MINI-MAX/STM32F7
(picoWiPOM)
User Manual

Document Revision: 1.02

Date: 30 April 2021

BiPOM Electronics, Inc.

E-mail: info@bipom.com
Web: www.bipom.com

1. Overview

BIPOM's MINI-MAX/STM32F7 (also known as picoWiPOM) microcontroller board is based on the STM32F745VGT6 high-performance ARM®Cortex®-M7 32-bit RISC core operating at up to 216 MHz frequency. The Cortex®-M7 core features a single floating-point unit (SFPU) precision which supports all ARM® single-precision data-processing instructions and data types. It also implements a full set of DSP instructions and a memory protection unit (MPU) which enhances the application security.

The STM32F745VGT6 incorporates high-speed embedded memories with a 1 Mbyte Flash memory, 320 Kbytes of SRAM (including 64 Kbytes of data TCM RAM for critical real-time data), 16 Kbytes of instruction TCM RAM (for critical real-time routines), 4 Kbytes of backup SRAM available in the lowest power modes, and an extensive range of enhanced I/O's and peripherals connected to two APB buses, two AHB buses, a 32-bit multi-AHB bus matrix, and a multi-layer AXI interconnects supporting internal and external memories access.

The microcontroller has 12-bit ADCs, two DACs, a low-power Real-Time Clock (RTC), thirteen general-purpose 16-bit timers including two PWM timers for motor control, and one low-power timer available in Stop mode, two general-purpose 32-bit timers, a true random number generator (RNG). The microcontroller also features standard and advanced communication interfaces.

2. Specifications

Dimensions are 2.35 X 2.40 inches (5.97 X 6.10 centimeters). Mounting holes of 0.125 inches (3 millimeters) on four corners. -40°C to +85°C operating temperature range.

- ARM® 32-bit Cortex®-M7
- STM32F745VGT6 Microprocessor
- 24 MHz crystal, with up to 216 MHz internal operation
- 256MB (32Mx8) SPI flash
- 4x Analog input
- 1x Digital output
- 1x Digital input
- 2x RS232 Serial ports with RTS/CTS handshake lines
- 1x RS485 Serial port (2 Wire)
- 1x USB Device port
- JTAG programming interface
- Screw terminal block for analog circuits
- Expansion bus interface to low-cost peripheral boards
- 32.768KHz crystal and 3V battery holder for RTC
- Ultra-Low Power, USB or Battery operation possible, peripheral shutdown capability
- 3.3 Volt onboard regulator

3. Functional Blocks

Figure 1 reflects the block diagram of the board as shown below:

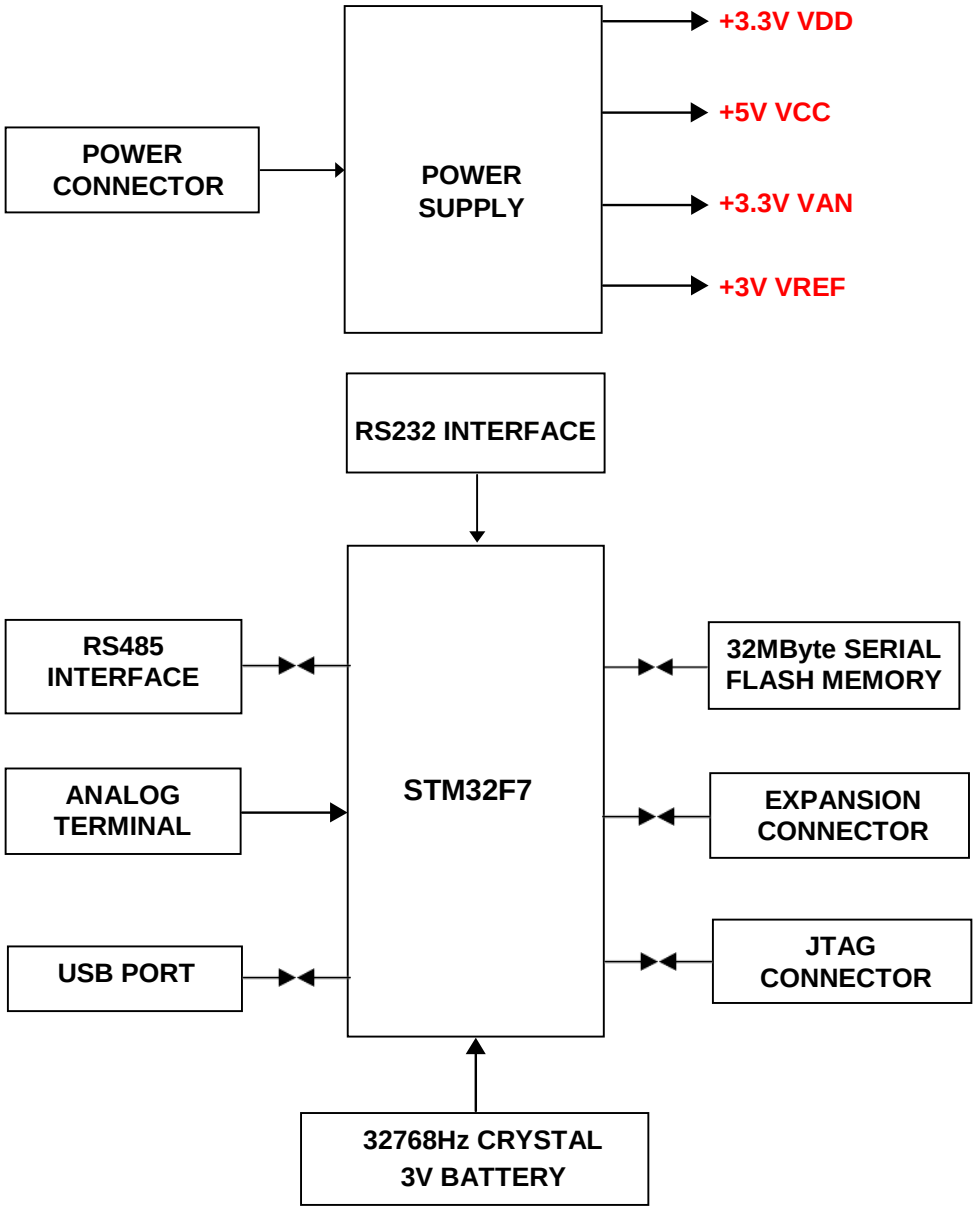


Figure 1

3.1. In-System Programming

STM32F745VGT6 micro-controller can be programmed over the RS232 interface.

Cortex-M7 Development System based on Micro-IDE Integrated Development Environment from BiPOM Electronics fully supports In-System Programming on the MINI-MAX/STM32F7 using the serial port.

The MINI-MAX/STM32F7 board provides the second interface (JTAG, X5) that can be used to program Flash memory. JTAG port can also be used for debugging.

3.2. RS232 Serial Ports

Two RS232 serial ports are available on the MINI-MAX/STM32F7. IC4 converts the micro-controller's RXD and TXD pins to/from RS232 levels. IC4 has an internal circuit that generates +/- 10 Volts for RS232 logic levels. RS232 port is wired to a 10-pin header (X4).

There are two options. RS232 ports, each port has TXD and RXD lines only. The second option is a single RS232 interface with TXD, RXD, CTS, and RTS signals on X4.

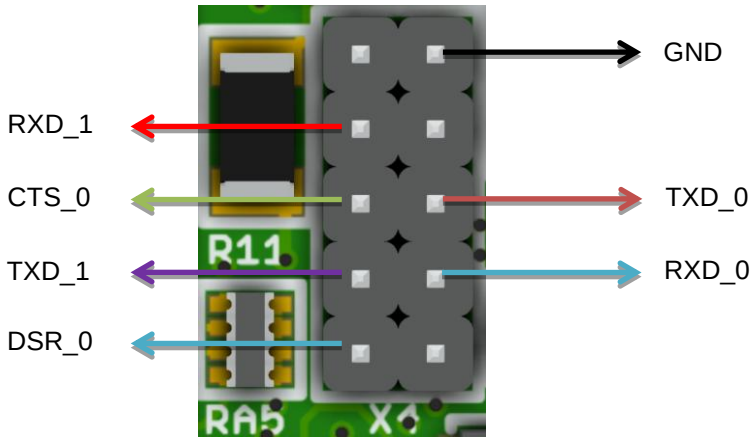


Figure 2

The first serial port also serves to download the procedure to the MINI-MAX/STM32F7 board. DSR is used by an external host to switch between BOOT and RUN modes.

Signal	Pin	Pin	Signal
NC (Not Connected)	1	2	DSR_0 (BOOT)
RXD_0 (RX0 input)	3	4	TXD_1
TXD_0 (TX0 output)	5	6	CTS_0 (CTS0 input)
NC (Not Connected)	7	8	RXD_1
Ground (GND)	9	10	NC (Not Connected)

Table 1

3.3. RS485 Serial Port

RS485 serial port is available on the MINI-MAX/STM32F7. IC10 converts the micro-controller's RXD and TXD pins to/from RS485 levels.

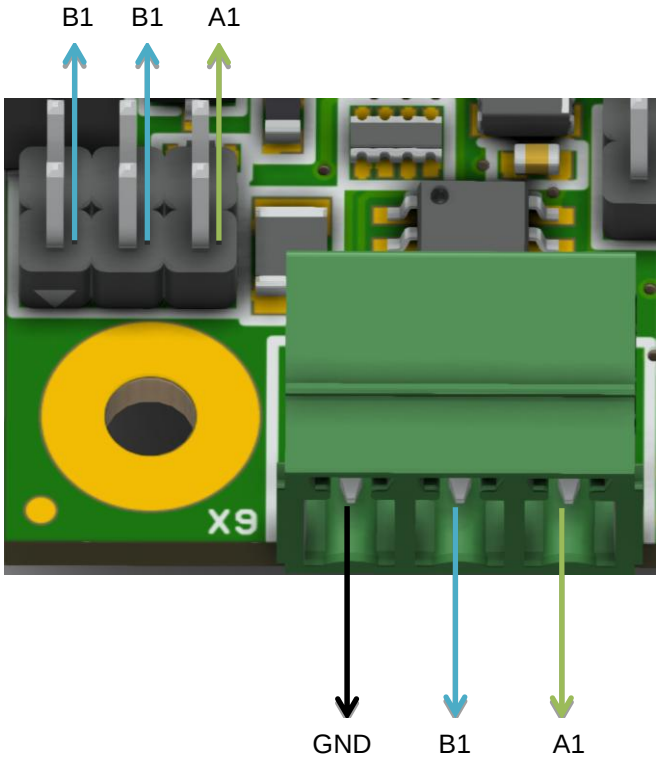


Figure 3

Signal	Pin
Ground (GND)	1
B1	2
A1	3

Table 2

3.4. Expansion connector

An expansion connector can be used for interfacing with external circuitry, prototyping boards, and peripheral boards. The expansion connector has 16 lines, which can be used as general-purpose I/O. Some of these lines have special functions. MINI-MAX/STM32F7 peripheral boards can be connected either as a piggyback daughterboard on MINI-MAX/STM32F7 using standoffs or can be placed up away from MINI-MAX/STM32F7 using a 20-wire ribbon cable. The peripherals section lists the available expansion boards. Table 3 shows the pin assignments for the MINI-MAX/STM32F7 Expansion connector.

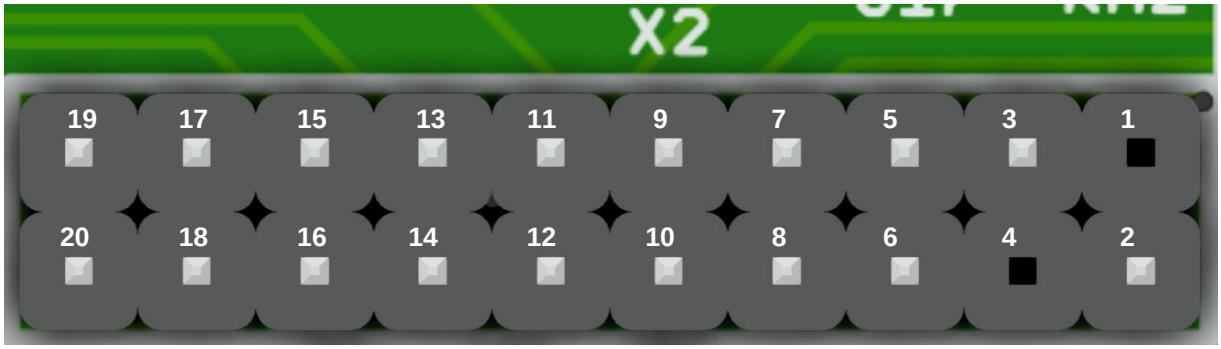


Figure 4

Signal	Pin	Pin	Signal
NC	1	2	V_EXP
GND	3	4	NC
SDA	5	6	SCL
IO4	7	8	IO5
CAN1_TX	9	10	CAN1_RX
IO0	11	12	IO1
MOSI	13	14	IO7
CS	15	16	SCK
MISO	17	18	IO6
TX_D	19	20	RX_D

Table 3

3.5. Analog interface

Analog terminal X3 allows interfacing with various types of analog peripherals, such as strain gauges, pressure sensors, thermocouples, etc. ADC inputs, analog reference VREF, analog power supply VAN, and analog ground are wired to X3.

There are 4 different Analog pins, 3 GND pins, one VREF, one DOUT, and VDDA pin.

Figure 5

Signal	Pin	Function
DOUT	1	Digital Output
AN1	2	Analog Input 1 (0 to 3V range)
Analog Ground (AGND)	3	Analog Ground
AN2	4	Analog Input 2 (0 to 3V range)
Analog Ground (AGND)	5	Analog Ground
AN3	6	Analog Input 3 (0 to 3V range)
VREF	7	3.0V
AN4	8	Analog Input 4 (0 to 3V range)
Analog Ground (AGND)	9	Analog Ground
VDDA	10	3.3V Analog Supply

Table 4

3.6. JTAG (X5)

There are 2 +3.3V power pins, 9 GND pins, one of each TRST, TDI, TMS, TCK, RTCK, TDO, NRST, DBGRQ, and DBGACK pins.

Figure 6

Signal	Pin	Pin	Signal
+3.3V	1	2	+3.3V
TRST	3	4	GND
TDI	5	6	GND
TMS	7	8	GND
TCK	9	10	GND
RTCK	11	12	GND
TDO	13	14	GND
NRST	15	16	GND
DBGRQ	17	18	GND
DBGACK	19	20	GND

Table 5

3.7. Digital interface

X6 connector is a port that contains various pins and has several auxiliary functions such as main and USB power input, 5V power output and jumper for DRY pin.

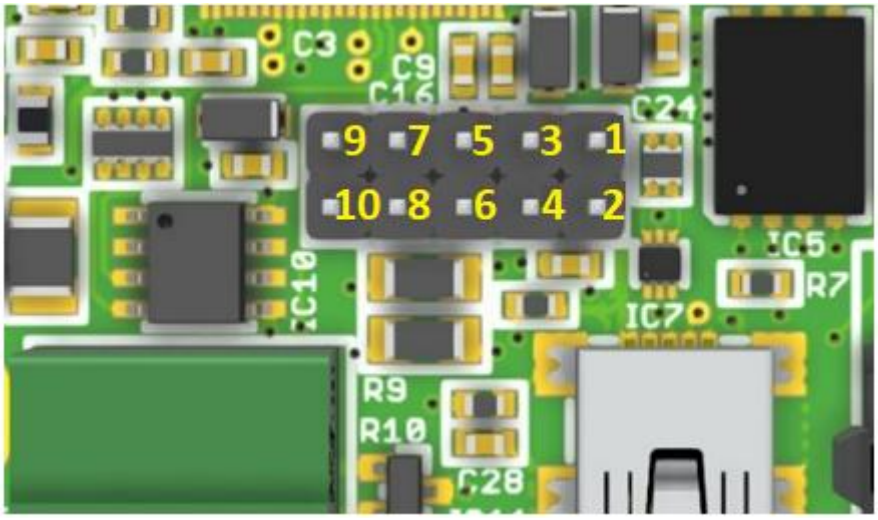


Figure 7

Signal	Pin	Pin	Signal
VIN	1	2	5V_ON
VUSB	3	4	+5V
GND	5	6	DRY
CTSO	7	8	BOOT0
DSR0	9	10	NRST

Table 5

X8 is the main power input connector. Digital input pin that can use as voltage input and dry contact input. The following figure shows the X8 connector.

Figure 8

Signal	Pin	Pin	Signal
5V	1	2	GND
DRY	3	4	DRY

Table 6

3.7.1. Digital input

There are two modes for Dry pin.

3.7.1.1. Digital Input – Voltage Input Mode

To select Voltage Input mode, there should be no jumper between DRY and GND pins on the X6 header. Figure 9 shows how to connect an external battery. This is in addition to the power source. For example, to measure if the ignition voltage exists on a vehicle.

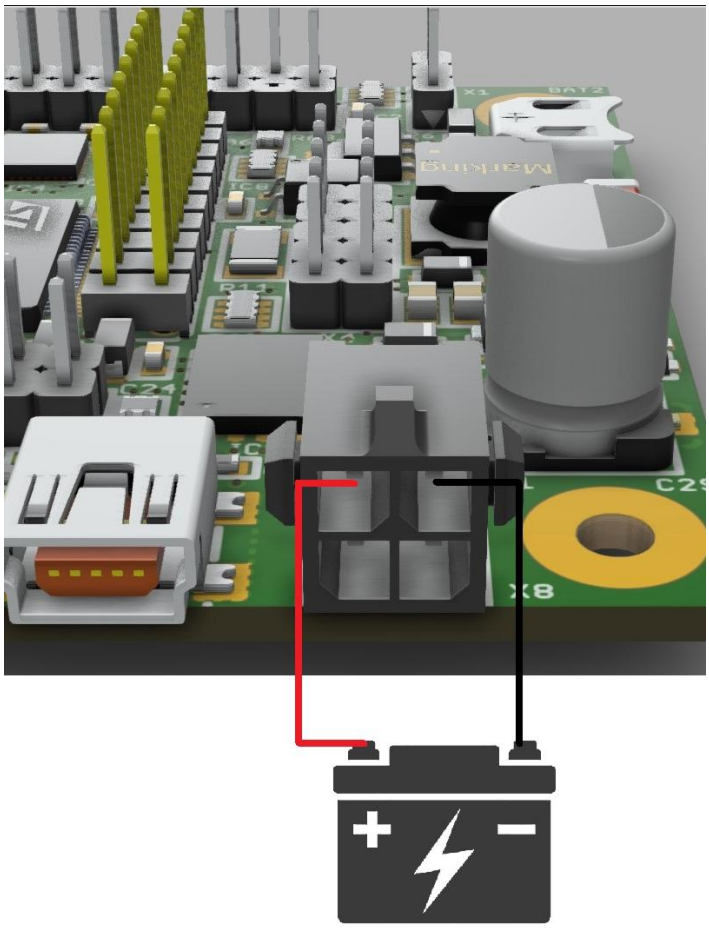


Figure 9

3.7.1.2. Digital Input – Dry Contact Mode

To select Dry Contact mode, there should be a jumper between DRY and GND pins on X6 header. A switch or a relay contacts can be connected to pin as shown in Figure 10.

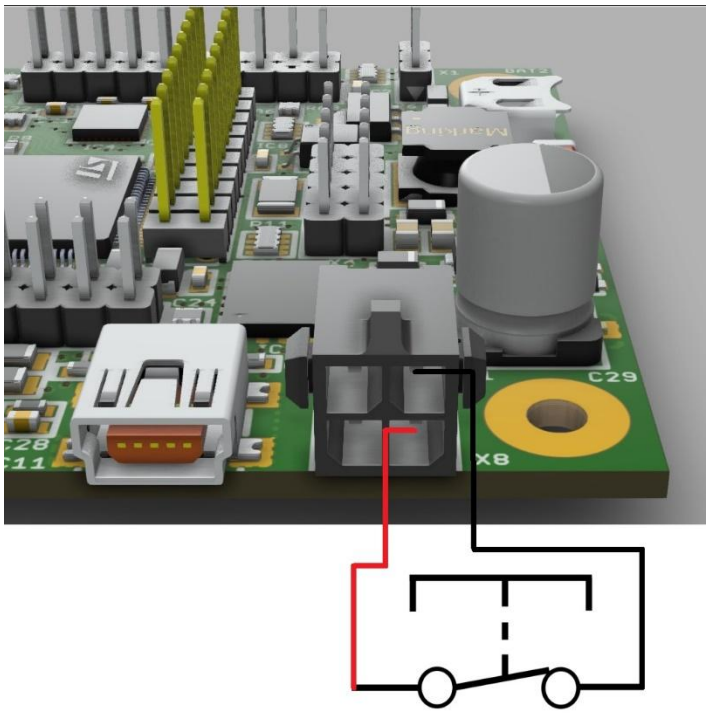


Figure 10

3.7.2. Digital output

DOUT pin is located on 1 pin of X3 terminal. BSP75 IC pin is open drain, and it is connected to DOUT pin. For that reason, there should be external load on DOUT pin such as 1K Ohm. Figure 11 shows DOUT connection. The resistor can be replaced with another DC load such as a lamp or relay.

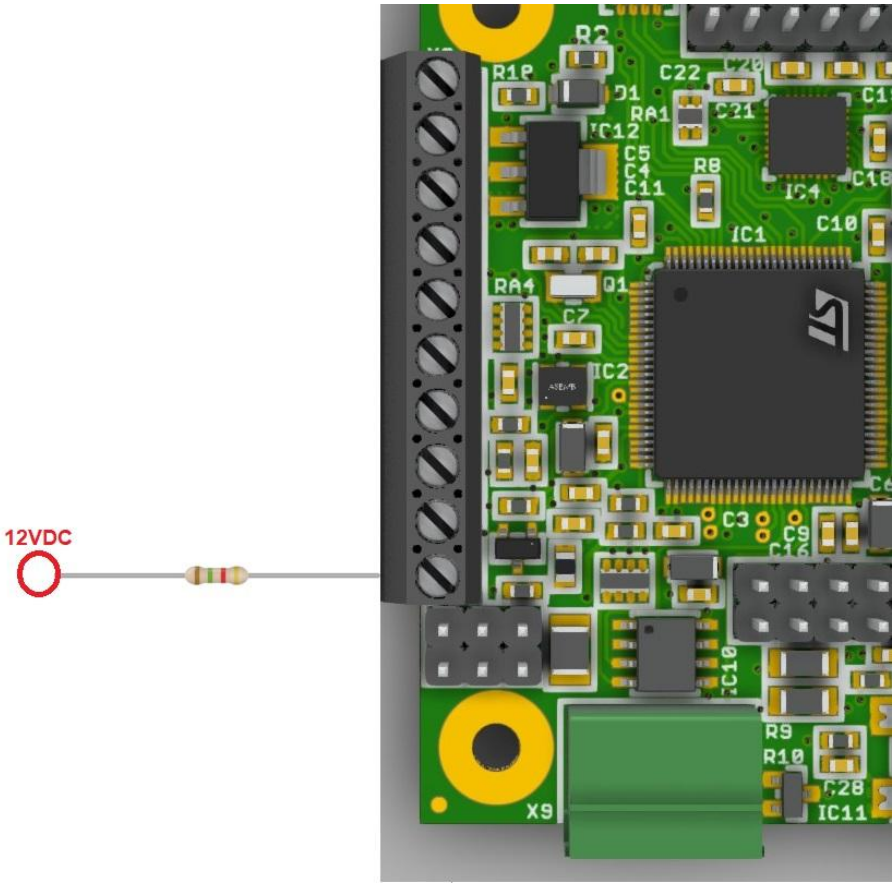


Figure 11

3.8. Real-Time Clock

The Real-Time Clock (RTC) is a set of counters for measuring time when system power is on, and when it is off. It uses very little power in power-down mode. RTC provides Seconds, Minutes, Hours, Day of Month, Month, Year, Day of Week, and Day of Year. On the MINI-MAX/STM32F7, the RTC can be clocked by an external 32.768 kHz oscillator, or by a programmable divider based on the peripheral clock. Also, the RTC is powered by its power supply pin, VBAT, which is connected to a 3.3V battery and the 3.3V supply used by the rest of the device. If the board is on, the RTC is powered by the 3.3V power supply. If the board is off, the RTC is powered by the 3V battery automatically.

3.9. Power Supply Unit

MINI-MAX/STM32F7 board comes with a 12VDC unregulated DC power supply. Other power supplies can also be used. The external power supply should be able to supply 7 to 30 Volts DC at a minimum of 350mA current.

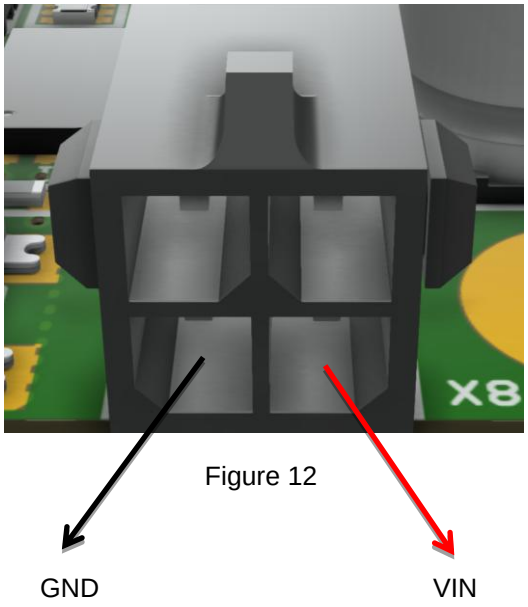


Figure 12

WARNING: Correct polarity should be observed when applying external DC supply to the power jack, otherwise MINI-MAX/STM32F7 will be permanently damaged.

MINI-MAX/STM32F7 has three onboard voltage regulators. IC9 provides +5V digital supply, IC6 is +3.3V for digital circuits.

CAUTION: Depending on the current requirements IC6 may dissipate enough heat to cause skin injury upon touch. Contact with this regulator should always be avoided, even after the power to the circuit has been switched off.

4. Peripherals

A peripheral board can either be stacked on top of MINI-MAX/STM32F7 using stand-offs or connected in a chain configuration using a flat ribbon cable. Figure 5 shows how any peripheral board can be connected to a micro-computer board in a stacked fashion. Figure 6 shows the chain connection.

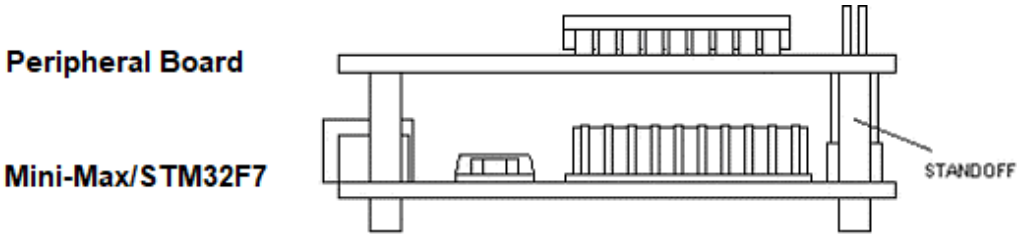


Figure 13

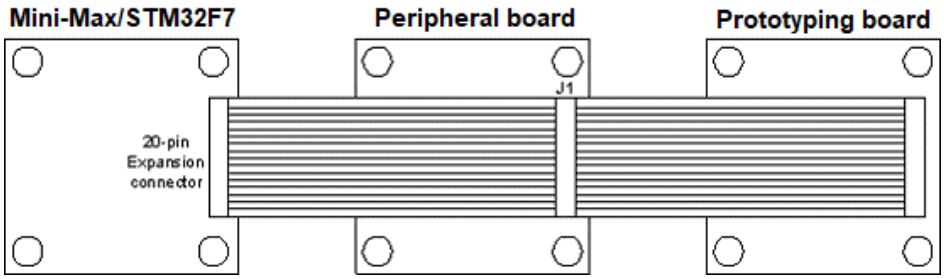


Figure 14

More details concerning BiPOM Peripheral boards are available from the link below:
http://www.bipom.com/periph_boards.php

5. Board Layout

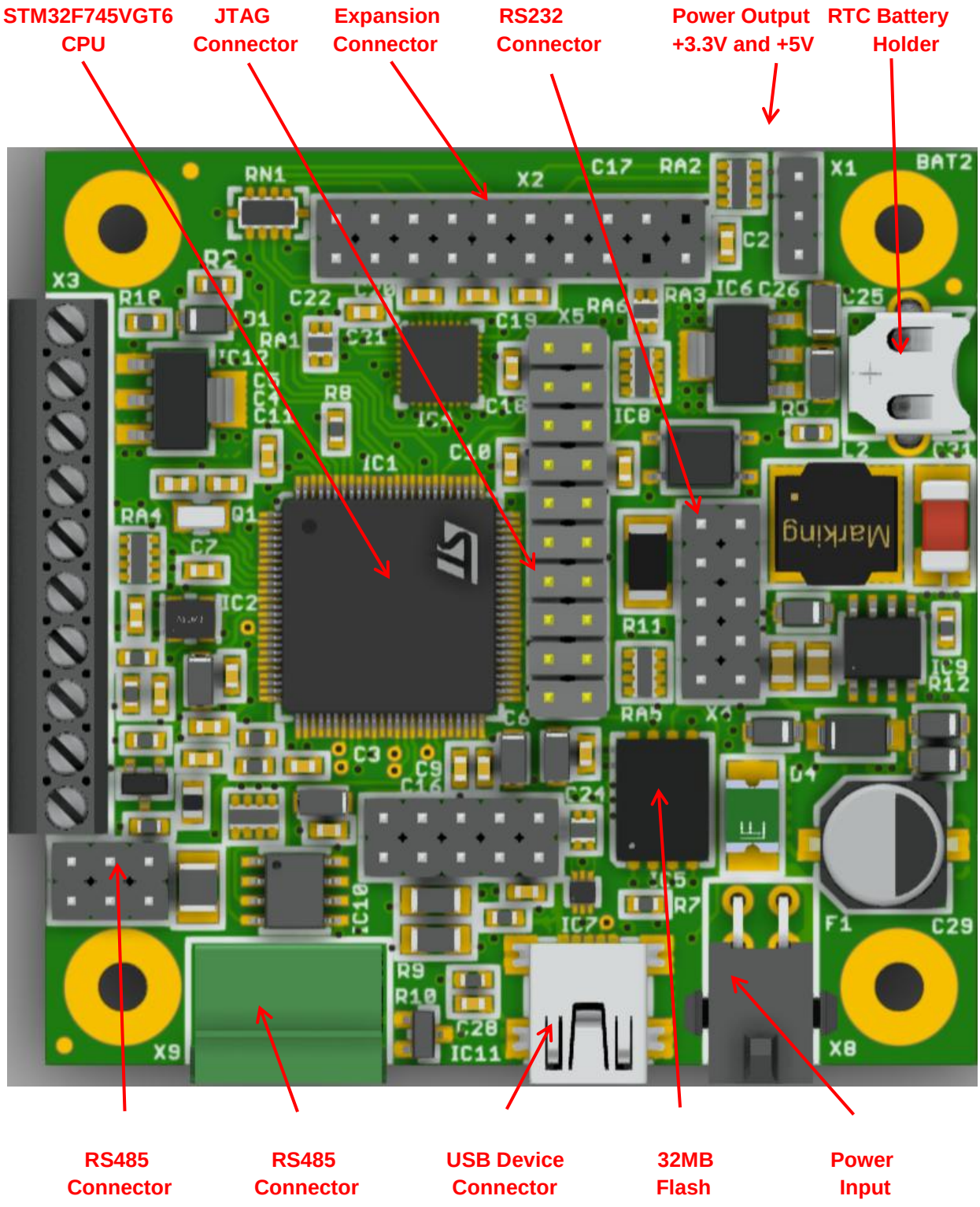
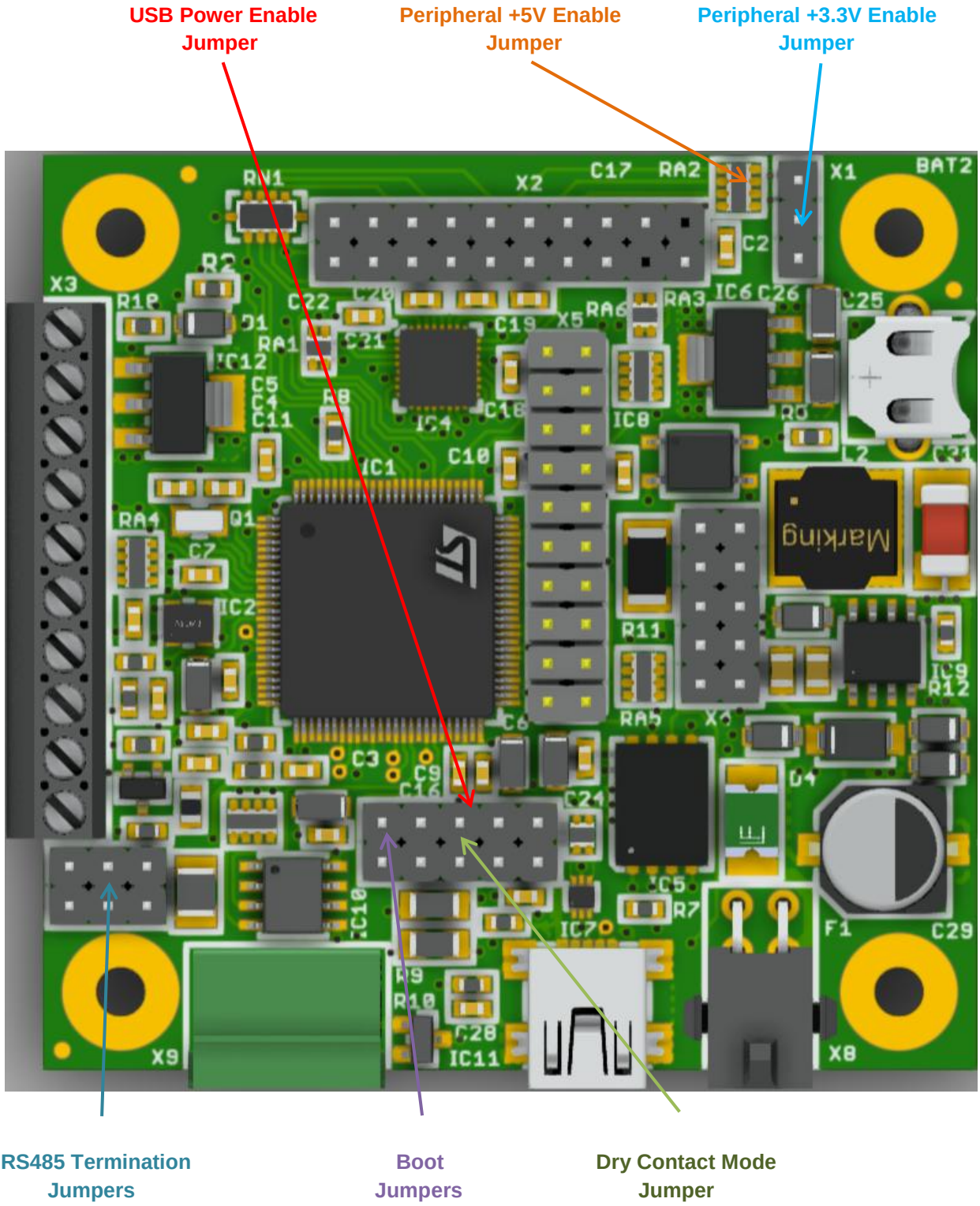
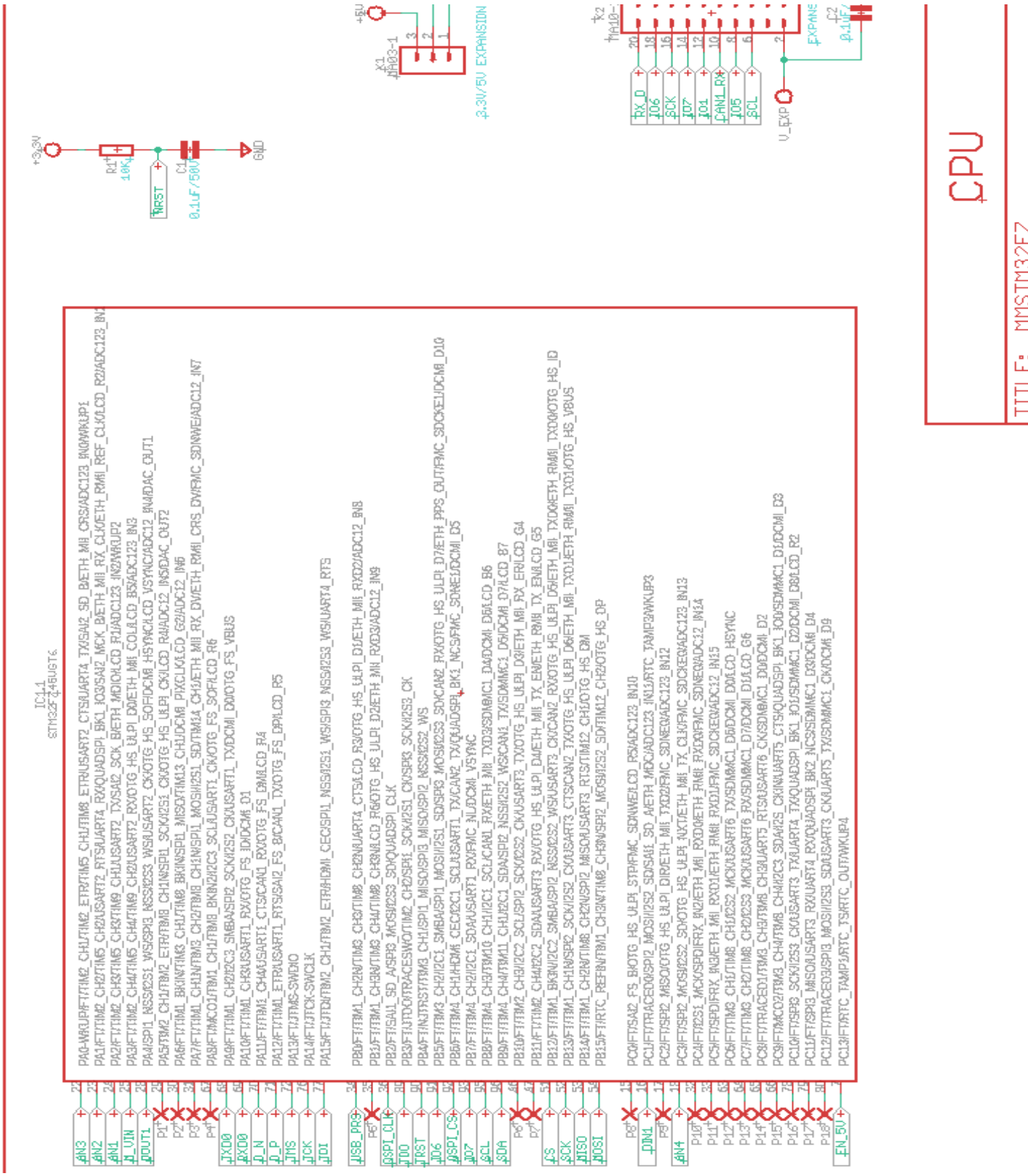


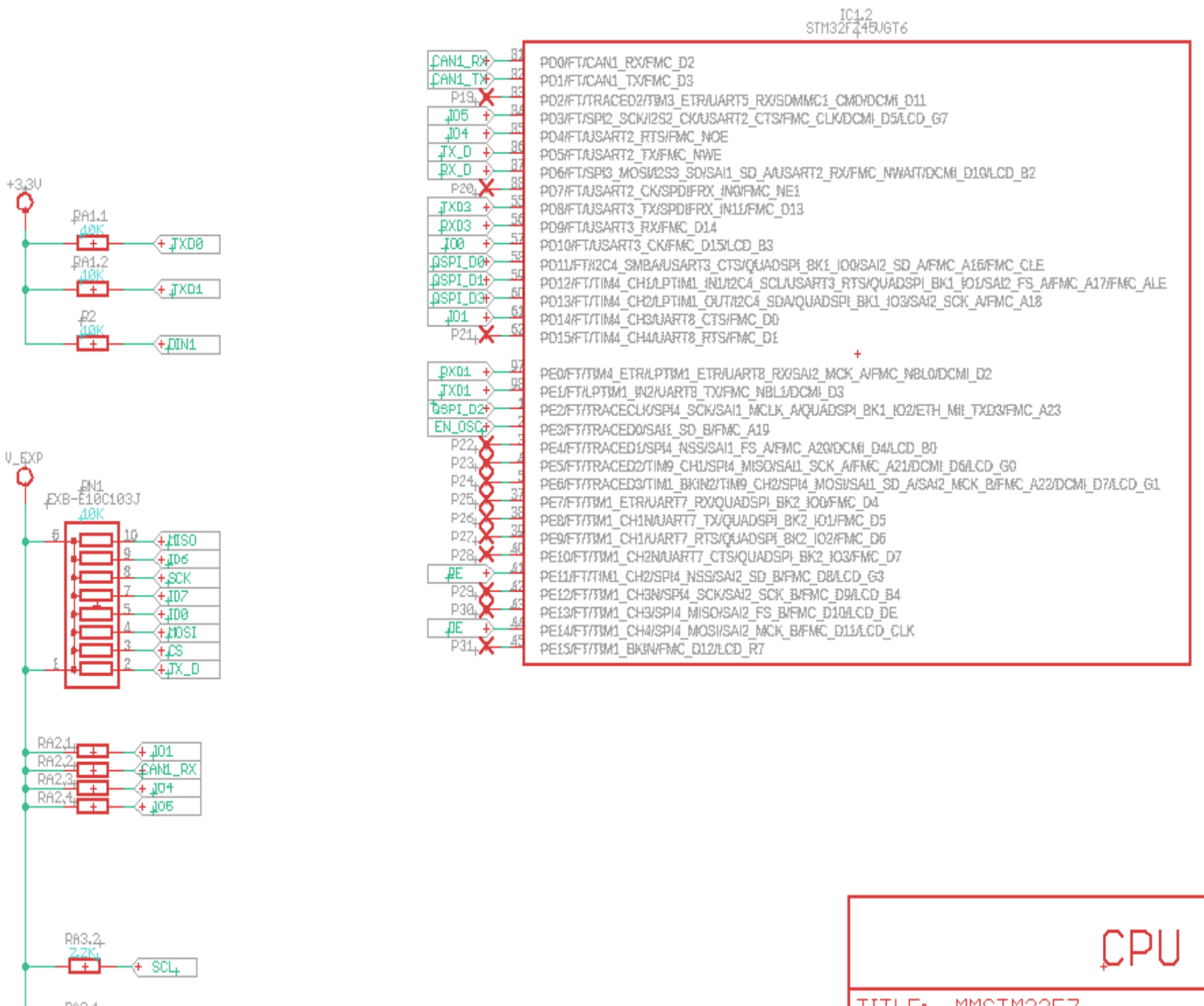
Figure 15

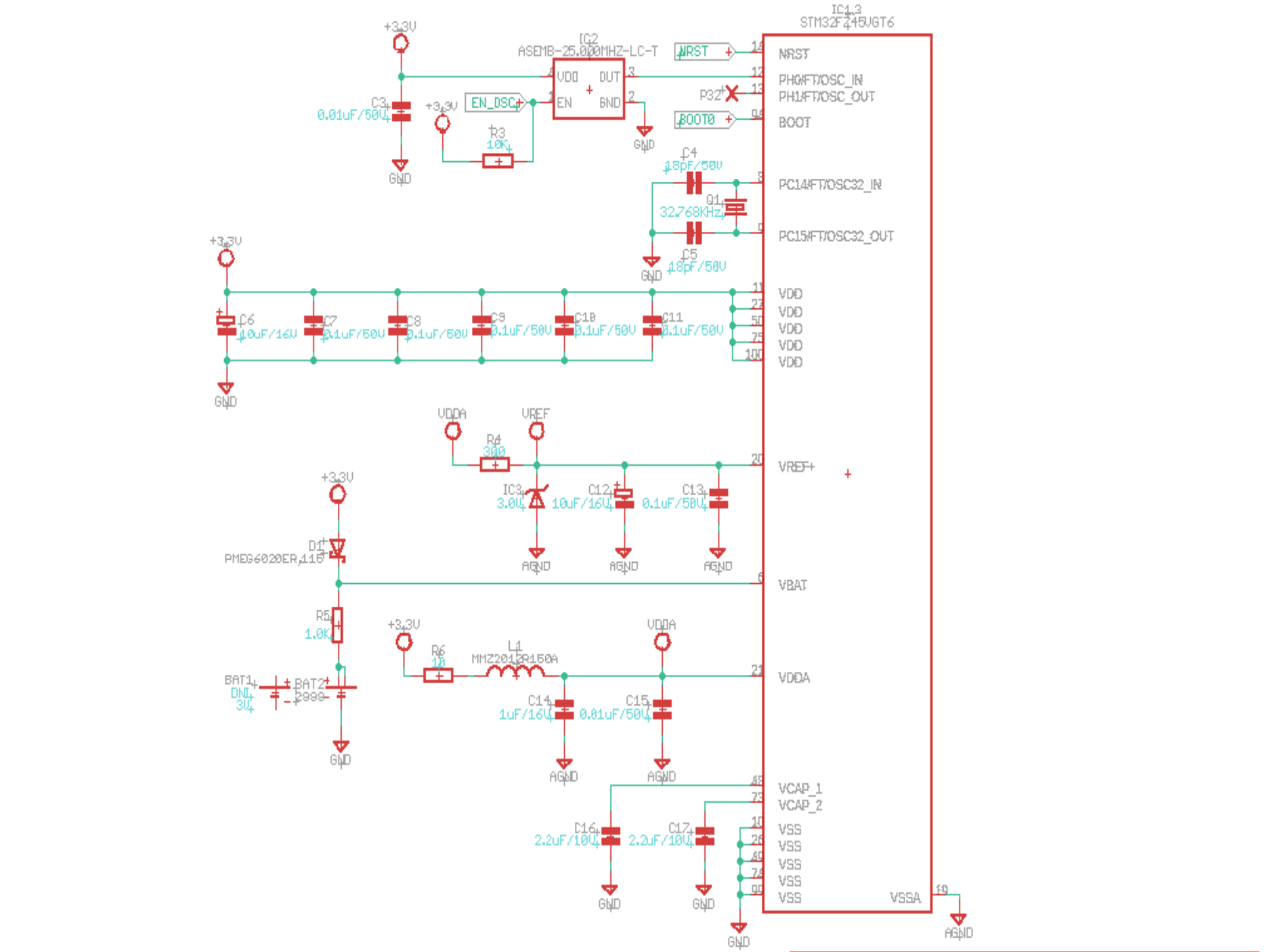
6. Jumpers


USB Power Enable Jumper
Peripheral +5V Enable Jumper
Peripheral +3.3V Enable Jumper
RS485 Termination Jumpers
Boot Jumpers
Dry Contact Mode Jumper

7. Schematics

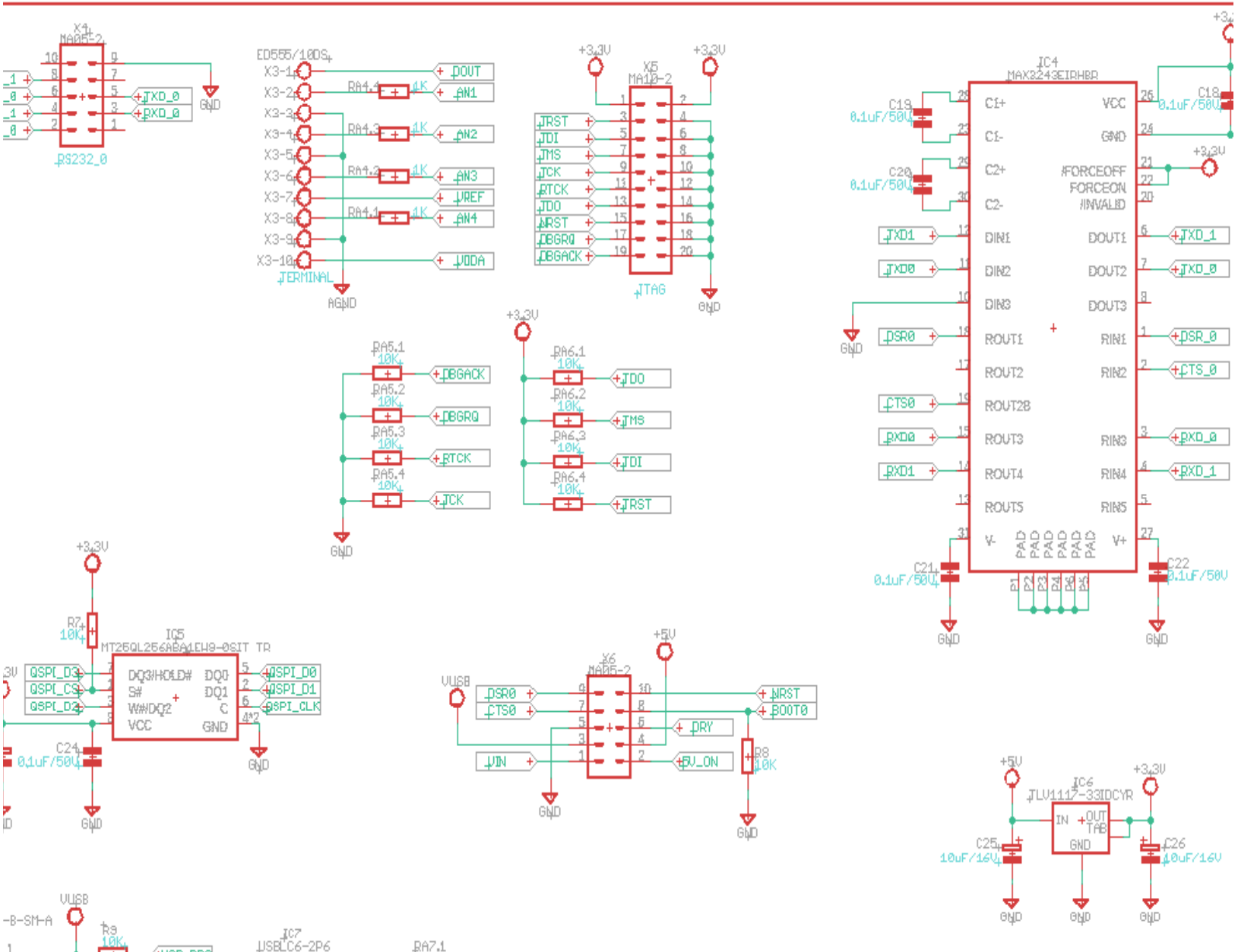


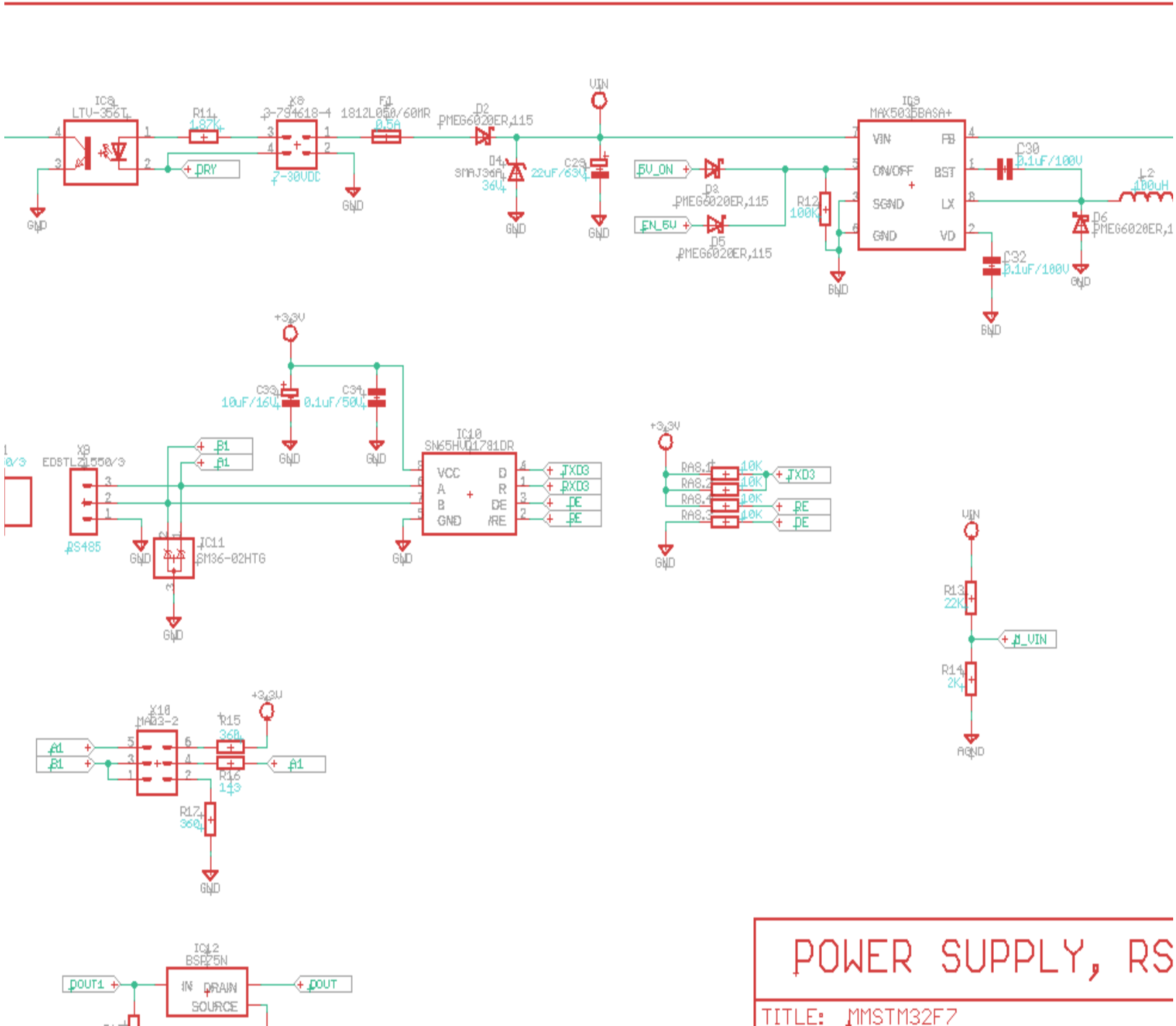

IC1.2
STM32F415VGT6
CAN1_RX
CAN1_TX
IO5
IO4
TX_D
RX_D
TXD3
RXD3
IO0
QSPI_D0
QSPI_D1
QSPI_D3
IO1
RXD1
TXD1
QSPI_D2
EN_OSC
IE
IE
PD0/FT/CAN1_RX/FMC_D2
PD1/FT/CAN1_TX/FMC_D3
PD2/FT/TRACED2/TIM3_ETR/UART5_RX/SDMMC1_CMD/DCMI_D11
PD3/FT/SPI2_SCK/I2S2_CK/USART2_CTS/FMC_CLK/DCMI_D5/LCD_G7
PD4/FT/USART2_RTS/FMC_NOE
PD5/FT/USART2_TX/FMC_NWE
PD6/FT/SPI3_MOSI/I2S3_SD/SAI1_SD_A/USART2_RX/FMC_NWAIT/DCMI_D10/LCD_B2
PD7/FT/USART2_CK/SPDIFRX_IN0/FMC_NE1
PD8/FT/USART3_TX/SPDIFRX_IN1/FMC_D13
PD9/FT/USART3_RX/FMC_D14
PD10/FT/USART3_CK/FMC_D15/LCD_B3
PD11/FT/I2C4_SMBA/USART3_CTS/QUADSPI_BK1_IO0/SAI2_SD_A/FMC_A16/FMC_CLE
PD12/FT/TIM4_CH1/LPTIM1_IN1/I2C4_SCL/USART3_RTS/QUADSPI_BK1_IO1/SAI2_FS_A/FMC_A17/FMC_ALE
PD13/FT/TIM4_CH2/LPTIM1_OUT/I2C4_SDA/QUADSPI_BK1_IO3/SAI2_SCK_A/FMC_A18
PD14/FT/TIM4_CH3/UART8_CTS/FMC_D0
PD15/FT/TIM4_CH4/UART8_RTS/FMC_D1
PE0/FT/TIM4_ETR/LPTIM1_ETR/UART8_RX/SAI2_MCK_A/FMC_NBL0/DCMI_D2
PE1/FT/LPTIM1_IN2/UART8_TX/FMC_NBL1/DCMI_D3
PE2/FT/TRACECLK/SPI4_SCK/SAI1_MCLK_A/QUADSPI_BK1_IO2/ETH_MII_TXD3/FMC_A23
PE3/FT/TRACED0/SAI1_SD_B/FMC_A19
PE4/FT/TRACED1/SPI4_NSS/SAI1_FS_A/FMC_A20/DCMI_D4/LCD_B0
PE5/FT/TRACED2/TIM9_CH1/SPI4_MISO/SAI1_SCK_A/FMC_A21/DCMI_D6/LCD_G0
PE6/FT/TRACED3/TIM1_BKIN2/TIM9_CH2/SPI4_MOSI/SAI1_SD_A/SAI2_MCK_B/FMC_A22/DCMI_D7/LCD_G1
PE7/FT/TIM1_ETR/UART7_RX/QUADSPI_BK2_IO0/FMC_D4
PE8/FT/TIM1_CH1N/UART7_TX/QUADSPI_BK2_IO1/FMC_D5
PE9/FT/TIM1_CH1/UART7_RTS/QUADSPI_BK2_IO2/FMC_D6
PE10/FT/TIM1_CH2N/UART7_CTS/QUADSPI_BK2_IO3/FMC_D7
PE11/FT/TIM1_CH2/SPI4_NSS/SAI2_SD_B/FMC_D8/LCD_G3
PE12/FT/TIM1_CH3N/SPI4_SCK/SAI2_SCK_B/FMC_D9/LCD_B4
PE13/FT/TIM1_CH3/SPI4_MISO/SAI2_FS_B/FMC_D10/LCD_DE
PE14/FT/TIM1_CH4/SPI4_MOSI/SAI2_MCK_B/FMC_D11/LCD_CLK
PE15/FT/TIM1_BKIN/FMC_D12/LCD_R7
+3.3V
RA1.1
10K
RA1.2
10K
R2
10K
TXD0
TXD1
DIN1
V_EXP
RN1
EXB-E10C103J
10K
MISO
IO6
SCK
IO7
IO0
MOSI
CS
TX_D
RA2.1
RA2.2
RA2.3
RA2.4
IO1
CAN1_RX
IO4
IO5
RA3.2
2.2K
SCL
CPU



CPU

TITLE: MMSTM32F7


X4
MA05-2
RS232_0
ED555/10DS
X3-1
X3-2
X3-3
X3-4
X3-5
X3-6
X3-7
X3-8
X3-9
X3-10
TERMINAL
AGND
RA4.4
RA4.3
RA4.2
RA4.1
4K
DOUT
AN1
AN2
AN3
VREF
AN4
VDDA
X5
MA10-2
JTAG
JTRST
JTDI
JTMS
JTCK
JRTCK
JTDO
JNRST
JDBGRQ
JDBGACK
RA5.1
RA5.2
RA5.3
RA5.4
RA6.1
RA6.2
RA6.3
RA6.4
10K
IC4
MAX3243EIPHBP
C1+
C1-
C2+
C2-
VCC
GND
#FORCEOFF
FORCEON
#INVALID
DIN1
DIN2
DIN3
ROUT1
ROUT2
ROUT2B
ROUT3
ROUT4
ROUT5
V-
V+
DOUT1
DOUT2
DOUT3
RIN1
RIN2
RIN3
RIN4
RIN5
PAD
C18
C19
C20
C21
C22
0.1uF/50V
JTXD1
JTXD0
JDSR0
JCTS0
JRXD0
JRXD1
JTXD_1
JTXD_0
JDSR_0
JCTS_0
JRXD_0
JRXD_1
IC5
MT25QL256ABA1EW9-0SIT TR
DQ3/HOLD#
S#
W#/DQ2
VCC
DQ0
DQ1
C
GND
QSPI_D3
QSPI_CS
QSPI_D2
QSPI_D0
QSPI_D1
QSPI_CLK
R7
C24
X6
MA05-2
VUSB
JDSR0
JCTS0
JVIN
JDRY
JBV_ON
JNRST
JBOOT0
R8
10K
IC6
JTLV1117-33IDCYR
IN
OUT
TAB
GND
C25
C26
10uF/16V
VUSB
-B-SM-A
R9
JUSB_PRS
IC7
USBLC6-2P6
I/O1
I/O2
VBUS
RA7.1
RA7.2
20
J_N
J_P
P39
P10
1.8M 1%
C27
DEVICE
INTERFACE
TITLE: MMSTM32F7



POWER SUPPLY, RS

TITLE: MMSTM32F7