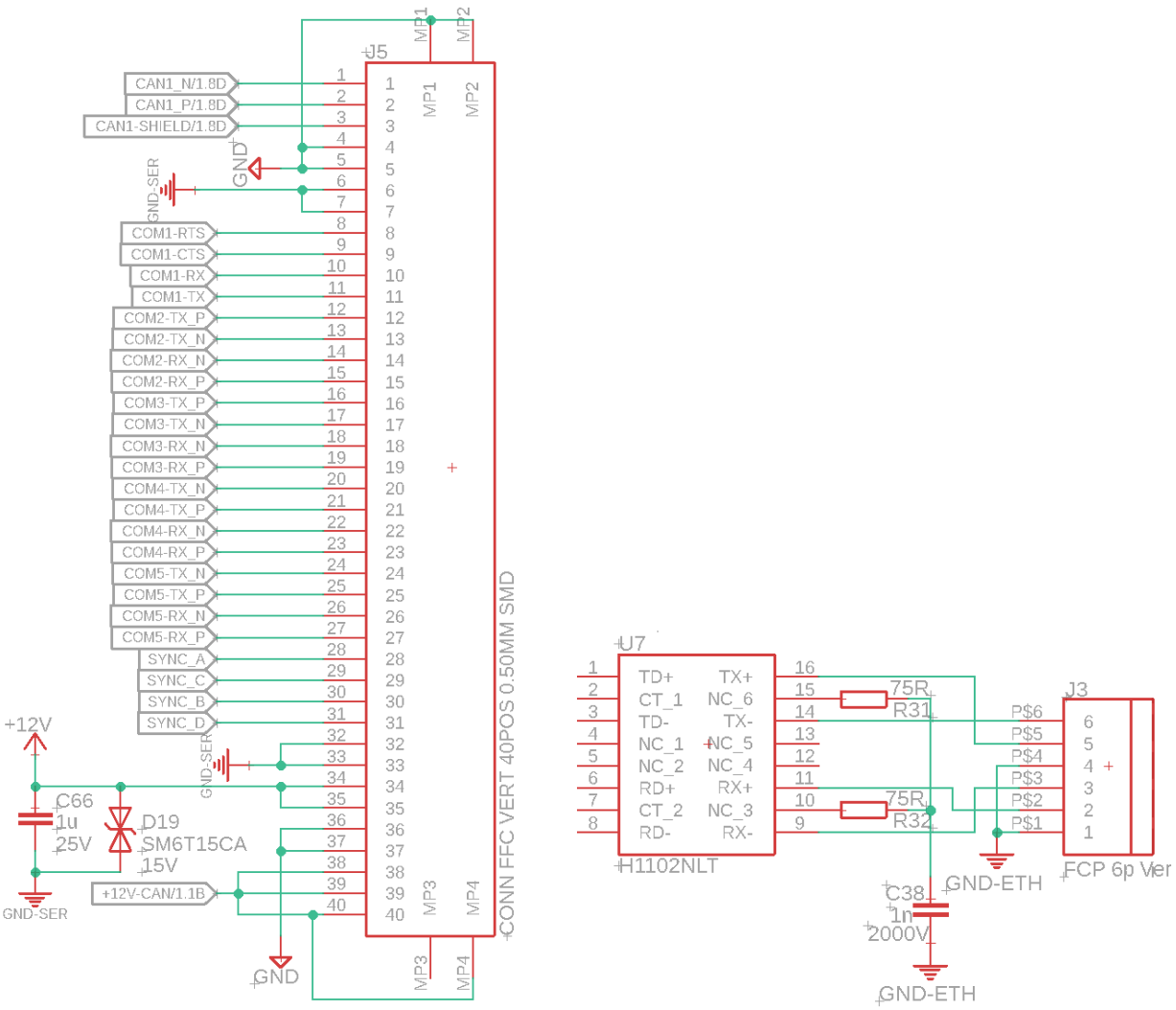
MAX1486EUB+ Functional Diagram & Tables

Note:

- **DE:** Driver Output Enable for RS485 mode (0=High Impedance)
- **H/F:** Hall / Full Duplex Selector (1=RS485 Half-Duplex, 2=RS422 Full-Duplex)
- **RS485/RS422 mode**: You will need 120 ohms terminators and 120 ohms 26AWG twisted-pair(s)
- **RS485 half-duplex mode**: You will need biasing resistor(s) in order to read correctly the first start bit of the sentence (see FAQ)
- **RS232_RX mode**: COMx_RX+ must be connected to GND_SER and COMx_RX- is connected the RS232 TX output

9.8 INTERFACES CONNECTORS

If you buy the bare electronic board only, you will need J3 and J5 pinout in order to connect the Thunderball H7 board to your board with Flex FFC jumper (100-ohm flex for Ethernet).



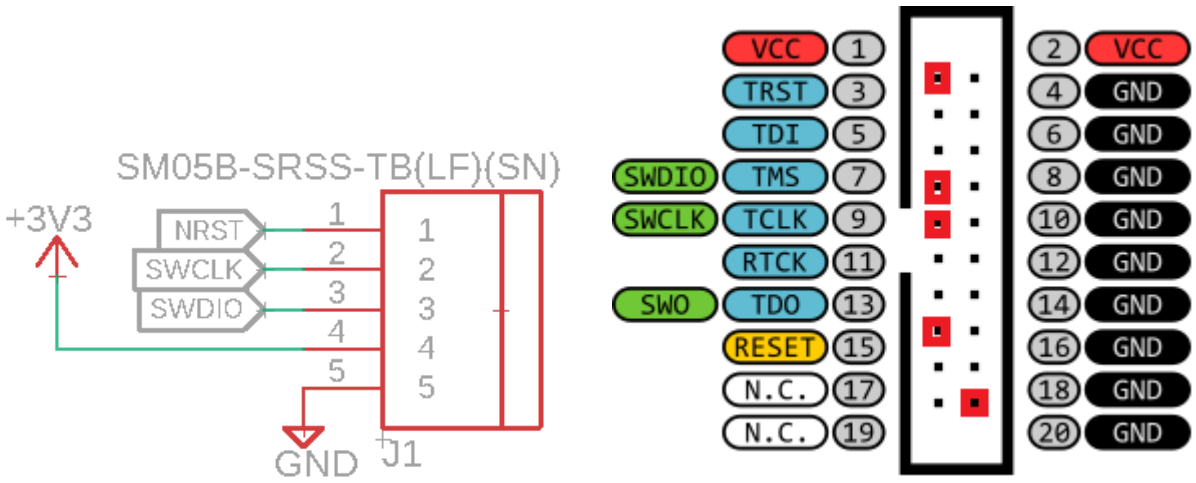
Pinout for J5 (CANbus / Serials / Power_In) & J3 (Ethernet 100MB)

Note:

- **J3:** TE Connectivity 1734742-6 (FCC/FPC connector 6 contacts, 0.5mm pitch)
- **J5:** Molex 501951-4010 (FCC/FPC connector 40 contacts, 0.5mm pitch)

9.9 JTAG/SWD ADAPTER

A JTAG/SWD connector J1 is available for development under a blind grommet integrated into the base of the case.



J1 (JTAG/SWD) Pinout & ST-LINK/V2 Pinout

Wiring a JTAG/SWD Adapter to the ST-LINK/V2 debugger

Note:

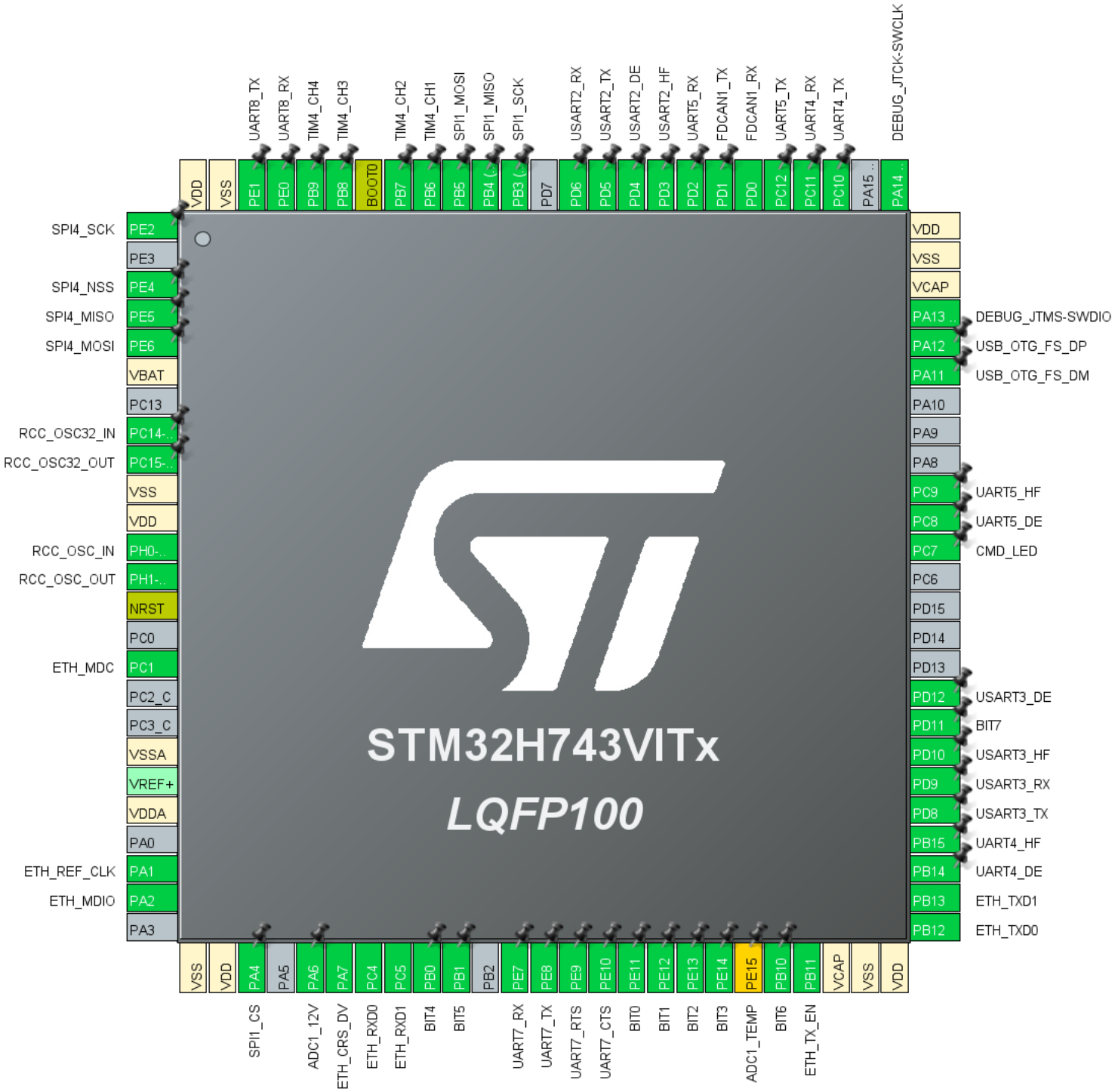
- **P1:** JST SHR-05V-S-B to plug in J1
- **20 Pins Header:** Molex 0702462004 to plug to the 20 pins ribbon
- **Wires:** JST ASHDSHD28K102 (Black) and JST SH3-SH3-28150 (Red)

9.10 ACCES TO JTAG/SWD CONNECTOR

Development products have an enclosure with a base having blind grommet to access the JTAG/SWD connector to develop your software.
You can ask to have a base without this cap for pre-series and mass-produced product.

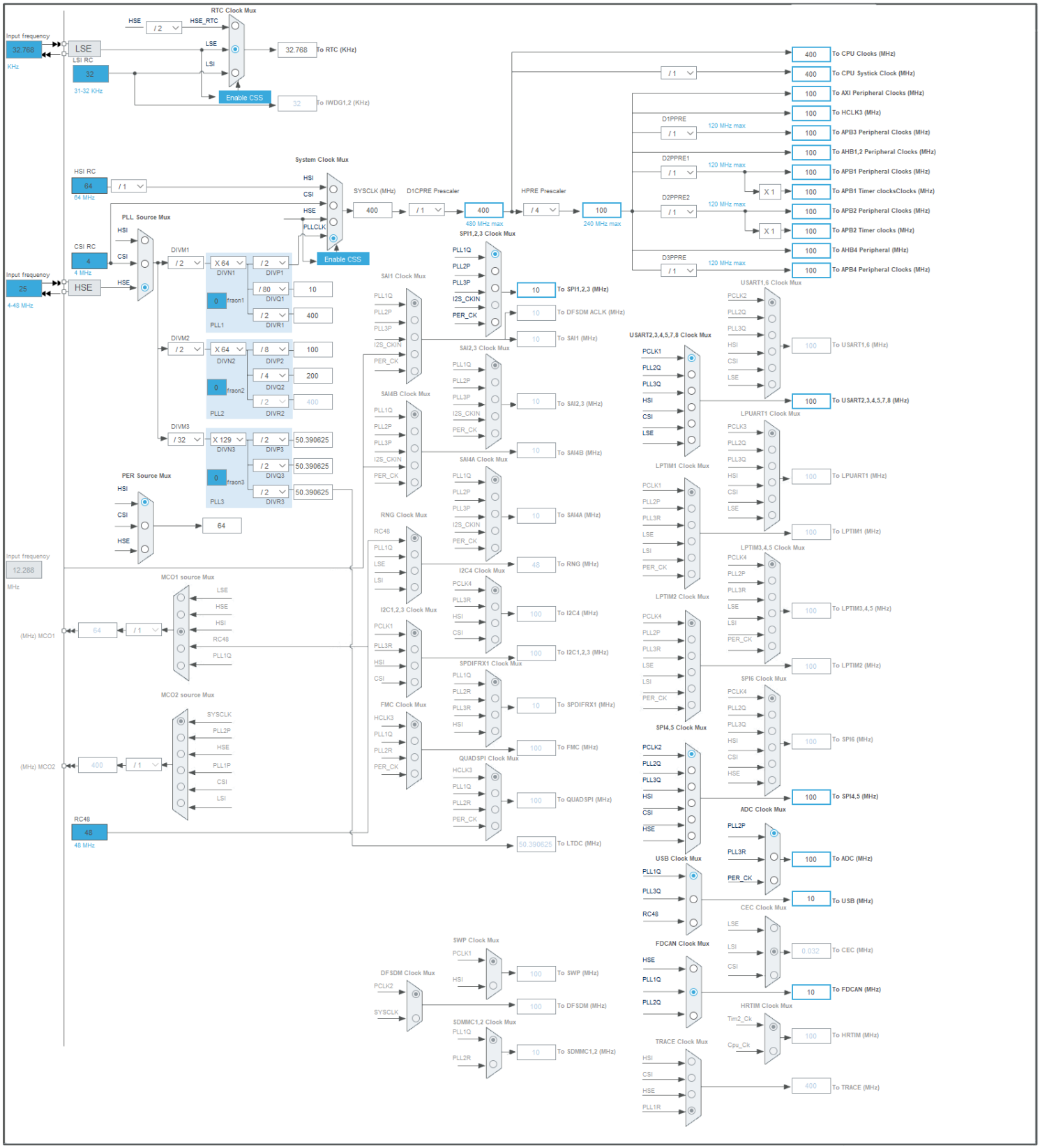
JTAG/SWD connector under a blind grommet

9.11 STM32CubeMX PINOUT



Pin	Port	Sofware Label	I/O	Description
1	PE2	SPI4_SCK	Output	SCLK uSD Card
3	PE4	SPI4_NSS	Output	CS uSD Card
4	PE5	SPI4_MISO	Input	DATA_OUT uSD Card
5	PE6	SPI4_MOSI	Output	DATA_IN uSD Card
8	PC14-OSC32_IN	RSS_OSC32_IN	Input	RTC LSE 32.768Khz Crystal input
9	PC15-OSC32_OUT	RSS_OSC32_OUT	Output	RTC LSE 32.768Khz Crystal output
12	PH0-OSC_IN	RCC_OSC_IN	Input	HSE 25 MHz Crystal input
13	PH1-OSC_OUT	RCC_OSC_OUT	Output	HSE 25 MHz Crystal output
14	NRST	-	Input	Hardware Reset (J1.1)
16	PC1	ETH_MDC	Output	Ethernet MDC (LAN8742Ai mode RMII)
23	PA1	ETH_REF_CLK		Ethernet REF_CLK (LAN8742Ai mode RMII)
24	PA2	ETH_MDIO	I/O	Ethernet MDIO (LAN8742Ai mode RMII)
28	PA4	SPI1_CS	Output	CS/ FRAM (FM25L16B-GTR)
30	PA6	ADC1_12V	Analog Input	ADC1 INP3 – Power Voltage 100K to 12V-VIN and 10K to GND
31	PA7	ETH_CRS_DV	Input	Ethernet CRS_DV (LAN8742Ai mode RMII)
32	PC4	ETH_RDX0	Input	Ethernet RXD0 (LAN8742Ai mode RMII)
33	PC5	ETH_RDX1	Input	Ethernet RXD1 (LAN8742Ai mode RMII)
34	PB0	BIT4	Input	Hardware Revision Bit 4
35	PB1	BIT5	Input	Hardware Revision Bit 5
37	PE7	UART7_RX	Input	COM1-RX
38	PE8	UART7_TX	Output	COM1-TX
39	PE9	UART7_RTS	Output	COM1-RTS
40	PE10	UART7_CTS	Input	COM1-CTS
41	PE11	BIT0	Input	Hardware Revision Bit 0
42	PE12	BIT1	Input	Hardware Revision Bit 1
43	PE13	BIT2	Input	Hardware Revision Bit 2
44	PE14	BIT3	Input	Hardware Revision Bit 3
45	PE15	ADC_TEMP	Analog Input	ADC1 EXT15 – PCB Temperature NCP18XH103F03RB NTC to 3V3 and 10K to GND
46	PB10	BIT6	Input	Hardware Revision Bit 6
47	PB11	ETH_TX_EN	Output	Ethernet TX_EN (LAN8742Ai mode RMII)
51	PB12	ETH_TXD0	Output	Ethernet TXD0 (LAN8742Ai mode RMII)
52	PB13	ETH_TXD1	Output	Ethernet TXD1 (LAN8742Ai mode RMII)
53	PB14	UART4_DE	Output	COM3-DE (MAX1486 RS485 Hardware Flow Control)
54	PB15	UART4_H/F	Output	COM3-HF (MAX1486 Half/Full Duplex Control)
55	PD8	USART3_TX	Output	COM2-TX
56	PD9	USART3_RX	Input	COM2-RX
57	PD10	USART3_HF	Output	COM2-HF (MAX1486 Half/Full Duplex Control)
58	PD11	BIT7	Input	Hardware Revision Bit 7
59	PD12	USART3_DE	Output	COM2-DE (MAX1486 RS485 Hardware Flow Control)
64	PC7	CMD_LED	Output	Command Austral (Or your Brand) Logo Backlight
65	PC8	UART5_DE	Output	COM4-DE (MAX1486 RS485 Hardware Flow Control)
66	PC9	UART5_HF	Output	COM4-HF (MAX1486 Half/Full Duplex Control)
70	PA11	USB_OTG_FS_DM	I/O	USB Device Data Minus - Bootloader
71	PA12	USB_OTG_FS_DP	I/O	USB Device Data Plus - Bootloader
72	PA13	DEBUG_JTMS-SWDIO		JTAG/SWD SWDIO (J1.3 connector)
76	PA14	DEBUG_JTMS-SWCLK		JTAG/SWD SWCLK (J1.2 connector)
78	PC10	UART4_TX	Output	COM3-TX
79	PC11	UART4_RX	Input	COM3-RX
80	PC12	UART5_TX	Output	COM4-TX
81	PD0	FD_CAN1_RX	Input	(FD) CANbus RX
82	PD1	FD_CAN1_TX	Output	(FD) CANbus TX
83	PD2	UART5_RX	Input	COM4-RX
84	PD3	USART2_HF	Output	COM5-HF (MAX1486 Half/Full Duplex Control)
85	PD4	USART2_DE	Output	COM5-DE (MAX1486 RS485 Hardware Flow Control)
86	PD5	USART2_TX	Output	COM5-TX
87	PD6	USART2_RX	Input	COM5-RX
89	PB3	SPI1_SCK	Output	SCK FRAM (FM25L16B-GTR)
90	PB4	SPI1_MISO	Input	SO FRAM (FM25L16B-GTR)
91	PB5	SPI1_MOSI	Output	SI FRAM (FM25L16B-GTR)
92	PB6	TIM4_CH1	I/O	Option SYNC A
93	PB7	TIM4_CH2	I/O	Option SYNC B
94	BOOT0	-	Input	Strap to 3V3 to force the Bootloader at startup 100K to GND / Test Point TP1
95	PB8	TIM4_CH3	I/O	Option SYNC C
96	PB9	TIM4_CH4	I/O	Option SYNC D
97	PE0	UART8_RX	Input	Unused - Test Point TP2
98	PE1	UART8_TX	Output	Unused - Test Point TP36

9.12 STM32CubeMX DEFAULT CLOCK CONFIGURATION (400Mhz)



11 MAINTENANCE

Contain a cell coin battery

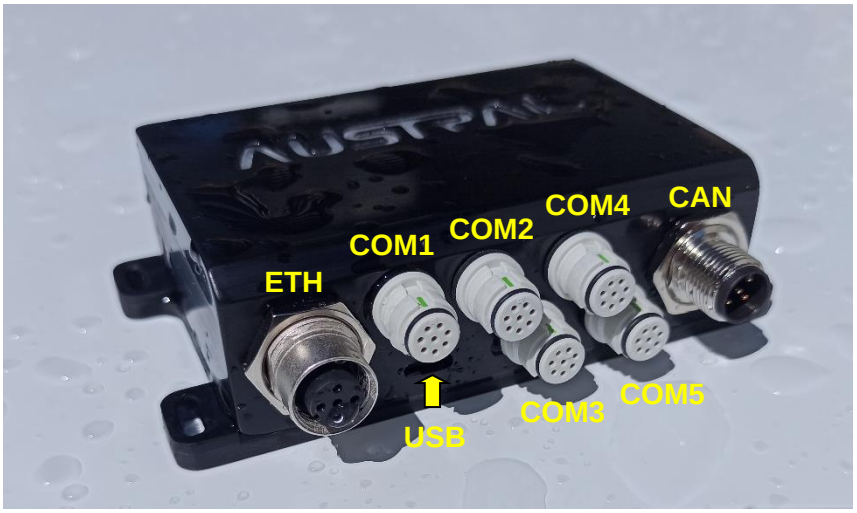
This product includes a CR-2032/HFN coin cell in order to maintain the Real Time Clock and datalog at startup with the correct time without waiting an NTP or GNSS time synchronization.

The service life of this cell is more than 15 years in a protected environment (20°C) and power off.

Contact the after sale in order to change this coin cell.

12 ELECTRICAL INTERFACES

12.1 Sockets:



Ref	Function	Type	Software
ETH	100MB/s Ethernet	M12, 4 pin D-coded (Profinet standard)	
USB	USB2 Device / Bootload	USB-C	
COM1	Isolated RS232	Binder 620 series 8 pins female	huart7
COM2 to COM5	Isolated RS485 / RS422 / RS232 Rx Only	Binder 620 series 8 pins female	COM2 -> huart3 COM3 -> huart4 COM4 -> huart5 COM5 -> huart2
CAN	CANBus and Power Input	M12, 5 pins male A-coded shielded (NMEA2000/DeviceNet/CANopen standard)	fdcan1

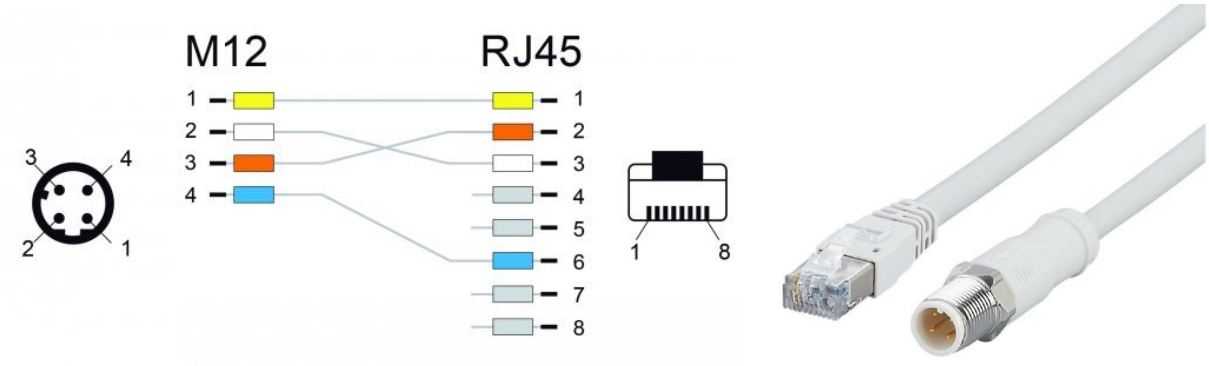
12.2 Pinouts:

Pin	ETH	USB-C	COM1 RS232	COM2 to 5 RS485 (4)	COM2 to 5 RS422 (4)	COM2 to 5 RX-RS232	CAN (5) & PWR-IN
12		-					
11		-					
10		-					
9		-					
8		-	12V-SER (2) Red				
7		USB-D-	GND-SER Blue				
6		USB-D+	COM1-CTS Pink	- Pink	COMX_RX+ Pink	Must be connected to GND Pink	
5		-	COM1-RX Gray	- Gray	COMX_RX- Gray	COMX-RX (6) Gray	CAN-Low Blue
4	ETH-RD-	5V In (3)	COM1-TX Yellow	COMX-D- Yellow	COMX-TX- Yellow	- Yellow	CAN-High White
3	ETH-TD-	-	COM1-RTS Green	COMX-D+ Green	COMX-TX+ Green	- Green	GND Black
2	ETH-RD+	-	- Brown				PWR-IN Red (1)
1	ETH-TD+	GND	- White	Reserved (SYNC_A to SYNC_D) White			Shield
Shield	ETH-GND	GND					Shield

(1) The calculator is powered by the NMEA2000 (Reverse battery protection and Internal SMT fuse)
(2) Regulated 12V output from an internal isolated DC/DC converter (6W max)
(3) 5V Input (2W) !!! Warning - Do not connect to a voltage >5V!!!
(4) The 100/120-ohm terminator is not included
(5) The 120-ohm terminator is not included
(6) !!! Warning - Receiver Input voltage: -8V to +12.5V max!!!

COM wires colors using Binder 77-7405-0000-50008-0200 cable

12.3 ETHERNET: Profinet standard :



M12 to RJ45 Cable pinout

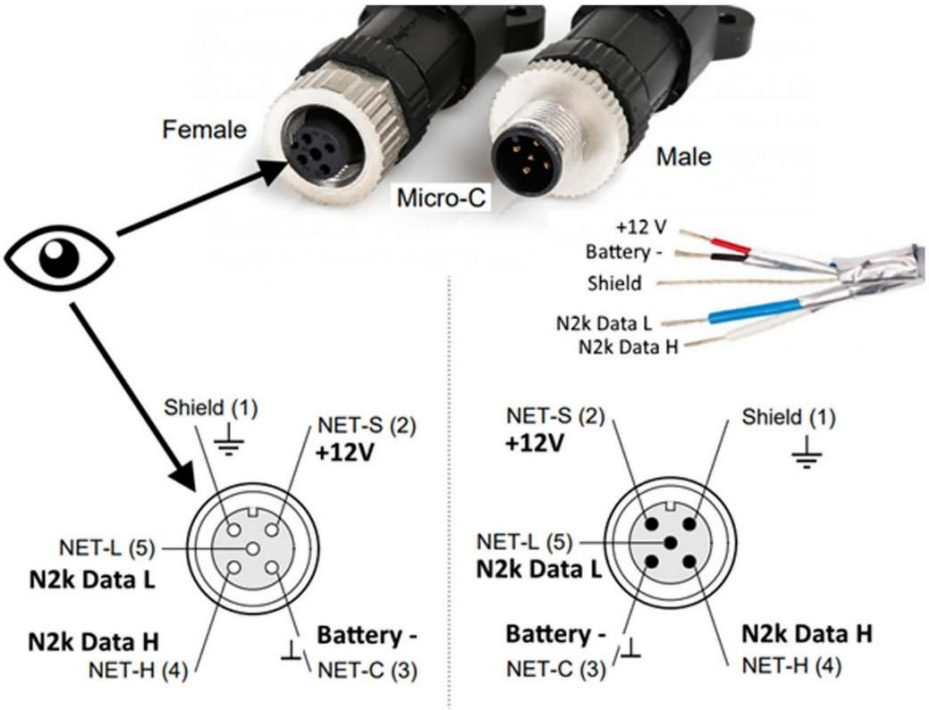
Marine M12 to RJ45 MPPE grey cable: *IFM EVF549 (0.5m, 48g), EVF550 (1m), EVF551 (2m)*

https://www.ifm.com/

Industrial M12 to RJ45 PVC green cable: *Delock 85437 (1m), 85438 (2m), 85439 (3m)*
https://www.delock.com/

Small soldering plug: *Amphenol M12D-04BMM1-SL8001*

12.4 CANbus: NMEA200/DeviceNet/CANopen standard :



Note: Aerospace CANbus cable:

- https://www.nexans.fr/fr/products/Transportation/Aerospace/Data-Bus-cables-for-high-frequency-transmission/Twinax-Bus-Cable/EN-3375-0025450.html
- https://www.wiremasters.com/product/GF120T-24CANB
- https://www.gore.com/products/canbus-cables-civil-aircraft

12.5 SERIALS: Binder 620 - 8 positions

2m Cable : Binder 77-7405-0000-50008-0200
Farnell 2949614

Or soldering plug: *Binder* 99-9225-400-08 (grey) or 99-9225-00-08 (Black)
Farnell 2949942 (grey) or 1778691 (black)

Note: Binder 620 connectors are compatible with aerospace RS485 cable :

- https://www.nexans.fr/fr/products/Transportation/Aerospace/Data-Bus-cables-for-high-frequency-transmission/Twinax-Bus-Cable/EN-3375-0025450.html
- https://www.farnell.com/datasheets/319605.pdf

12.6 USB-C

Use a standard android phone USB-C to USB-A charging cable to connect to your PC

13 PRODUCT INFORMATIONS & HARDWARE SERVICES

This product can be sold by unit or in volume and is designed to fit to your needs (SD-card, logo, JTAG/SWD…). We can also provide the cables.
It can be easily customized with your company's visual for low volume (your logo with a white or blue backlight, colors, marking…).

AUSTRAL Electronics is a design office, we can support you on your specific needs in electronics, embedded computing, specific RTOS, certification…

14 PRODUCT STATUS

PCB Revision —	**002** —
Introduction	Q1 2022
Life Cycle Phase	**Active**
Expected EOF	2032

15 PRINCING & ORDERING

Product Pricing & Ordering : http://austral-eng.com/en/thunderball-h7-oem-industrial-marine-rugged-ip67-mission-calculator-iot-gateway/

16 TROUBLESHOOTING

16.1 Force USB Bootload by hardware

To call the STM32 bootloader code by hardware, you must force BOOT0 pin of the STM32 (TP1) to 3V3 during power up. This is done automatically when the Thunderball H7 is powered solely by the 5V of the USB-C cable connected to a PC.
You must unplug the CANBus cable or switch off the power supply and then plug the USB cable.
You should hear the USB driver notification sound when you plug/ unplug in the Thunderball H7.

Please refer to the software documentation for use of the STM32CubeProgrammer software.

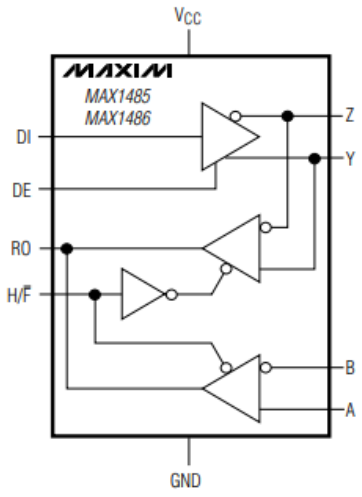
STM32 Bootloader (P263) : https://www.st.com/resource/en/application_note/an2606-stm32-microcontroller-system-memory-boot-mode-stmicroelectronics.pdf

DFU Protocol : https://www.st.com/resource/en/application_note/an3156-usb-dfu-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf

16.2 RS485 Termination and Biasing

The most complex and misunderstood aspect of configuring a RS485 network is biasing. When a RS485 network is idle, all nodes are set to receive data and therefore all drivers are tri-stated. Without anything driving the network, the state of the line is unknown.

If the voltage at the receiver inputs is less than ±200 mV (Including in the MAX1486), the receiver output logic level will be undeterminable and can often be that of the last bit received. Without this, you can miss the start bit of every communication preventing correct interpretation of the transmission.



TRANSMITTING			
INPUTS		OUTPUTS	
DE	DI	Z	Y
1	1	0	1
1	0	1	0
0	X	High-Z	High-Z

RECEIVING				
INPUTS			OUTPUT	
H/$\overline{F}$	DE	A-B	Y-Z	RO
0	X	≥ 0.2V	X	1
0	X	≤ -0.2V	X	0
1	0	X	≥ 0.2V	1
1	0	X	≤ -0.2V	0

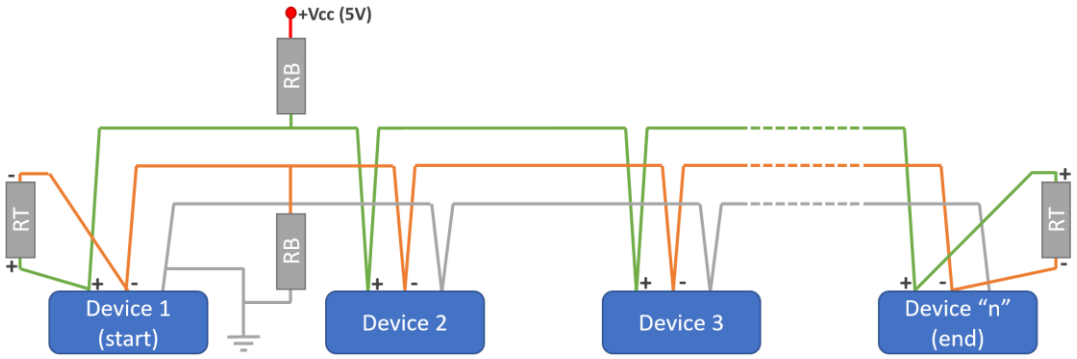
X = Don't care

MAX1486EUB+ Functional Diagram & Tables

Hardware solution: Pull-up and pull-down Resistors:

In order to maintain the correct idle state bias, resistors can be added to the transmission lines. A pull-up resistor, typically to +5V, is added to the non-inverting input, RX+, and a pull-down, to ground, is added to the inverting input, RX-.
The bias resistor values are determined by the network load, including terminations if fitted: When termination resistors are fitted, the loading effect of these is greater than that of the nodes, which have a typical load of 12kΩ per node.
This means that the bias resistor values are approximately 685Ω regardless of the number of nodes. When termination is not fitted, the bias resistors can vary from 122kΩ for two nodes to 4.5kΩ for 32 nodes, to achieve the voltage levels required.

Bias resistors can be added at any point on the network or can be split among multiple nodes. The parallel combination of all bias resistors on a network should be equal to or less than the biasing requirements. They are typically added to the master node. A number of modern RS485 transceivers have been designed to correctly identify the idle condition without biasing resistors. Without all RS485 transceivers having this capability, and device manufacturers not disclosing the transceiver type applied, biasing must still be considered when creating a RS485 network.



- The cable must be a twist pair with 120 Ohm (typically in 24 AWG).
- The Termination resistor RT near the end device is 120 Ohm.
- The Termination resistor RT near the start device is 130 Ohm with two bias resistor RB 685 to 750 ohm.

Software solution: If you write your own frame format you can manage the problem by software

End every sentence with the stop bit level.
Choose a frame preamble that allows a bad decoding of the very first byte.

References:

https://www.ti.com/lit/an/snla049b/snla049b.pdf?ts=1702831616325&ref_url=https%253A%252F%252Fwww.google.com%252F -> See page 12

https://embeddedcomputing.com/application/networking-5g/troubleshooting-rs485-networks
https://know.innon.com/bias-termination-rs485-network

https://www.mouser.fr/datasheet/2/609/MAX1481_MAX1486-3127167.pdf