Specifications for nominal voltages of components

1. Voltages involved and their values (the power supply rails)

In our robot, we primarily use two distinct voltage levels, each with a specific role (hence the need to design a power distribution board PCB):

Tension (rail)	Nominal Value	Role	Source on PCB
High voltage	12V (between 11.1V and 12.8V)	Power and movement. Powers all components requiring mechanical energy: traction motor (J4, J5) and the UBEC converter (J2)	Directly to the battery (after fuse FH1 and switch SW1)
Low voltage	5V	Logic and Control. Powers the sensitive electronics (the "brain" of the robot): Raspberry Pi 4, Arduino Mega 2560, and most Sensors/Servos.	The External UBEC (which converts 12V to 5V), returning to J3

A. Components on the 12V rail (power)

Component	Nominal Voltage	Role on the Robot	Connector on the PDB
DC motor with encoder (x2)	12V	Traction (motion) motors	J4 and J5
TB6612FNG motor driver (x2)	5V (Logic) s 12V (Power)	The driver requires 12V to power the motors themselves (V-Motor) and 5V for its own internal logic.	J6 (To 12V or direct wiring if the driver is remote)
UBEC 5V 5A (External)	12V (input)	DC-DC converter (takes 12V and outputs 5V).	J2 (In UBEC)

A. Components on the 5V rail (logic)

Component	Nominal Voltage	Role on the Robot
Raspberry Pi 4 Model B (8 GB)	5V	Robot brain (vision, ROS2, planning).
Arduino Mega 2560 R3	5V (USB ou broche VCC)	Microcontroller (low-level control of motors and sensors).
Servomotor (x2)	4.8 à 6V	Movements of the mechanisms.
Sensors (Distance, Line, etc.)	Typically, 5V or 3.3V	Perception of the environment.
MicroSD card	Powered by the RPi (3.3V regulated)	Raspberry Pi storage.
TB6612FNG	5V(logic)	Motor control logic.

2. Calculation of Estimated Total Power

Power (in Watts, W) is calculated by the formula: P = U / I (Voltage /Current).

Component	Voltage (U)	Estimated Current (Imax)	Power (P=U×I)
DC motors (x2)	12V	≈2x3 A continuous (5A peak)	≈60W (peak start-up)
UBEC (12V Input)	12V	5A (5V output) → ≈2.5A (12V input)	≈30W (at 12V)
Motor Drivers (TB6612)	12V	≈0.5A	≈6W
Estimated Total (Crest)			**≈96W**

Detailed Hypotheses

a. **Traction Motors:** DC motors, even though they draw 1A continuously, can draw up to 5A or 6A each during startup or when encountering an obstacle (stall current). We estimate here 5A per motor peak, or 10A for both.

$$P\_motors = 12V \times 10\ A = 120W$$

(We will use the total of 120W for the fuse calculation, as this is the worst-case scenario.)

b. **UBEC (Converter):**

- The UBEC delivers 5V with a maximum of 5A (i.e., 25W at 5V).

- Assuming a conversion efficiency of 85%, the current drawn at 12V is:

$$I\_ubec \approx \frac{P_{sortie}}{U_{entrée} X\ Efficacité} \approx \frac{25\text{W}}{12V\ X\ 0.85} \approx \mathbf{2.45A}$$

c. **Other 12V (Drivers):** The TB6612FNG drivers consume a small current for the power circuit, estimate 0.5A.

Calculation of the Total Maximum Current

I_tot(crete) = **I**_moteurs(crete) + **I**_ubec(crete) + **I**_drivers

I_tot(crete) = 10A+2.5A+0.5A=**13A**

Consequences for the PDB

☞ **Fuse (FH1):** The maximum current of 13 A amply justifies the choice of a 10A fuse if we only wish to protect stable continuous regimes (where the current does not exceed 6-8A).

Conclusion

The maximum total power our robot can draw from the battery is approximately **156W** (12V x 13A) at startup. Our PDB (Power Distribution Board) is designed to handle this high power.