



DC Power Monitor – Module User Manual V1.0

Mutex Embedded Solutions

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This manual highlights all necessary information to use and operate the DC Power Monitoring Module. This includes device specifications, hardware design, serial interface and data formats.

Version Control

The following table lists the version history of this document:

Table 1: Version Control

Version	Date	Modified by	Description
1.0	29/05/2025	M.Yaqoob	Create the initial DPWR User Manual fully

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1. Specifications

The DPWR module is a DC Power Measurement and Logging module with 4-Channels measurement capability. The module is designed for industrial applications and only certified components from Mouser are used on the module PCB.

1.1. Features

The DPWR module has the following features:

- Measurement data: Voltage, Current, Power, Energy and 7-days history.
- 4-Channels Power Measurement.
- SD Card Data Logging in CSV format for up to 1 year.
- Integrated Real-Time clock with Coin battery socket for Clock and Timestamps.
- Real-Time clock can be read for your own application.
- Module can be mounted on your PCB.

1.2. Electrical Ratings

The DPWR module electrical nominal ratings are highlighted in the following table:

Table 2: Electrical Specifications

Parameter	Minimum	Nominal	Maximum
Power Supply Input	-	3.3V	-
Measurement Voltage	0V	-	32V
Measurement Current	0A	-	5A
I2C signal level	-	3.3V	-
UART signal level	-	3.3V	-
RS485 EN signal level	-	3.3V	-

1.3. Applications

The DPWR module is useful for DC power measurement generally including, but not limited to, the following applications:

- PCB voltage rails monitoring.
- Device power consumption monitoring and fault detection.
- Battery powered devices.
- Predictive maintenance.
- Any DC Power monitoring application.

2. Hardware

2.1. Pinout

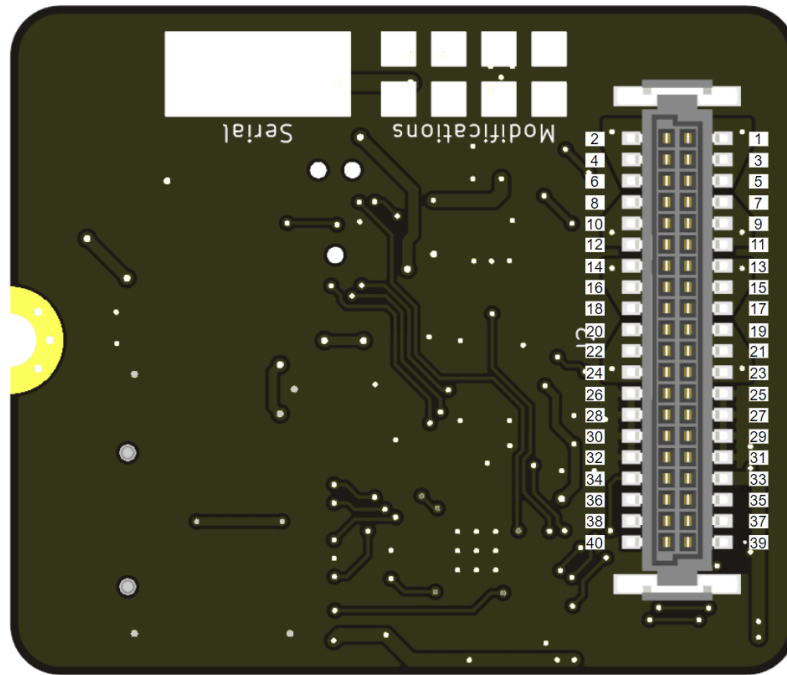


Figure 1: DPWR Module Pinout

Table 3: DPWR Connector Pinout

Pin	Name	Description	Pin	Name	Description
2	Ch2-	Channel 2 – Output to Load	1	Ch3+	Channel 3 – Input from supply
4			3		
6			5		
8	Ch2+	Channel 2 – Input from supply	7	Ch3-	Channel 3 – Output to Load
10			9		
12			11		
14	Ch1-	Channel 1 – Output to Load	13	Ch4+	Channel 4 – Input from supply
16			15		
18			17		
20	Ch1+	Channel 1 – Input from supply	19	Ch4-	Channel 4 – Output to Load
22			21		
24			23		
26	GND	Common Ground	25	GND	Common Ground
28			27		
30			29		
32			31		
34	ESP32_EN	Pull-down to reset	33	VCC	Vin: 3.3V
36	TX (Out)	UART Transmit	35	SCL	I2C Clock
38	RX (In)	UART Receive	37	SDA	I2C Data
40	RS485_EN (Out)	RS485 EN signal	39	Event (Out)	N/A

2.2. Channel wiring

To wire a measurement channel, voltage supply line shall be fed directly to Ch+, Ch- shall be connected to output load, and a common ground as shown on the following diagram:

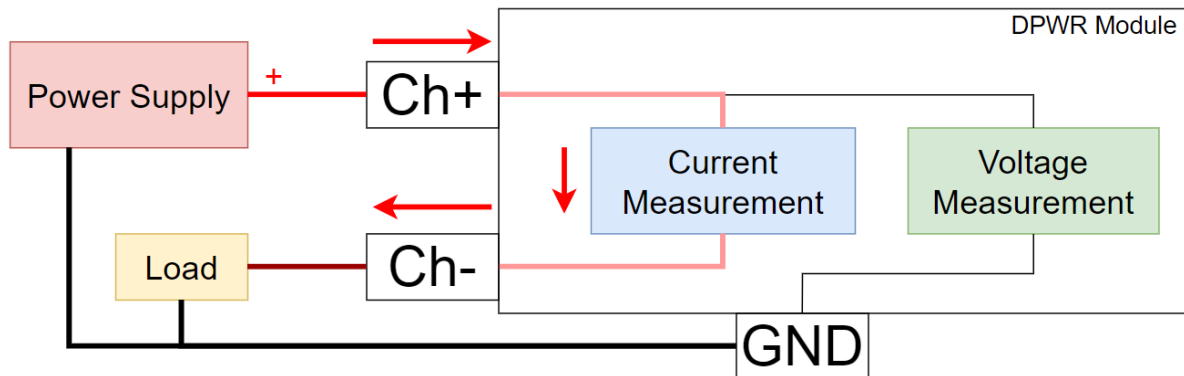


Figure 2: Channel Wiring Diagram

2.3. Dimensions

The essential dimensions for the DPWR module and the Extension board will be highlighted.

DPWR Module

- Length = 47 mm
- Width = 40 mm
- Standoff distance from connector origin = 40 mm

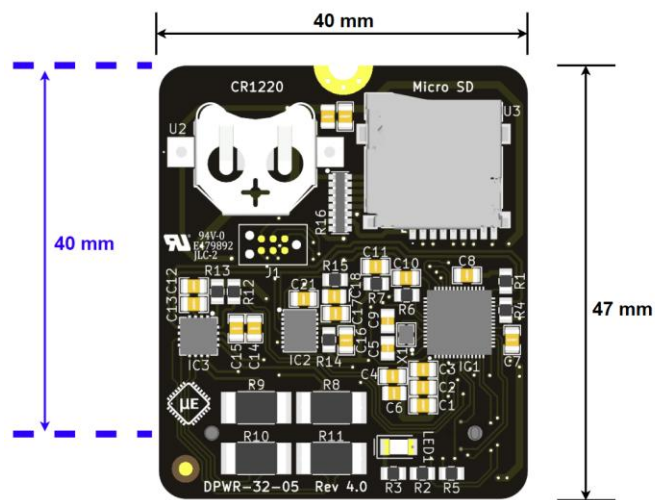


Figure 3: DPWR Module Dimensions

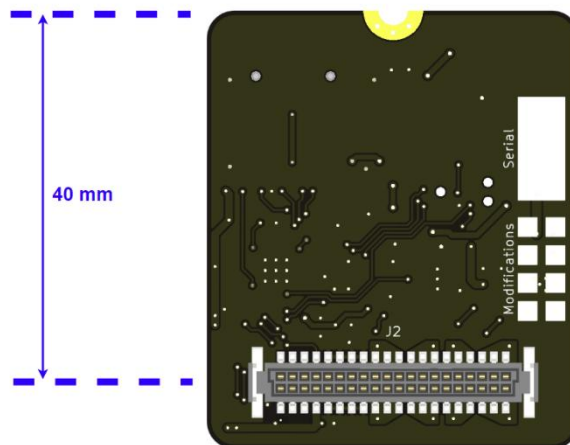


Figure 5: DPWR Module back view

2.4. Hardware design guideline

To mount the DPWR module on your own PCB, this hardware design guideline shall be followed for socket connector part number, standoff and circuitry.

1) Connector

To mount the DPWR module on a custom PCB, the following connector shall be used:

- 40-pins Male socket connector 20x2
- Pitch = 1.27mm
- Manufacturer: Phoenix Contact
- Part Number: **1337142**



2) Standoff

A standoff shall be used to fix and support the DPWR module PCB:

- Height = **10mm**
- **M3** screw with **5mm** height
- Part number: **SMTSO-M3-10ET**



3) Minimum Circuitry

To run the DPWR module, the following minimum circuitry is required:

- Supply a fixed **3.3V** power to the module and **GND**.
- Connect your preferred interface: **I2C** or **UART-Modbus**, can also use **RS485** with external circuitry. Refer to the Pinout section for more details.

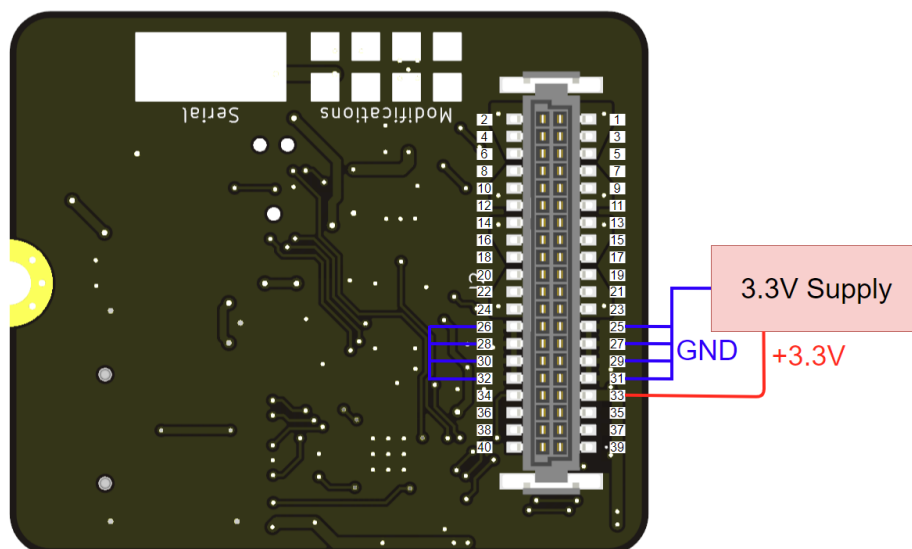


Figure 6: DPWR Module Power Circuit

3. Serial Interface

To communicate with the module and access the internal registers, users need to use one of the interfaces: UART-Modbus, I2C or RS-485 (Requires an external circuitry).

3.1. Registers Map

Note: Registers are 16-bit each, based on Modbus standard register size.

Holding Registers (Write / Read)

Table 4: DPWR Module Holding Registers

Address	Size / U16	Function	Range	Default	Type	Description
0	1	Slave Address	1 - 127	8	uint16	Modbus/I2C Slave address. (Restart required)
1	2	Baud Rate	0 - 4	1	enum	0: 9600 1: 19200 (default) 2: 38400 3: 57600 4: 115200 (Restart required)
3	2	Parity	0 - 3	0	enum	0: None (default) 1: -/ 2: Even 3: Odd (Restart required)
5	1	Set Hours	0 - 23	0	uint16	Hours - 24 format
6	1	Set Minutes	0 - 59	0	uint16	Minutes
7	1	Set Seconds	0 - 59	0	uint16	Seconds
8	1	Set Day	1 - 31	0	uint16	Day
9	1	Set Month	1 - 12	0	uint16	Month
10	1	Set Year	2000 - 2999	0	uint16	Year
11	1	Set Clock	0 - 1	0	bool	Once you update the above clock parameters, write 1 to update clock.
12	1	Clear Total Energy - Ch1	0 - 1	0	uint16	Write 1 to clear
13	1	Clear Total Energy - Ch2	0 - 1	0	uint16	Write 1 to clear
14	1	Clear Total Energy - Ch3	0 - 1	0	uint16	Write 1 to clear
15	1	Clear Total Energy - Ch4	0 - 1	0	uint16	Write 1 to clear
16	1	Data Logging Enable - Ch1	0 - 1	0	bool	
17	1	Data Logging Enable - Ch2	0 - 1	0	bool	
18	1	Data Logging Enable - Ch3	0 - 1	0	bool	
19	1	Data Logging Enable - Ch4	0 - 1	0	bool	
20	1	Data Logging Sampling Period	1 - U16	10	uint16	Seconds

39	1	Firmware Update Enable	0 - 1	0	bool	1: Start Firmware Update Process
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Input Registers (Read Only)

Real-time registers

Table 5: DPWR Module Input Registers - Realtime

Address	Size	Function	Range	Scaling	Default	Type	Description
40	1	Hours	0 - 23		0	uint16	Hours - 24 format
41	1	Minutes	0 - 59		0	uint16	
42	1	Seconds	0 - 59		0	uint16	
43	1	Day	1 - 31		0	uint16	
44	1	DayOfWeek	0 - 6		0	uint16	0: Sunday
45	1	Month	1 - 12		0	uint16	
46	1	Year	2000 - 2999		0	uint16	
47	1	SD Card Mount Status	0 - 1		0	bool	1: Mounted Successfully, 0: Requires re-insertion
48	1	FW Version	1 - 10000		1	uint16	e.g. v1.6 (Version = 1, Sub = 6)
49	1	FW Version Sub	0 - 1000		0	uint16	
Channel - 1							
80	2	Voltage	0 - 32000	0.001	0	uint32	V
82	2	Current	0 - 5000	0.001	0	uint32	A
84	2	Power	0 - 160000	0.001	0	uint32	W
86	2	Day Energy	U32	0.001	0	uint32	Wh
88	2	Total Energy	U32	0.001	0	uint32	Wh. All time energy, User cleared.
90	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
92	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
Channel - 2							
120	2	Voltage	0 - 32000	0.001	0	uint32	V
122	2	Current	0 - 5000	0.001	0	uint32	A
124	2	Power	0 - 160000	0.001	0	uint32	W
126	2	Day Energy	U32	0.001	0	uint32	Wh
128	2	Total Energy	U32	0.001	0	uint32	Wh. All time energy, User cleared.
130	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
132	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
Channel - 3							

160	2	Voltage	0 - 32000	0.001	0	uint32	V
162	2	Current	0 - 5000	0.001	0	uint32	A
164	2	Power	0 - 160000	0.001	0	uint32	W
166	2	Day Energy	U32	0.001	0	uint32	Wh
168	2	Total Energy	U32	0.001	0	uint32	Wh. All time energy, User cleared.
170	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
172	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
Channel - 4							
200	2	Voltage	0 - 32000	0.001	0	uint32	V
202	2	Current	0 - 5000	0.001	0	uint32	A
204	2	Power	0 - 160000	0.001	0	uint32	W
206	2	Day Energy	U32	0.001	0	uint32	Wh
208	2	Total Energy	U32	0.001	0	uint32	Wh. All time energy, User cleared.
210	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
212	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage

History Registers

Table 6: DPWR Module Input Registers - History

Address	Size	Function	Range	Scaling	Default	Type	Description
Channel - 1							
1 Day ago							
240	2	Energy	U32	0.001	0	uint32	Wh
242	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
244	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
2 Days ago							
246	2	Energy	U32	0.001	0	uint32	Wh
248	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
250	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
3 Days ago							
252	2	Energy	U32	0.001	0	uint32	Wh
254	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
256	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
4 Days ago							
258	2	Energy	U32	0.001	0	uint32	Wh
260	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage

262	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
5 Days ago							
264	2	Energy	U32	0.001	0	uint32	Wh
266	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
268	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
6 Days ago							
270	2	Energy	U32	0.001	0	uint32	Wh
272	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
274	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
7 Days ago							
276	2	Energy	U32	0.001	0	uint32	Wh
278	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
280	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
Channel - 2							
1 Day ago							
290	2	Energy	U32	0.001	0	uint32	Wh
292	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
294	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
2 Days ago							
296	2	Energy	U32	0.001	0	uint32	Wh
298	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
300	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
3 Days ago							
302	2	Energy	U32	0.001	0	uint32	Wh
304	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
306	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
4 Days ago							
308	2	Energy	U32	0.001	0	uint32	Wh
310	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
312	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
5 Days ago							
314	2	Energy	U32	0.001	0	uint32	Wh
316	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
318	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
6 Days ago							
320	2	Energy	U32	0.001	0	uint32	Wh
322	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage

324	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
7 Days ago							
326	2	Energy	U32	0.001	0	uint32	Wh
328	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
330	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
Channel - 3							
1 Day ago							
340	2	Energy	U32	0.001	0	uint32	Wh
342	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
344	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
2 Days ago							
346	2	Energy	U32	0.001	0	uint32	Wh
348	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
350	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
3 Days ago							
352	2	Energy	U32	0.001	0	uint32	Wh
354	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
356	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
4 Days ago							
358	2	Energy	U32	0.001	0	uint32	Wh
360	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
362	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
5 Days ago							
364	2	Energy	U32	0.001	0	uint32	Wh
366	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
368	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
6 Days ago							
370	2	Energy	U32	0.001	0	uint32	Wh
372	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
374	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
7 Days ago							
376	2	Energy	U32	0.001	0	uint32	Wh
378	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
380	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
Channel - 4							
1 Day ago							
390	2	Energy	U32	0.001	0	uint32	Wh

392	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
394	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
2 Days ago							
396	2	Energy	U32	0.001	0	uint32	Wh
398	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
400	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
3 Days ago							
402	2	Energy	U32	0.001	0	uint32	Wh
404	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
406	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
4 Days ago							
408	2	Energy	U32	0.001	0	uint32	Wh
410	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
412	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
5 Days ago							
414	2	Energy	U32	0.001	0	uint32	Wh
416	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
418	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
6 Days ago							
420	2	Energy	U32	0.001	0	uint32	Wh
422	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
424	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage
7 Days ago							
426	2	Energy	U32	0.001	0	uint32	Wh
428	2	Voltage Min	0 - 32000	0.001	0	uint32	V Minimum day voltage
430	2	Voltage Max	0 - 32000	0.001	0	uint32	V Maximum day voltage

3.2. UART – Modbus

The DPWR module uses a standard Modbus RTU format with the following default specifications:

Parameter	Value
Baud Rate	115200
Data bits	8 bits
Parity	None
Stop bit	1 bit
Flow Control	RS485 - DTR
Mode	RTU

Default Slave Address	8
Functions	03: Holding read 04: Input read 06: Holding write single 16: Holding write multiple
CRC	CRC-16 Modbus

Data Format

Accessing Modbus Registers require interpreting the data correctly, the following table highlights the data formats:

Data Type	Registers Count	Value	Data Format
Bool	1	True = 0x0001, False = 0x0000	0x0001
U16	1	0x1234	0x1234
I16	1	-123 = 0xFF85	0xFF85
U32	2	0x12345678	[0] = 0x5678 [1] = 0x1234
I32	2	-123456 = 0xFFFE1DC0	[0] = 0x1DC0 [1] = 0xFFFE
Enum	2	4 = 0x00000004	[0] = 0x0000 [1] = 0x0004
Float	2	12.567 = 0x4149126f (IEEE-754)	[0] = 0x126F [1] = 0x4149
String	ceil(Strlen / 2) e.g. 10 chars = 5 registers	"World" = 0x48 0x65 0x6C 0x6C 0x6F	[0] = 0x6548 "oW" [1] = 0x6C6C "lr" [2] = 0x006F "d"

Note: Not all these data types are used at the DPWR Registers.

3.3. RS485 – Modbus

To use RS485 Bus, the DPWR module provides the RS485 Enable output pin to connect to an external RS485 transceiver. The DPWR Extension board has an onboard RS485 transceiver that takes DPWR UART lines alongside the EN pin and provides RS485 levels interface. The following is the Extension Board RS-485 schematic:

RS485

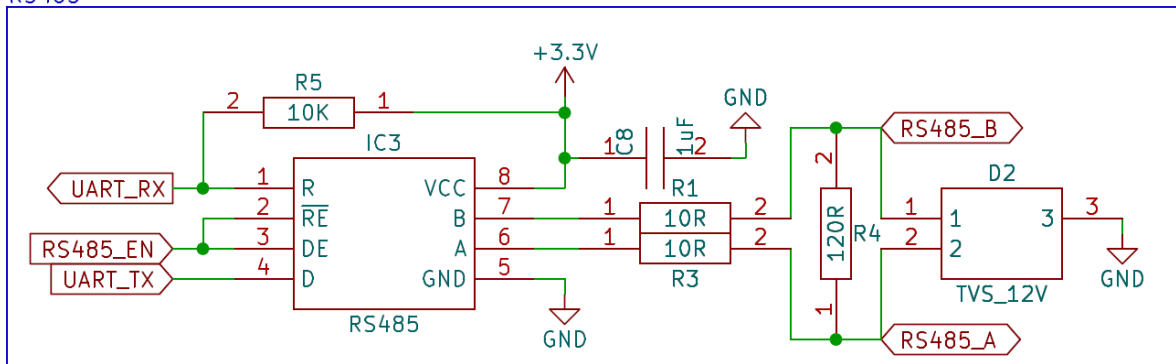


Figure 7: RS485 External Circuit

3.4. I2C Interface

This section describes how to interface to the DPWR module using I2C Bus.

To interface to the DPWR module via I2C, refer to the pinout table:

- Pin 35: SCL
- Pin 37: SDA
- Signal Level: 3.3V
- Pull-up: Pull-up resistors already included the DPWR module PCB. **No need** for any external pull-up resistors.

4. Data Logging

The DPWR module features data logging in CSV format into an SD Card. At this section, we will detail all data logging specifications including SD Card and Data Format.

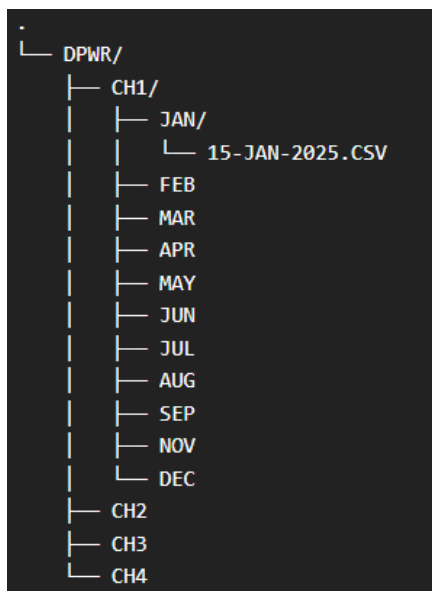
4.1. SD Card

The SD Card needs to meet the following specifications:

- Micro SD Card
- Minimum Size: 16GB (To be able to log 1-year work of data at the fastest logging rate)
- Default format: FAT32

4.2. File System

Log data are stored in the SD card with the following file tree:



4.3. CSV Format

Logging file name is **15-JAN-2025.CSV**, it is named after date.

The data format in each .CSV file is as follows:

Time	Timestamp (s)	Voltage (V)	Current (A)	Power (W)	Day Energy (Wh)	Total Energy (Wh)
12:36:53	45413.9	0.353	0	0	7.516	214.959
12:37:03	45423.9	0.218	0	0	7.516	214.959
12:37:13	45433.85	0.217	0	0	7.516	214.959
12:37:23	45443.85	0.226	0	0	7.516	214.959

CSV raw format:

Time, Timestamp (s), Voltage (V), Current (A), Power (W), Day Energy (Wh), Total Energy (Wh)

12:36:53, 45413.900, 0.353, 0.000, 0.000, 7.516, 214.959

12:37:03, 45423.900, 0.218, 0.000, 0.000, 7.516, 214.959

12:37:13, 45433.850, 0.217, 0.000, 0.000, 7.516, 214.959

12:37:23, 45443.850, 0.226, 0.000, 0.000, 7.516, 214.959

Timestamp: Time of the day in seconds and tens of seconds (e.g. 12:36:53 = $12 \times 60 \times 60 + 36 \times 60 + 53 + .9 = 45413.9$)

5. Extension Board

An extension board is available to evaluate the module functionality and to connect to the PC App via UART – USB bridge. The Extension board is a great way to test the module.

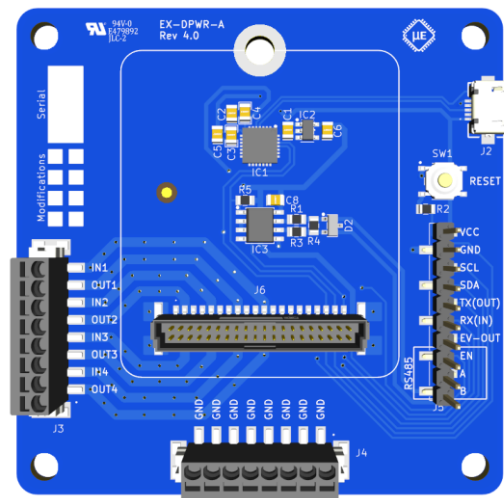


Figure 8: Extension Board 3D View

- Extension Board dimensions: **70 x 70 mm**
- Standoff hole diameter: **4.2 mm**
- Distance between mounting connector origin and Standoff center: **40 mm**

5.1. Pinout

Table 7: Power Measurement Connector

Pin	Function	Description
IN1	Channel 1 - Input	From supply
OUT1	Channel 1 - Out	To Load
IN2	Channel 2 - Input	
OUT2	Channel 2 - Out	
IN3	Channel 3 - Input	
OUT3	Channel 3 - Out	
IN4	Channel 4 - Input	
OUT4	Channel 4 - Out	

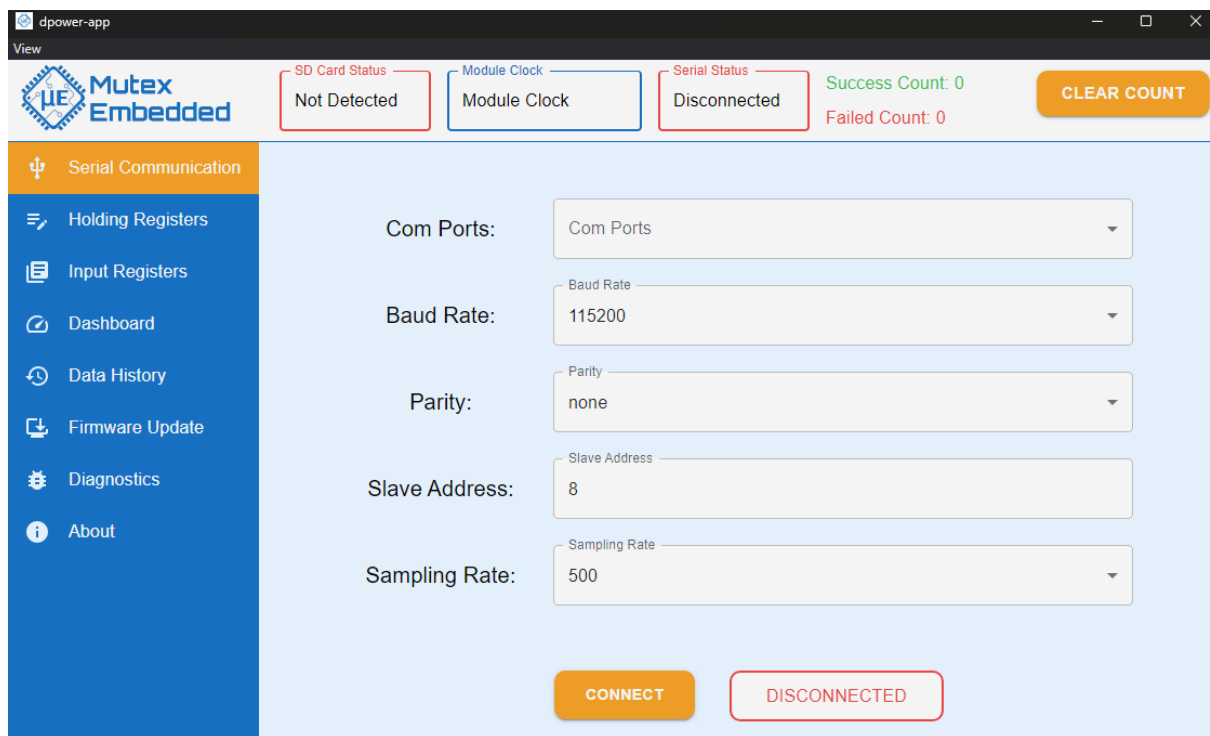
Table 8: Digital IO Connector

Pin	Function	Direction	Description
VCC	Digital Supply	Power	3.0 to 5.5V
GND	Ground		
SCL	I2C Clock	Output	3.3V level
SDA	I2C Data	Input/Output	3.3V level
TX	UART – TX	Output	3.3V level
RX	UART – RX	Input	3.3V level
EV-OUT			
EN	RS485 - DE/RE	Output	3.3V level

6. PC Application

Mutex Embedded Solutions provide a PC Application to communicate with the device for configuration and monitoring. It features the following:

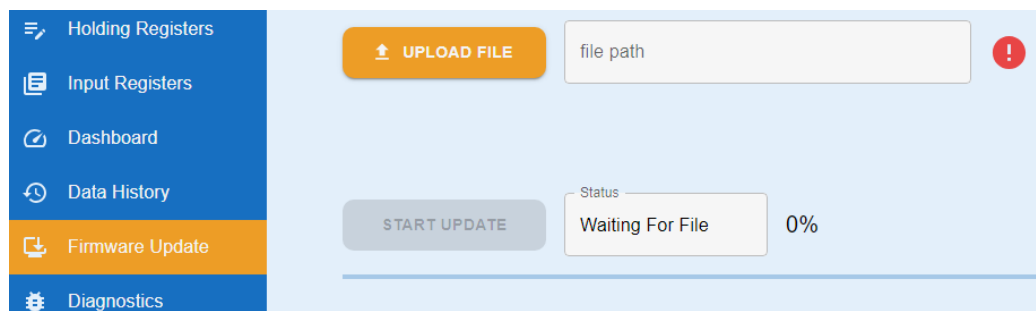
- Holding Registers Read/Write
- Input Registers Read
- Power data real-time monitoring in Charts
- History of data in bar chart
- Module Firmware Update
- PC Application Diagnostics Log for bug reporting



6.1. Firmware Update

To update the Module Firmware, navigate to the Firmware Update tab:

- Upload new Firmware binary file from Mutex Embedded website
- Press Start Update button
- Wait for the progress bar to finish



6.2. PC Application update

To check for PC Application software updates:

- Go to About page in the App
- Click on: **Check for software update** link

