Automated Microbial Analysis
Jorian Bruslind, Zach Bendt, Macklin Hall
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Automated Microbial Analysis Power Budget

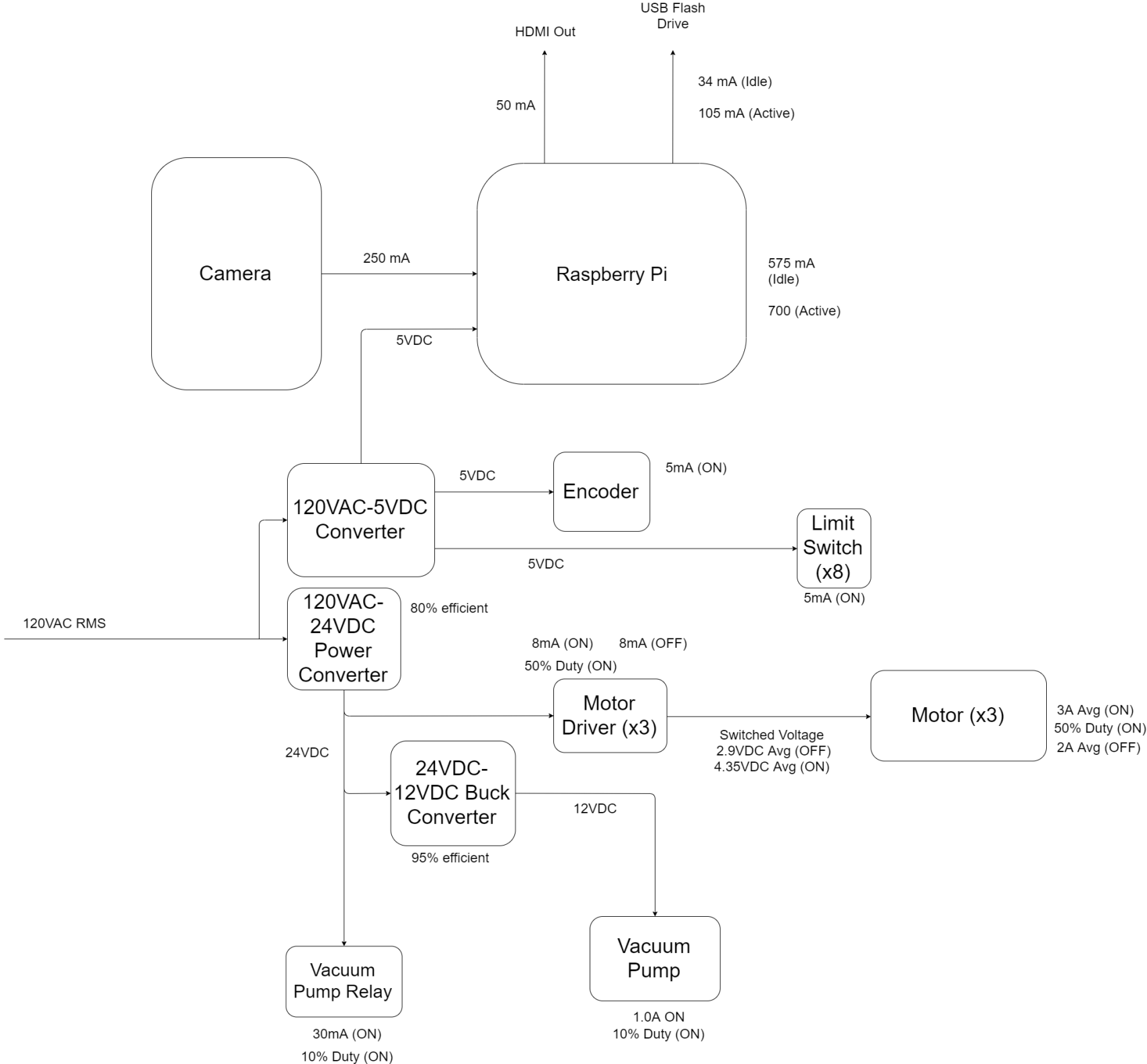
1. How many different voltages are in use in your system? For each one, what is the allowable voltage range and the expected peak and nominal current? This is best shown as a table of power interfaces.

Voltage	Nominal Current	Peak Current	Expected Voltage Range
24V	6.524A	10.9A	23.4 - 25V
12V	1.0A	2.0A	11.7 - 12.4V
5V	2.0A	4.0A	4.5 - 5.5V
3.3V	.01A	.1A	3.0 - 3.6V

For the 24V voltage line, it is supplying all the other voltages so it will have the majority of current flowing through it nominally. In addition, it will supply the stepper motors directly, but only for short peaks (nominally, the current should be very small).

2. Averaging over a second of operation answer either that is applicable: What is the amount of power (VA) used from the system power source (batteries, external power, or both)?

Based on the attached spreadsheet, the average amount of power for any point of operation (active or non) will be the average between the 2: (52.194W + 27.168W)/2 = 39.681W (assuming equal operation vs off time)


HDMI Out
USB Flash Drive
50 mA
34 mA (Idle)
105 mA (Active)
Camera
250 mA
Raspberry Pi
575 mA (Idle)
700 (Active)
5VDC
120VAC-5VDC Converter
5VDC
Encoder
5mA (ON)
Limit Switch (x8)
5VDC
5mA (ON)
120VAC RMS
120VAC-24VDC Power Converter
80% efficient
8mA (ON)
8mA (OFF)
50% Duty (ON)
Motor Driver (x3)
Switched Voltage
2.9VDC Avg (OFF)
4.35VDC Avg (ON)
Motor (x3)
3A Avg (ON)
50% Duty (ON)
2A Avg (OFF)
24VDC
24VDC-12VDC Buck Converter
95% efficient
12VDC
Vacuum Pump Relay
30mA (ON)
10% Duty (ON)
Vacuum Pump
1.0A ON
10% Duty (ON)

Block	Voltage (Nominal) (Volts)	Current (Nominal) (Amps)	Duty Cycle (Idle)	Duty Cycle (Active)	SubTotal Energy (Idle) (Watts)	SubTotal Energy (Active) (Watts)		
NEMA 17 Stepper Motor (1) [Active]	4.348043478	3	0	1	0	13.04413043		
NEMA 17 Stepper Motor (2) [Active]	4.348043478	3	0	1	0	13.04413043		
NEMA 17 Stepper Motor (3) [Active]	4.348043478	3	0	1	0	13.04413043		
NEMA 17 Stepper Motor (1) [Idle]	2.9	2	1	0	5.8	0		
NEMA 17 Stepper Motor (2) [Idle]	2.9	2	1	0	5.8	0		
NEMA 17 Stepper Motor (3) [Idle]	2.9	2	1	0	5.8	0		
120VAC-24VDC Power Supply	120	0.4133431839	0	1	0	49.60118207	<-- Avg Power In	
24VDC-12VDC Buck Converter	24	0.5	0.5	0.5	6	6		
Encoder (1)	5	0.005	1	1	0.025	0.025	Total Energy (Active) (Watts)	52.19439130
Encoder (2)	5	0.005	1	1	0.025	0.025	Total Energy (Idle) (Watts)	27.1675
Encoder (3)	5	0.005	1	1	0.025	0.025		
D2028 Vaccum Pump	12	1	0	0.1	0	1.2	Total Power Available	
Omron G5V-1-DC9 Relay	12	0.03	0	0.1	0	0.036	from power supply (Watts)	
DRV8825 Stepper Controller IC (1)	24	0.008	1	1	0.192	0.192		
DRV8825 Stepper Controller IC (2)	24	0.008	1	1	0.192	0.192		
DRV8825 Stepper Controller IC (3)	24	0.008	1	1	0.192	0.192		
Limit Switch (1)	5	0.005	1	1	0.025	0.025		
Limit Switch (2)	5	0.005	1	1	0.025	0.025		
Limit Switch (3)	5	0.005	1	1	0.025	0.025		
Raspberry Pi 4	5	0.7	0.821	1	2.8735	3.5		
Pi Camera 2	3.3	0.25	0	1	0	0.825		
HDMI Out	5	0.05	0	1	0	0.25		
USB 3.0 Port	5	0.105	0.32	1	0.168	0.525		

Block	Voltage (Nominal) (Volts)	Current (Nominal) (Amps)	Current (Peak) (Amps)	
NEMA 17 Stepper Motor (1) [Active]	4.35	3	4	
NEMA 17 Stepper Motor (2) [Active]	4.35	3	4	
NEMA 17 Stepper Motor (3) [Active]	4.35	3	4	
NEMA 17 Stepper Motor (1) [Idle]	2.90	2	2	
NEMA 17 Stepper Motor (2) [Idle]	2.90	2	2	
NEMA 17 Stepper Motor (3) [Idle]	2.90	2	2	
120VAC-24VDC Power Supply	120.00	0.413	0.5436875	<-- Power In
24VDC-12VDC Buck Converter	24.00	0.5	0.53	
Encoder (1)	5.00	0.005	0.007	
Encoder (2)	5.00	0.005	0.007	
Encoder (3)	5.00	0.005	0.007	
D2028 Vaccum Pump	12.00	1	1.1	
Omron G5V-1-DC9 Relay	12.00	0.03	0.005	
DRV8825 Stepper Controller IC (1)	24.00	0.008	0.01	
DRV8825 Stepper Controller IC (2)	24.00	0.008	0.01	
DRV8825 Stepper Controller IC (3)	24.00	0.008	0.01	
Limit Switch (1)	5.00	0.005	0.007	
Limit Switch (2)	5.00	0.005	0.007	
Limit Switch (3)	5.00	0.005	0.007	
Raspberry Pi 4	5.00	0.7	1	
Pi Camera 2	3.30	0.25	0.32	
HDMI Out	5.00	0.05	0.007	
USB 3.0 Port	5.00	0.105	0.12	