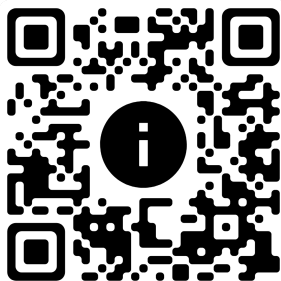


Power Bench: References



Examples

Queries List



PDF (Queries List)

<https://qr.page/g/1FG90ytGtOp>

Queries, 5 Selected
Examples



PDF (Example Results)

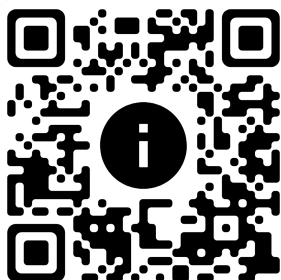
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Index (this document)



<https://qr.page/g/55aph1FCepu>

Instructions



PDF Instructions

<qr.page/g/3Z1AHENxIDy>

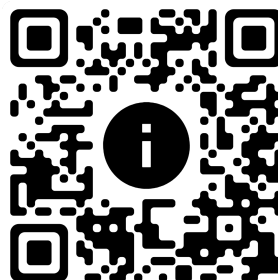
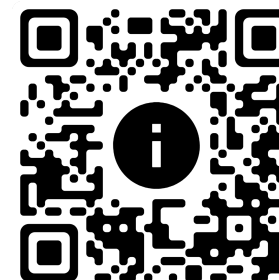


Diagram File, Draw.io

<qr.page/g/3Z1AHENxIDy>



icons library, Draw.io

<qr.page/g/3Z1AHENxIDy>

Devices Manuals



CBA Manual

<qr.page/g/2Gbm5eF5LD9>



AC Power Meter Manual

<qr.page/g/2Gz7zQ1hXL5>



120w USB power supply

<qr.page/g/51rwPdnPbKS>



USB-C Meter Manual

<qr.page/g/2fG6cJvZi27>

Power Bench: Queries and Solutions

Updated: 4/3/2023

[My Team Needs Tutorials for...](#)

Topics			Characteristics			
Query	Nominal voltage	Question	Measure	Of:	Units	Experiment Recommended
Q1	5v	Does my 5v regulator provide the rated amperage?	Current	Converter	Amps	source 5v from the DC converter & measure using a Quick Load test on CBA
Q2	12V	How much power does my load require?	Power	Load	Watts	source power from a reliable source through the Powerwerx connector
Q3	12v	Does my 12v regulator provide the rated amperage?	Current	Converter	Amps	source 12v from the DC converter & measure using a Quick Load test on CBA
Q4	B+	What is the capacity of my battery?	Energy	Battery	Watt-hours	Perform a discharge test of the battery from fully charged
Q5	USB	How much Power does my device consume?	Power	Consumed	Watts	source power from a reliable USB adapter through the USB power meter
Q6	USB	How much Power does my source offer?	Power	Sourced	Watts	Perform a Quick Load test using CBA & gradually ramp up current.
Q7	USB	What no-load voltage does my source offer?	Voltage	Source	volts	Source power from your converter to the USB power meter
Q8	USB	At what power level does my voltage drop too low?	Power	Source	Watts	Load your USB source with CBA. Raise load in increments, with Quick Load Test. Monitor voltage
Q9	USB	Does my USB adapter provide sufficient power?	Amps	Source	Amps	source power (0.1 thru 1.5A) from a USB battery pack using "quick load test." Find sharp voltage drop when we reach 1.5A
Q10	USB	Does my battery maintain spec voltage under load?	Voltage	Battery	Volts	source 1A from USB battery pack. Discover 5.0v at 0.1A but drop to 4.88v at 1A
Q11	USB	At what rate does my USB power bank charge?	Power	Load	Watts	charge USB power bank from a known sufficient adapter. Use USB meter between source & load
Q12	DC load	How much current does my DC motor draw at stall?	Current	DC motor	Amps	source spec voltage from known sufficient supply - connect DC power meter in series
Q13	DC Boost	How much power is lost converting 5v to 12v?	Power	DC boost	Watts	source 0.5A from USB adapter (2.0A max). Measure wattage at USB outlet (x) and wattage of CBA (y) X = 6.99, y = 5.99 W. 1 watt lost
Q14	DC boost	How stable is the voltage of my 12v boost converter?	Voltage	DC boost	Volts	sourcing 0.6A yields 11.97v, sourcing 0.1A yields 12.01v. Voltage delta is 0.04v or 40mV
Q15	B+	What is the State of Charge of my battery?	SOC	Source	Percent	perform a discharge test of battery & map the voltage to the amp-hours. Must match current
Q16	AC 120v	What is the power factor of my AC load	PF		Ratio	Connect an air pump (AC power) to the AC power meter. Read out power factor
Q17	AC 120v	What is the efficiency of my AC ► DC converter?	Efficiency	Converter	percent	source DC load from DC converter. Must use intended wattage.
Q18	AC 120v	How much energy is lost in AC ► DC conversion?	Energy	Loss	Watts	source DC load from DC converter. Must use intended wattage.
Q19	5v	What is the power of my MCU at idle?	Power	Load	Watts	Source 5v from USB power meter and measure wattage while running a program
Q20	5v	How much current does my MCU board draw?	Current	MCU	mA	source 5v from USB adapter with USB meter at outlet. Run your MCU's software.
Q21	24v	How much power does my actuator consume?	Power	Actuator	Watts	power actuator from known sufficient 24v source.
Q22	12V	How many amps does my load require?	Current	Load	Amps	connect an LED to the 12v power source inline with Powerwerx Meter
Q23	12v	What is the frequency of my power converter?	Frequency	Source	Hz	draw power from 12v variable controller to a DC motor (peristaltic pump). Hear ringing when knob is turned halfway.
Q24	12v	What is the voltage drop across my chosen connector?	Voltage	Contacts	Volts	connect your connector across a source and load and draw the intended current. Measure with multimeter
Q25	B+	How much energy is lost in charging a battery?	Energy	charging	Amp-hours	charge battery (v1 start to v2 finish) & measure source output. Discharge battery with CBA until it returns to v1. Use a discharge test

ETID Power Bench Query Examples with Results

Priority Queries for Demos

Updated 5/15/2023

No.	Test	Type	Selected Experiment	Device	Name
1	Source	USB	Test peak power on 12v ► usb-c adapter	USB DC adapter	DATA_query1
2	Load	USB	Test power consumption of arduino project	ESP8266	DATA_query2
3	Battery	12v	Test capacity of 3-cell battery	SCTL battery	DATA_query3
4	Source	12v	Find Max Current of 12v 3A adapter	12v adapter	DATA_query4
5	Source	12v	Evaluate voltage of ATX Power Supply	Antec ATX PSU	DATA_query5

Details:

See document: Power Bench Queries, for more queries

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Test Query 12v►5v USBC adapter

Query No. 1

Updated 4/19/2023

Task

Draw load on the usbc adapter ranging from 0 amps to 3.3 amps
Measure the voltage available at various currents



Equipment:

- 1 DC Power adapter, 12v to USBC 5V
- 2 ATX power supply, 12v bus
- 3 CBA battery analyzer, CBA IV

Data collected:

DC Load (A)	DC voltage	Power out Pwr (W)
0	5.02	0.0
0.5	5.02	2.5
1	4.96	5.0
1.5	5.16	7.7
2	5.09	10.2
2.5	5.02	12.6
3	4.95	14.9
3.1	4.94	15.3
3.2	4.92	15.7
3.3	4.9	16.2

Key Results

This adapter offers up to 3.3 amps without any major reduction in voltage.
The amperage is rated for 3.0 Amps and 3.3 amps was achieved at 4.9 volts.

Test Query **Arduino Power Consumption**

Query No. **2**

Updated 4/20/2023



Task

Source power from USB adapter to run Arduino & its accessories

Measure the power consumed during operation

Equipment:

- 1 USB adapter
- 2 USB power meter
- 3 Arduino project

Data collected:

Sourcing power from the USB tester while running various firmwares:

Condition	voltage	Load (mA)	Power (mW)
using WiFi	5.03	83	417
simple code	5.08	10	51
with LED activ	5.08	21	107

Key Results

Codes without actuator use only 51 miliwatts.

Operating the LED doubles power draw, to 107 miliwatts

Activating the wifi transceiver raises power dramatically: 420 miliwatts

Test Query Li-ion Battery Capacity

Query No. 3

Updated 4/20/2023



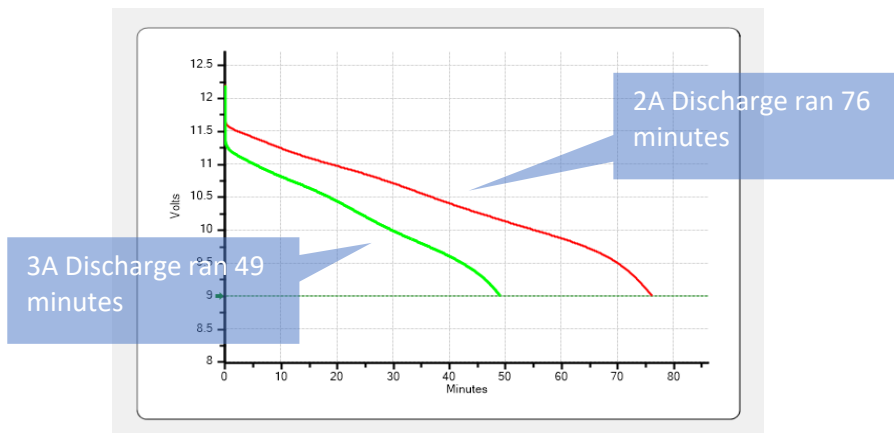
Task

Discharge a li-ion battery & measure capacity in mAh
Log the data, voltage over time, at constant current

Equipment:

- 1 Li-ion battery pack, 3S
- 2 CBA power meter

Data collected:



Discharge rate	2A	3A	
Capacity	2.54	2.45	amp-hours
Capacity	26.5	25.1	watt-hours

Key Results

The cells offer up to 2.54 amp-hours or 26.5 watt-hours

Discharge is more efficient at lower current.

Optimal conditions may give the rated capacity of 3400 mAh

Test Query 12v Adapter, 3 Amps

Query No. 4

Updated 4/20/2023



Task

Draw load on the 12v power adapter up to the rated 3.0A
Measure if the voltage is maintained at the rated Amperage

Equipment:

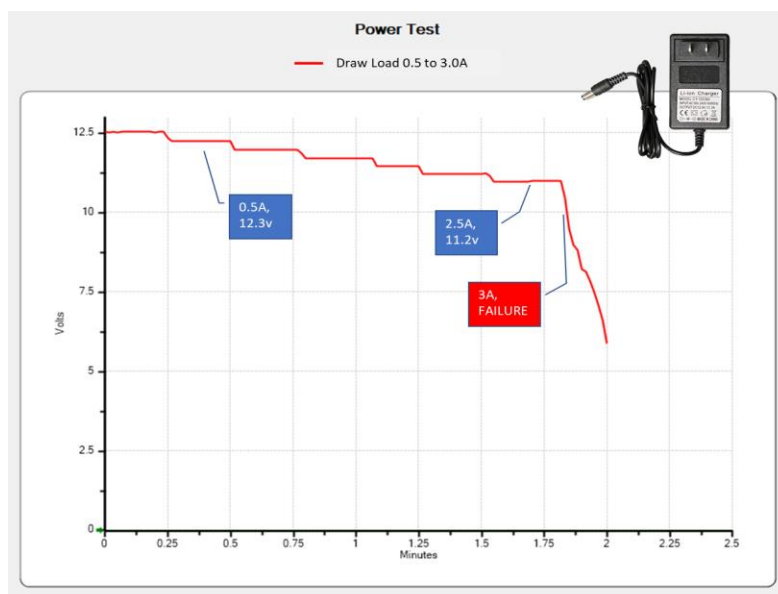
- 1 AC/DC power adapter, 12v
- 2 CBA battery analyzer, CBA IV

Data Collected:

DC Load (A)	voltage	DC Load (W)
0	12.58	0
0.5	12.25	6.125
1	11.96	11.96
1.5	11.69	17.535
2	11.45	22.9
2.5	11.22	28.05
3	10.97	32.91
3.5	fail	

Key Results

This power supply fails at 3 Amps, and must be limited to 2.5A.
The peak power (2.5A) is only 33 watts compared with rated 36w.



Test Query

ATX Power Supply

Query No. 5

Updated 4/10/2023



Task

Draw load on the ATX power supply & measure the AC power and DC output power
Also measure Power Factor (PF), and increment load from 0A to 4A

Equipment:

- 1 AC Power Meter D52-2066
- 2 ATX Power Supply, Antec EA-380D
- 3 CBA battery analyzer, CBA IV

Data Collected:

DC Load (A)	DC voltage	DC Load (W)	AC Pwr (W)	AC Power Factor	Efficiency
0	12.1	0	2.8	0.35	0.0
0.1	12.0	1.2	4.8	0.51	0.3
1	11.7	11.7	18.1	0.86	0.6
2	11.4	22.8	30.7	0.93	0.7
3	11.2	33.5	42.9	0.95	0.8
4	10.9	43.6	55	0.95	0.8

Key Result

The ATX power supply operates more efficiently at higher powers.

The voltage drops down to 10.9v at 44 watts, much less than the rated power