PHOENIX ROCKET FLIGHT COMPUTER V.1.0

USER MANUAL

DESIGNED AND DEVELOPED BY

SPARK TECH INDUSTRIES

dhanushs193@gmail.com

www.sparktechind.ml

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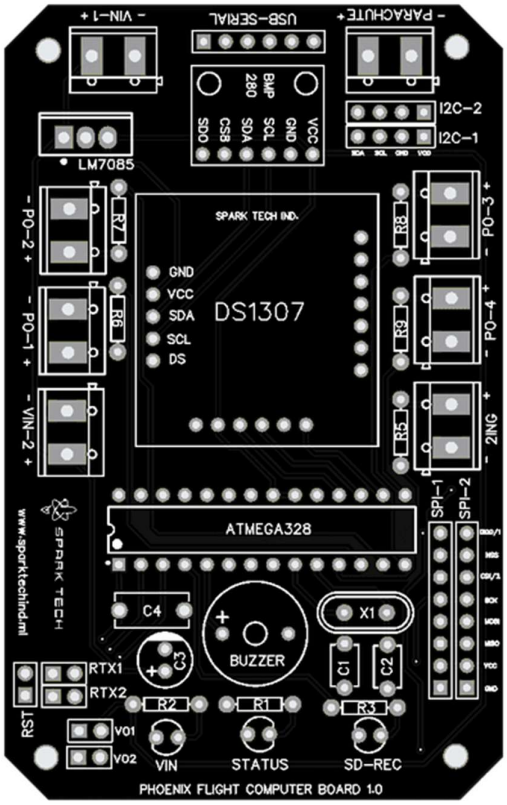
SPARK TECH

PHOENIX

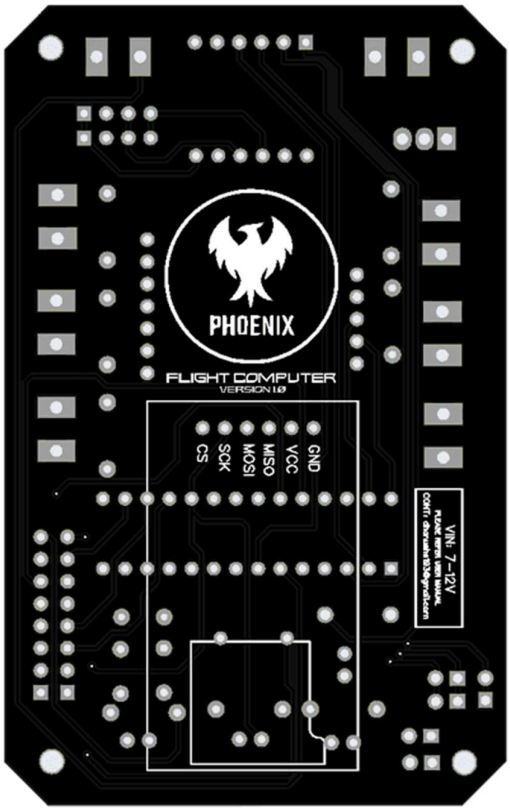
A PRODUCT OF SPARK TECH IND.

INTRODUCTION:

Phoenix is an avionics board which is used in rocket for collecting data, logging data, deploying parachute and other programmable output (PO pins).



FRONT VIEW



BACK VIEW

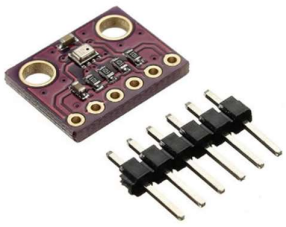
Its operating voltage is around 7-16v. But it preferred to use 12v input voltage. It draws __A of current**.

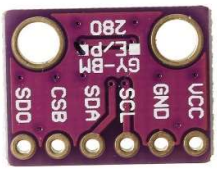
**depends on sensor and modules connected to the PO pins and other terminal (SPI-1, SPI-2, I2C-1, I2C-2, VO-1, VO-2, RTX-1, RTX-2 and RST).

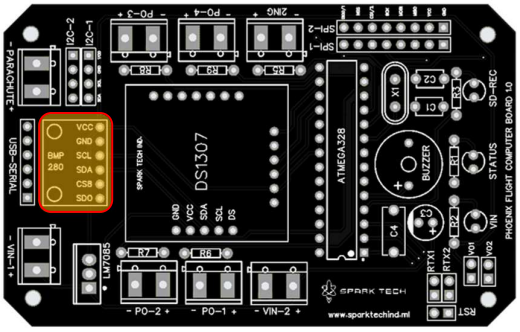
1. INPUT SENSORS AND MODULES:

1.1 BMP280 SENSOR

BMP280 module is used for collecting data like Temperature, Pressure and Altitude. Basically, BMP280 is a digital pressure and temperature, the altitude is determined by pressure.







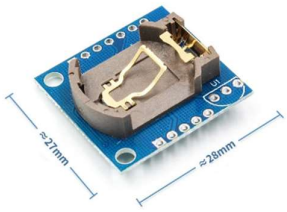
It has both SPI and I2C interface, but in Phoenix FLC uses I2C interface at 3.4MHz (if used in SPI interface at 10MHz). Because it requires less connection pin.

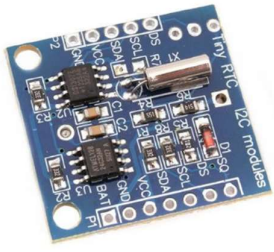
It operates on 3.3v and 5v and consumes very low current and it is pretty accurate.

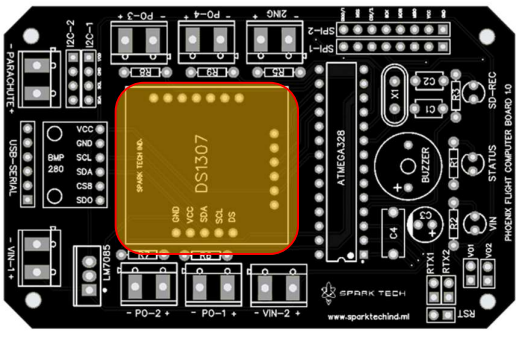
Parameters	
Pressure range	300….1100 hPa (equiv.to +9000…-500m above/below sea level) With accuracy of ±0.12hpa, equiv. To ±1m
Temperature range	-40…+85°C (1.5 Pa/K, equiv. to 12.6cm/K)
Current consumption	2.7µA @ 1 Hz sampling rate
Minimum voltage	1.71 v - V_{DD} and 1.20 v – V_{DDIO}

1.2 REAL TIME CLOCK MODULES

Here, TinyRTC DS1307 module is used for recording time. For data logging from sensors with respect to time. So that the Flight data can be viewed easily and flight data can be plotted in graph.





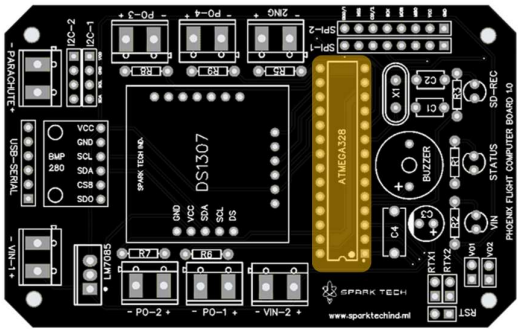


It has I2C interface. It operates at 5V and it requires 3v button cell (CR2032).

Because the clock will be running even after the FLC is not connected to source. The CR2032 cell can be used for four years**. (**may differ)

2. MICROCONTROLLER

Phoenix FLC uses ATmega328P 8-bit microcontroller with arduino bootloader. Because it can offer high profamance at low power.



2.1 FEATURES:

- 32Kb of programmable FLASH
- 1Kb EEPROM
- 2Kb SRAM
- Data retention for 20 years at 85ºC and 100 years at 25ºC
- It supports both SPI and I2C

2.2 OTHER IC

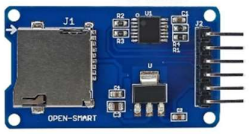
ATmega168P / ATmega8A microcontroller can be used, but it has less storage and can not handle more data efficiently. It preferred to use ATmega328P/ATmega328 only. **please do not remove IC or change IC if you do not have idea about IC orientation. If you want to use less powerful IC you should not use PO or any extra modules only BMP280, RTC and SD card modules should be used. **

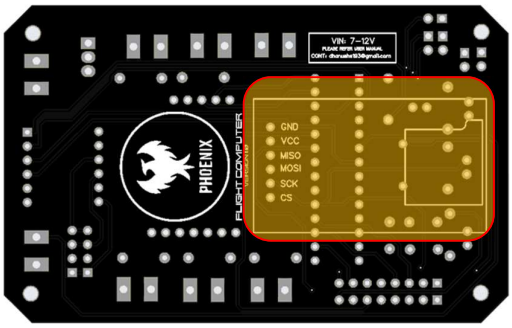
2.3 VOLTAGE REGULATOR

The has a pre-installed voltage regulator LM7805 and a decoupling capacitor for constant 5v and constant __A current and it is connected for the LED “VIN” for indication for source input.

3. OUTPUT MODULES (SD CARD)

Micro SD card module is used to log the input sensor and module data in a systematic order as programmed. There is no limitation for the micro-SD card size, any memory size can be used. The SD card should be connected at bottom layer of PCB.





This micro-SD card module has SPI interface. With VCC and GND it requires 4 more separate connection for transferring and receiving data.

It has operating voltage of 3.3v but the module has to be supplied 5v because it has voltage regulator and level shifter

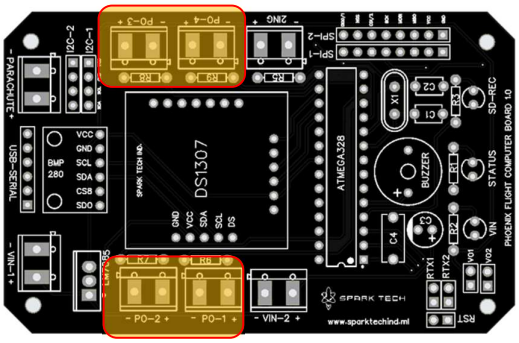
3.1 OTHER MICRO / LARGE SD CARD MODULES

Other SD card modules can be used. But if there is no voltage regulator it should be given only 3.3v. But Phoenix FLC has no 3.3v voltage regulator. so, if any module which has no regulator should be connected with an external voltage regulator.

4. SCREW TERMINALS

4.1 PROGRAMMABLE OUTPUT TERMINALS

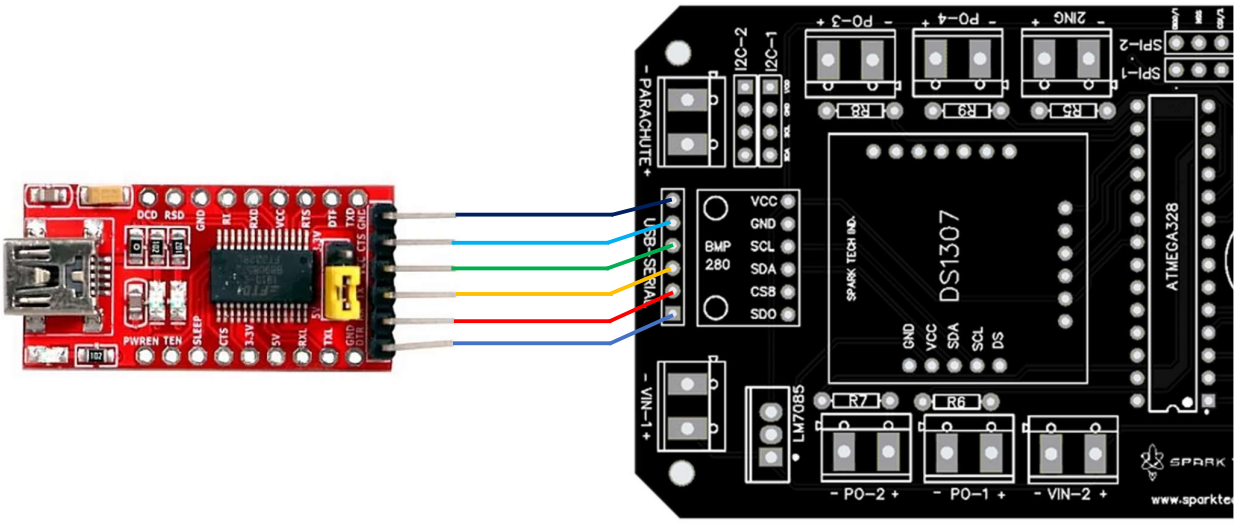
Phoenix FLC has four programmable terminals named as PO-1, PO-2, PO-3 and PO-4. Every terminal provides constant 5v output.



Screw terminal are installed with a 1k resistor if the resistor is not required it can be made short using wire.

4.1.1 PROGRAMMING OF PO PINS

Programming of PO terminal can be done by USB-SERIAL connector in the PCB by connecting USB-SERIAL MODULE. (Programming language "ARDIUNO IDE")

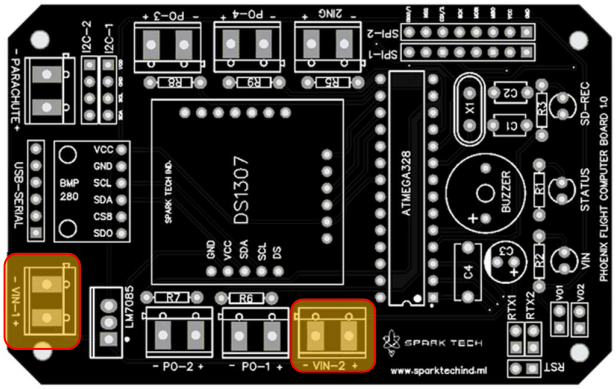


The connection should be made or fixed according to the schematic only. If connected in wrong orientation the IC may get damaged or the track may get damaged, if so the PBC will cannot be used further.

The pre-installed program should not be touched or modified on any condition, if done the board will be damaged

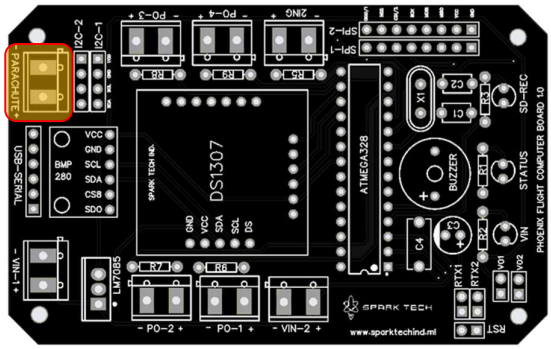
4.2 VOLTAGE INPUT TERMINALS

Phoenix FLC has two voltage inputs named as VIN-1 and VIN-2. The operating voltage of the board is between 7v - 12v. But it is recommended use 12v battery as input source.



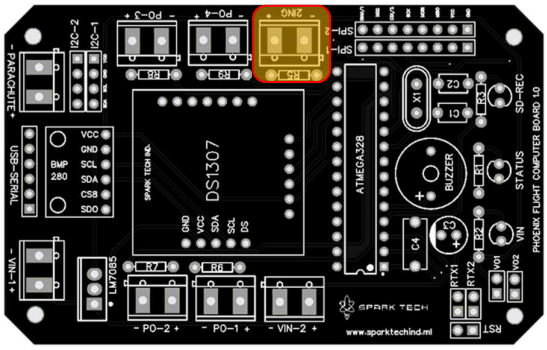
4.3 PARACHUTE DEPLOY TERMINAL

The parachute deploy terminal are pre-programmed for apogee detection. There is no external hardware sensor for detection, it is completely based on reading of altimeter BMP280 it has tolerance of 1m. But it does not have any angle or gyro detection for flight abort system**. The deployment of parachute can be done by any mode of system like using pyro-chargers, servo motor or any system which as two terminals positive and negative.



4.4 SECOND STAGE IGNITION TERMINAL

The second stage can be ignited using the 2ING screw terminal but by default it is not set. But it can be programmed easily by just writing the second stage ignition time in millisecond. But it required to know the absolute burn time of the first stage, so that no error happens.



5. OUTPUT INDICATORS

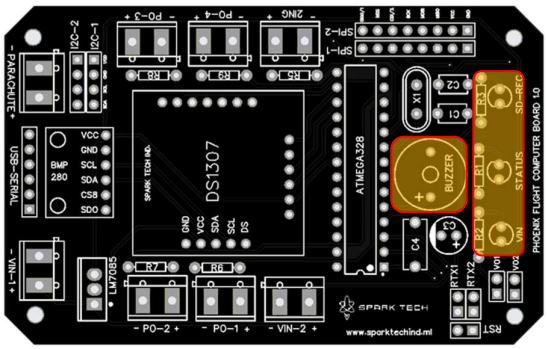
5.1 LED INDICATORS

The board has three LED named VIN, STATUS and SD-REC it indicates. (With resistors attached)

- VIN LED – it indicates source is connected to board.
- STATUS – it indicates the microcontroller status (if IC is damaged it will not glow).
- SD-REC – it indicates data logging is started.

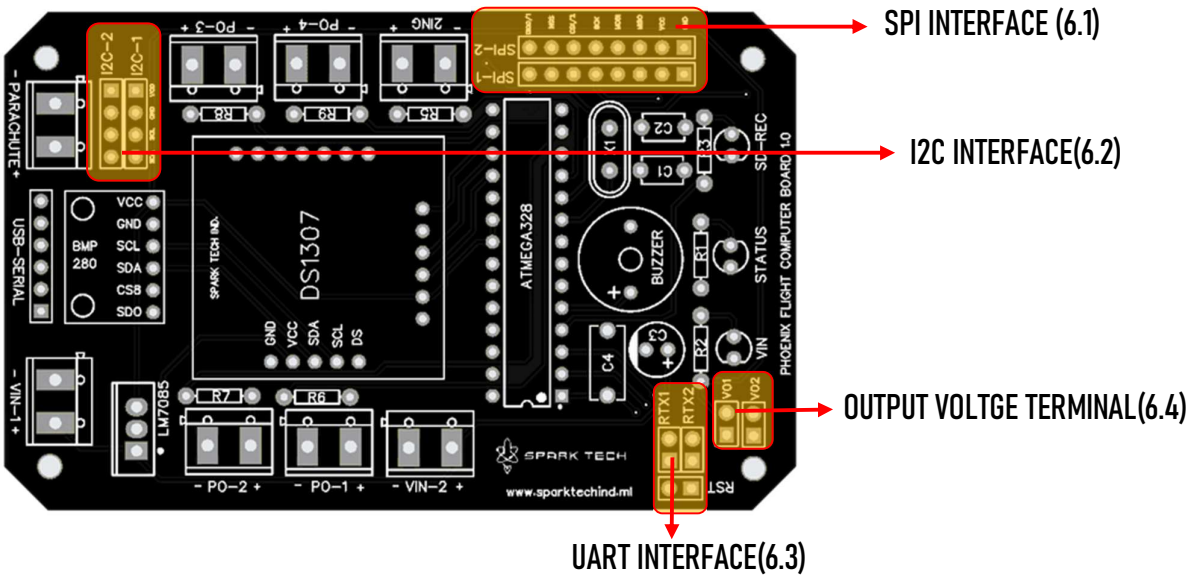
5.2 BUZZER INDICATORS

The buzzer is connected to locate the rocket after touch down and also it buzzes when the rocket is in apogee mode.



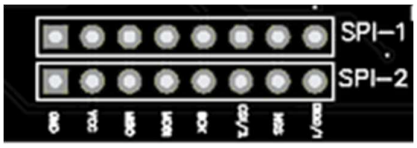
6. EXTERNAL SENSORS OR MODULES (developer mode)

"THE SPECIALITY" of Phoenix FLC is it has external input header pins so the board can be developed as per the person requirements it as extra Two SPI interface SPI-1 and SPI-2, Two I2C interface I2C-1 and I2C-2, Two UART interface RTX-1 and RTX-2 with Two RESET pin RST and Two voltage output pin VO1 and VO2. **ALL PIN REFERS TO ARDUINO ATMEGA328P PINOUT**



6.1 SPI INTERFACE

SPI interface communicates with microcontroller using *MISO, MOSI, SCK, NSS, CS1/2, DIO0/DIO1* to transfer data and receive data, VCC and GND for power supply.



6.1.1 SPI PINOUT

PIN	SPI-1	SPI-2
GND	GND	GND
VCC	5V	5V
MISO	D12	D12
MOSI	D11	D11
SCK	D13	D13
CS- 1 & 2	A0	A1
NSS	D10	D10
DIO- 0 & 1	D3	D2

DIO0 & CS1 → SPI-1

DIO1 & CS2 → SPI-2

The CS and DIO pin should be connected and the program should be written correctly to communicate.

6.2 I2C INTERFACE

I2C interface communicates with microcontroller using *SDA* and *SCK/SCL* to transfer data and receive data, VCC and GND for power supply. It is easy to connect I2C interface than SPI interface.

6.2.1 I2C PINOUT

PIN	I2C-1	I2C-2
VCC	5V	5V
GND	GND	GND
SCL	A5	A5
SDA	A4	A4

6.3 UART INTERFACE

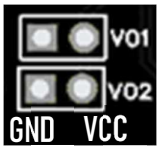
UART interface communicate with microcontroller using RX, TX and some modules RST to transfer data and receive data, VCC and GND for power supply.

6.3.1 UART PINOUT

PIN	RTX-1	RTX-2
VCC	V01	V02
GND	GND	GND
RX	D0	D0
TX	D1	D1
RST	RESET	RESET

6.4 VOLTAGE OUTPUT TERMINAL

The V0 pins can be used as power supply (output only) for modules, sensor or to another flight computer compatible with 5V input.



7. EXTERNAL COMPATIBLE DEVICES

There is many SPI, I2C, UART interface devices available. Any device which supports these interfaces can be connected. For example:

- For wireless communication modules like LoRa, HC-12 and etc….
- Camera can used like esp32 cam and etc….
- For input devices IMU's like MPU6050, temp and humidity sensor like AHT10 and etc….
- And many flight computer can also be connected or inter linked.
- Thrust vector control (TVC) can be connected.
- It can be sent to space with good communication device, cameras and space environment protection**.
- And it can be programmed for anything depending upon user imagination.

**not tested practically

ABBREVIATIONS

2ING- SECOND STAGE IGNITION

CS- CHIP SELECT

DIO- DIGITAL INPUT OUTPUT

EEPROM- ELECTRICALLY ERASABLE PROGRAMMING READ-ONLY MEMORY

FLC- ROCKET FLIGHT COMPUTER

I2C- INTER INTEGRATED CIRCUIT

IC- INTEGRATED CIRCUIT

MISO- MAIN IN, SUBNODE OUT

MOSI- MAIN OUT, SUBNODE IN

NSS- ACTIVE LOW SLAVE SELECT

PO- PROGRAMMABLE OUTPUT

REC- RECORD

RTC- REAL TIME CLOCK

RTX- RECIVER / TRANSMITTER

SCL/SCK- CLOCK

SDA- SERIAL DATA

SPI- SERIAL PERIPHERAL INTERFACE

SRAM- STATIC RANDOM ACCESS MEMORY

UART- UNIVERSAL ASYNCHRONOUS RECEIVER/ TRANSMITTER

VIN- VOLTAGE INPUT

VO- VOLTAGE OUTPUT