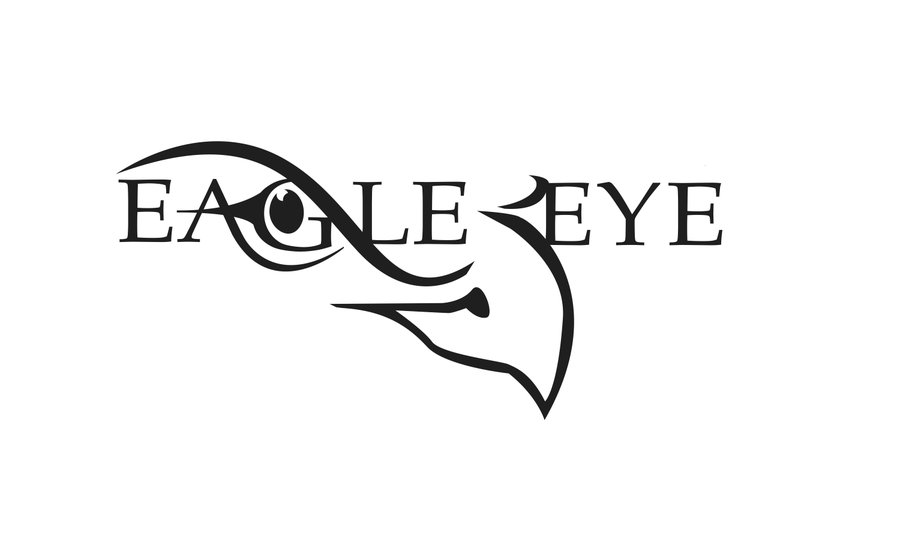
**Power Monitor**



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# Overview

Eagle Eye energy monitoring system is developed by Thermo Dynamics Ltd. It is used to monitor energy consumption of a variety of electrical appliances. This board uses split-core AC current transducers and is able to collect current reading form up to 8 loads simultaneously. To start working with the board, one of the current transducers can simply be clamped around Black or Neutral wire. After Wi-Fi link to local network is establish, the board will automatically provide AC current readings. Additional components have been added to original Eagle Eye board design.

Following is a list of specifications and features that this system provides:

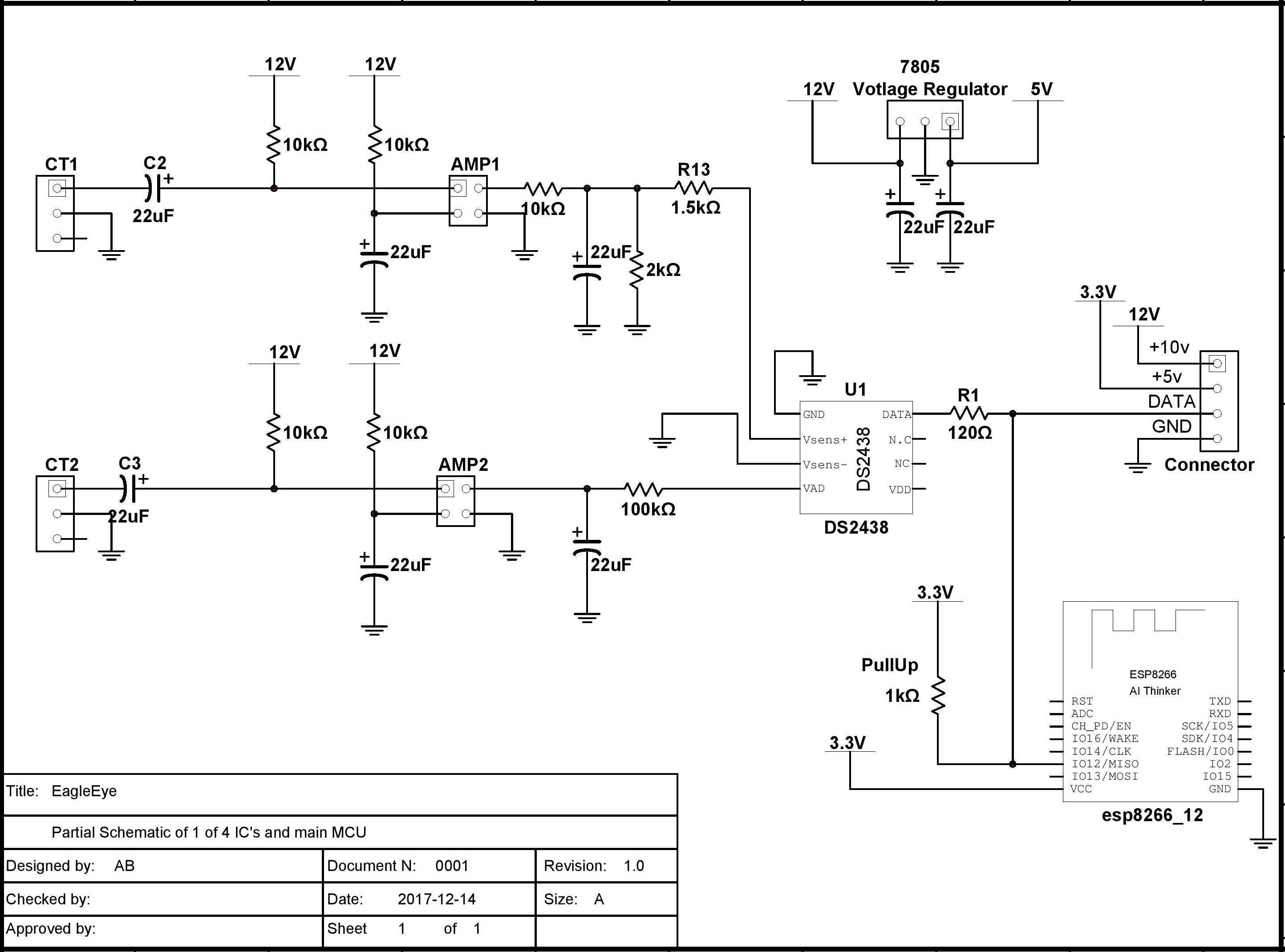
* Maximum current per CT: 30A (maximum load 3.6kW)
* Voltage regulation: 10-24v input
* Error: 5%
* Sample rate: 1 second
* Temperature Readings
* Wi-Fi Communication with Internet of Things server

Microcontroller that is used in this system is integrated with Wi-Fi communication module. This allows for data to be viewed and stored remotely. Since main user interface of this system is located on a remote server, wireless network communication must be established in the first place. Once module has the SSID and password of the router, the module will communicate with IoT server using MQTT protocol.

# Components

|  |  |
| --- | --- |
| Current Transducers | 30A split-core current transformers (3.5mm Jack) |
| DS2438 | Smart Battery Monitor manufactured by Maxim (OneWire interface) |
| LM7805 | Voltage regulator ( input: 6-24v output: 5v) |
| Esp8266 | Wi-Fi Microcontroller from adafuit industries. [Link](https://learn.adafruit.com/adafruit-huzzah-esp8266-breakout/overview) |

# Circuit Diagram



This is a partial diagram that represents the connection of two CTs, DS2438 and ESP8266. Input from the CT’s is represented on the left corner, where the 3.5mm Audio Jack is split into 3 connection lines. Signal from the CT’s is fed into Op Amp/Comparator where it gets amplified (AMP1, 2) before entering resistor network. DS2438 IC has two channels for voltage readings – **Vad** and **Vsense+**.   
First channel is used to feed reading directly to general purpose Analog to Digital voltage converter in the IC. For this channel a Low Pass filtering system on the input is built (22uF and 100Ohm).  
Second channel is used to read current, hence, a voltage divider and a shunt resistor (2kOhm) is used to convert CT current readings into voltage.  
Output of DS2438 is red by ESP8266 through OneWire data bus with a pull-up resistor of 1kOhm.  
Additionally, LM7805 voltage regulator is implemented to step down the input voltage to 5v.

# Communication

In order to view data remotely, Eagle Eye needs to be connected to a local network via Wi-Fi. This network must have gateway to the web and allow traffic on port 1883, which is enabled by default in most networks. Port forwarding in not necessary since Eagle-Eye is the one who initiates conversation with the server (Outgoing traffic).   
Eagle-Eye uses MQTT protocol to communicate with IoT server at [aerlab.ddns.net](https://aerlab.ddns.net). Sensor reading from the board are being sent to the server, where they are displayed and stored in the database. MQTT is the core infrastructure that allow IoT data exchange freely on the net. This protocol uses a simple messaging system of publish/subscribe, where each message has associated topic. And similar to a magazine distribution system, when a client subscribed to a specific topic, he gets all new updates.  
  
In MQTT, devices publish and subscribe to various topics. Any devices, such as mobile phones, microcontrollers or personal computers, can publish or subscribe to data. Eagle Eye is preprogrammed to post the following Topics to MQTT Broker – aerlab.ddns.net:

* Home/EnergyMonitor/EagleEye/Current/Data/CT1
* Home/EnergyMonitor/EagleEye/Current/Data/CT2
* Home/EnergyMonitor/EagleEye/Current/Data/CT3
* Home/EnergyMonitor/EagleEye/Current/Data/CT4
* Home/EnergyMonitor/EagleEye/Current/Data/CT5
* Home/EnergyMonitor/EagleEye/Current/Data/CT6
* Home/EnergyMonitor/EagleEye/Current/Data/CT7
* Home/EnergyMonitor/EagleEye/Current/Data/CT8
* Home/EnergyMonitor/EagleEye/Temperature/Data/Average
* Home/EnergyMonitor/EagleEye/Current/Status/DeviceCount

**CT** topics are used to post current reading from the specified Current Transducer with double precision.   
**Average** topic is used to transmit average temperature collected from all 4 DS2438 IC’s.  
**DeviceCount** topic specifies the number of CT’s connected to loads and currently monitoring power consumption. When CT current readings reach certain preprogrammed threshold, it is counted as active by the MCU and added to device count.

# Mobile App

MQTT messaging system allows the use of a mobile app for data monitoring. Since all messages are being broadcasted across the MQTT network, all that’s necessary is for a phone to join the network and listen to the topics.

1. Download any free MQTT apps for Android or Apple IOS
2. Join the broker, address:**aerlab.ddns.net**, port:**1883**, user: **aerlab**, pass: **server**
3. Create widgets and subscribe to the topics mentioned above and in UI section

Note: Please to not publish information to Eagle Eye Data topics as that will interfere with data being stored in the database.

# User Interface

Eagle Eye’s user interface can be using the following link:   
[aerlab.ddns.net](https://aerlab.ddns.net) -> Smart Network -> Energy Monitor  
username: aerlab  
password: server