IP1 Datasheet

PWM OUTPUT WITH SINGLE CHANNEL ADC MODULE

FEATURES

- 1 PWM Output (3.3V)
- 0 Hz – 1 kHz
- Single Channel 3.3V 12-bit ADC input for voltage sensing
- Optional automated PWM adjustment based on input voltage for standalone operation
- RS-485 MODBUS RTU Compatible

DESCRIPTION

The IP1 module can be used to generate a PWM output signal to control devices such as SSRs by directly interfacing with the SSR input. An single channel ADC input can be used with external resistor divider for high voltage sensing. Optionally, PWM duty cycle can be automatically controlled based on input voltage and set points, making it ideal for simple wind turbine control or dump load control. It can be configured and controlled by any Modbus-compliant server over RS-485.

CONNECTOR DETAILS

Pin	Name	Description
1-4	NC	Not connected
5	5V	5V. If connected to a Wattmon master, leave this disconnected or use it to

		power an SSR. If operating in standalone mode, provide a 5V power source between this pin and ground.
6	GND	Ground
7	PULSE	Pulse output
8	VIN	12-bit ADC input – Maximum input: 3.3V

MODBUS INTERFACE

This module is Modbus RTU compatible. It requires a baud rate of 9600 bps, no parity, and 1 stop bit for correct operation. The default slave ID of this module is set to 1 but can be changed via a Modbus register.
The two RJ45 sockets are connected in parallel, and are used for providing power and interfacing with the RS-485 bus. Devices can be daisy chained together easily using this method. When used in conjuction with the Wattmon controller any standard Ethernet patch cable (straight through) can be used to connect with the Wattmon master. One connector has two LED indicators. One indicates that the module is powered, and the other blinks when a packet is send or received. The second LED will start blinking slowly if Modbus communication stops for over 30 seconds.
When using this device with a third party Modbus master, use the following table for proper connection.

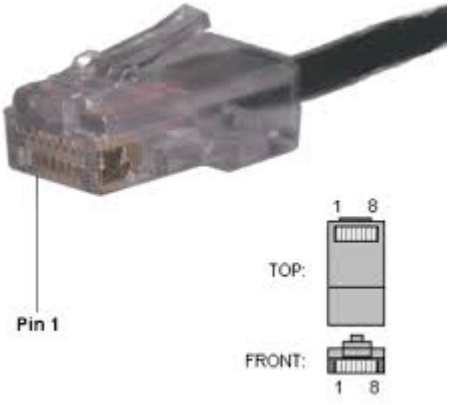


Figure 1: RJ-45 Pinouts

PIN	Description
1,2	GND
3	Not connected
4	A (-)
5	B (+)
6	Not connected
7,8	5V DC

MODBUS PROTOCOL

This device supports the following functions:

FUNCTION 3, READ HOLDING REGISTERS
FUNCTION 4, READ INPUT REGISTERS
FUNCTION 6, WRITE SINGLE REGISTER
FUNCTION 16, WRITE MULTIPLE REGISTERS
FUNCTION 17, REPORT SLAVE ID

MODBUS INPUT REGISTERS

Address	Name	Description
3000	CURDUTY	The current duty cycle active
3001	VOLTAGE	The calibrated voltage at the VIN pin
3002	RAWADC	The raw ADC value (0-4096) at the VIN pin

MODBUS HOLDING REGISTERS

4000	FREQ	Output frequency. Can be between 1 Hz and 5000 Hz. The higher the frequency is, the less accuracy the duty cycle has
4001	DUTY	Duty cycle between 0 and 100 where 0

		is fully off and 1 is fully on
4002	INVERTED	Inverted PWM signal. Set this to 1 in order to reverse the PWM signal (Duty cycle 0 means fully an duty cycle 100 means fully off). This is used when connecting to an external SSR since 3.3V is not always sufficient to power it. See below for application notes.
4003	MINV	Minimum voltage at VIN pin. In non-inverting mode, when the voltage goes below this, the PWM duty cycle will gradually increase. In inverting mode, the PWM duty cycle will decrease
4004	MAXV	Maximum voltage at VIN pin. In non-inverting mode, when the voltage goes below this, the PWM duty cycle will gradually decrease. In inverting mode, the PWM duty cycle will increase
4005	VMUL	Voltage multiplier for calibration. See below for details.
4006	VDIV	Voltage divider for calibration.
4007	PERTURB	In automatic mode, this duty cycle will automatically be adjusted at the perturb interval in ms. Can be between 1 and 1000.
10000	ADDR	Slave Address. This can be set using WRITE SINGLE REGISTER (Function 6) to set the slave address and is Write Only. To read the slave address, use the REPORT SLAVE ID function.

Calibrating Voltage Measurement

The VIN pin can measure a voltage between 0 and 3.3V with 12 bit accuracy.

The Calibrated voltage is calculated using this formula:

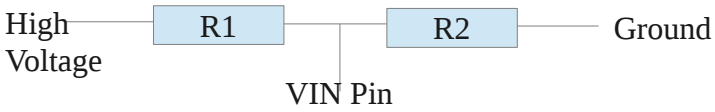
VOLTAGE=RAWADC * VMUL / VDIV

Reading Low Voltages (0-3.3V)

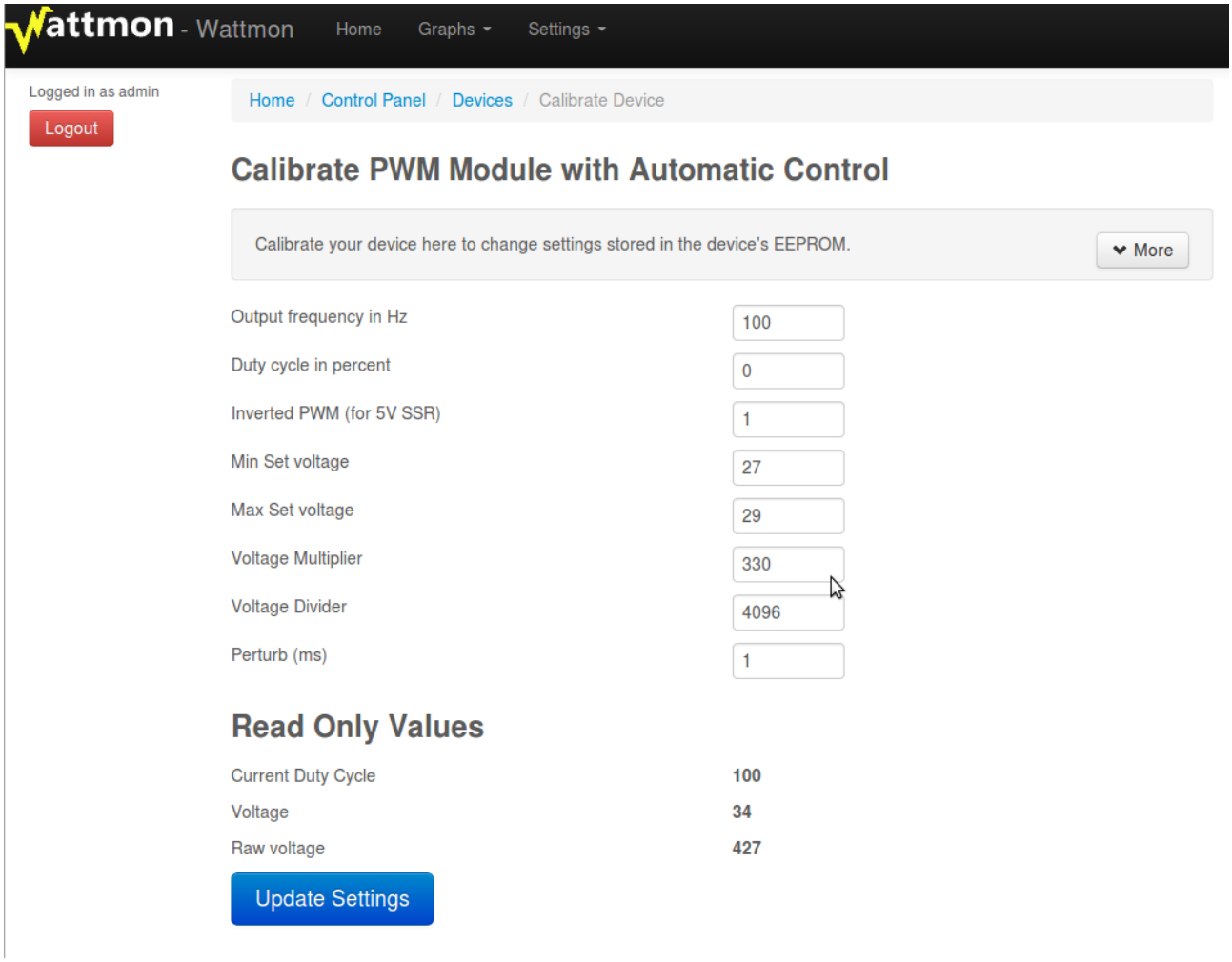
In order to get an accurate voltage reading, set VMUL to 330 and VDIV to 4096. This will result in a calibrated VOLTAGE value of 330 for 3.3V.

Reading High Voltages (0-320V DC)

Use a resistor divider between the high voltage input and ground.



Use a value of 100K ohms for R1 and 1K ohms for R2 to ensure that at 320V DC the input voltage at the VIN pin does not exceed 3.3V DC. The voltage at VIN will be equal to:
High Voltage * R2 / (R1 + R2)
For an input voltage of 333V DC, VIN will equal 3.29V DC (333 * (1000/(1000+100000))
Therefore, the ratio is approximaly 100 times. Enter 330 for VMUL and 4096 for VDIV and check the resulting value. In Wattmon, you can do this from the device calibration page.
Double check the reading with a multimeter and adjust VMUL until your reading matches, this may vary slightly from device to device.



Calibration page in wattmon showing calibration registers and live input values.

Setting up Automatic Control

In order to activate the automatic duty cycle control mode, set the Min Set Voltag and Max Set Voltage registers. A practical example of this would be to activate a dump load on a wind turbine automatcally when the voltage goes to high using a solid state relay.

A schematic of this is shown below.

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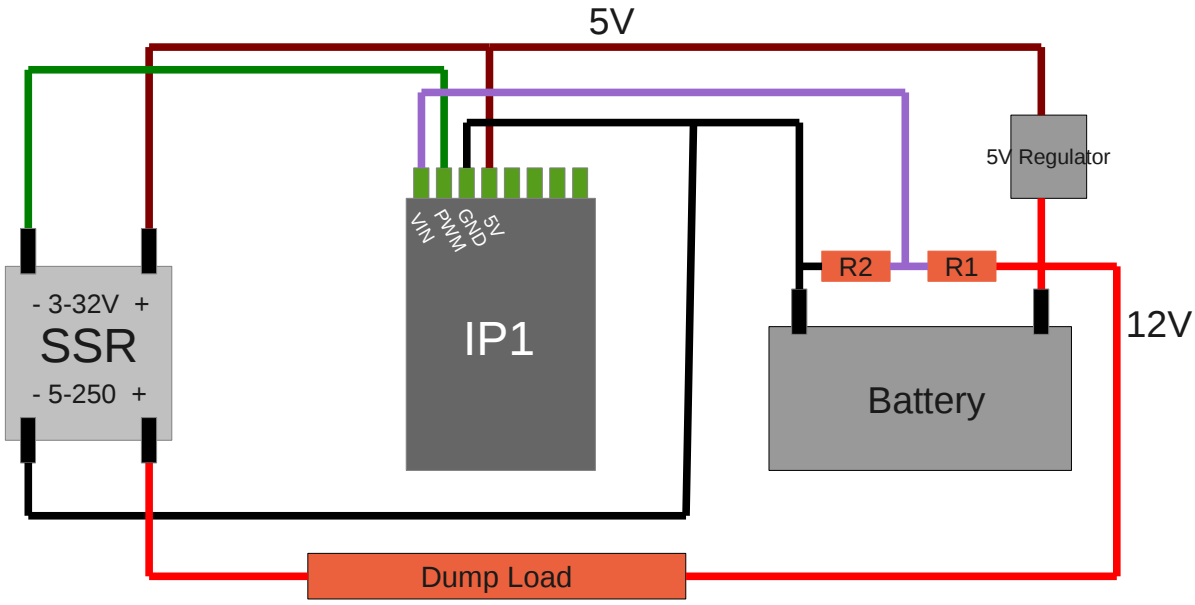

Connecting an SSR with dump load and voltage sense input

The SSR is connected between the 5V input and the PWM output. This is because the SSR may not properly switch on at 3V DC, so connecting it this way and setting the INVERTED option to 1 fixes the problem. The voltage divider resistors R1 an R2 should be set so as to ensure the voltage at the VIN pin never exceeds 3.3V DC, there is no internal circuit protection to prevent damage in case it is connected wrongly. A low cost regulator such as the 7805 could be used for up to 24V DC.
In this setup, once the voltage is calibrated properly, you could automatically increase the PWM frequency as the voltage goes above a preset value such as 14V and reduce the PWM duty cycle when it goes below 13V. This way you would have a self regulating dump load which would keep battery voltage below the absolute max. You could use a frequency of 100 to 300 Hz on such a system.