Networking Enhancement
for a GM1358 Sound Level Meter
(the swiss army knife)

Digest

There is a large choice of sound pressure level meters on the market, from pretty cheap to awfully expensive ones.
The cheap ones have frequently a sufficient accuracy for many purposes (albeit not being suitable for a legal enforcement). Most of them have however either no, or extremely primitive reporting abilities.

The purpose of this development is to provide networking and reporting abilities as close to IEC 61672-1:2013 specifications as possible to an extremely cheap sound pressure level meter GM1358, by adding a ESP8266 WiFi microcontroller to it.

In the first variant sound pressure level meter + WiFi adapter + Online Dashboard the total value of the bill of material will be below 30€ !seitenzeh

The ESP8266 microcontroller will be small enough to fit into the original case of the GM1358 and the requested soldiering will be limited to three wires.
With soldiering skills, you can do the job in less than 10 minutes.

Your modified GM1358 will then provide USB and WiFi connectivity and be programmable to do the coolest things that only high-end devices will provide:

Evaluate the noise level according to following time response standards (simultaneously):

- Fast
- Slow
- Impulse
- Real peak value by the minute (not the maximum of readings)

Statistics according to residential aircraft noise standards:

(steady noise equivalents)

- Leq 1 minute
- Leq for each hour of the day
- Leq for 24h
- Leq daytime 06:00 to 22:00
- Leq nighttime 22:00 to 6:00
- Leq 22:00 to 24:00
- Lden

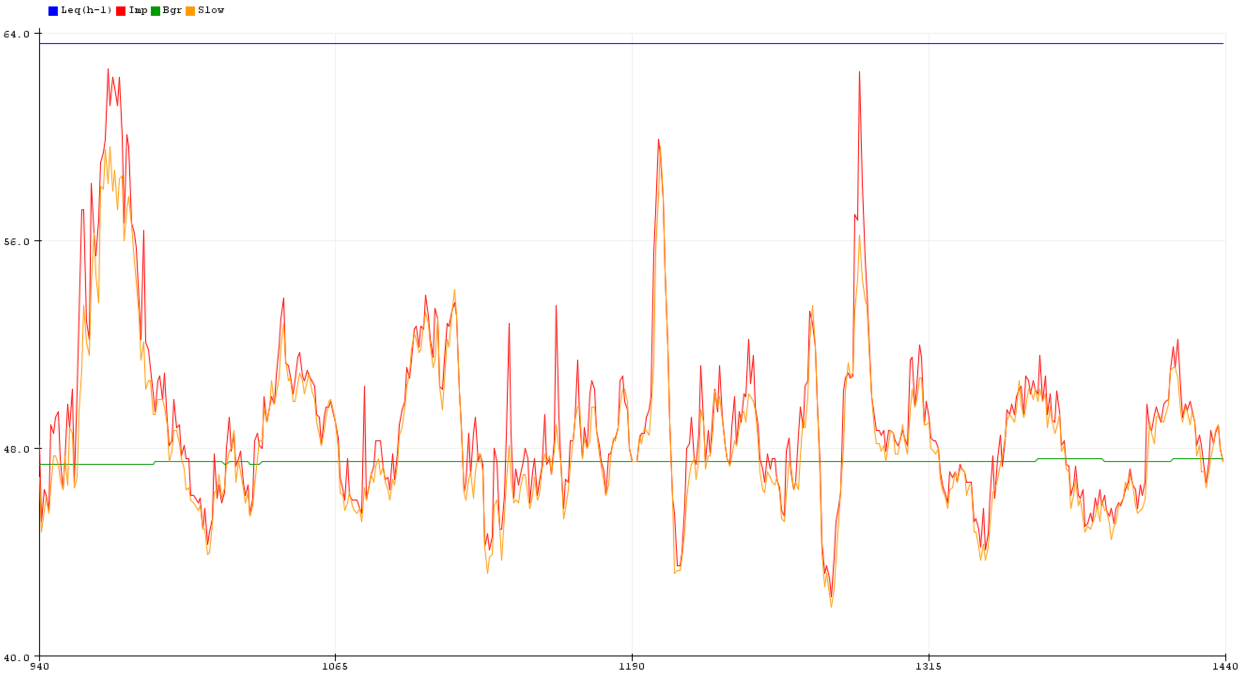
(number above threshold)

- NAT for each hour of the day
- NAT for 24h
- NAT daytime 06:00 to 22:00
- NAT nighttime 22:00 to 6:00
- NAT 22:00 to 24:00

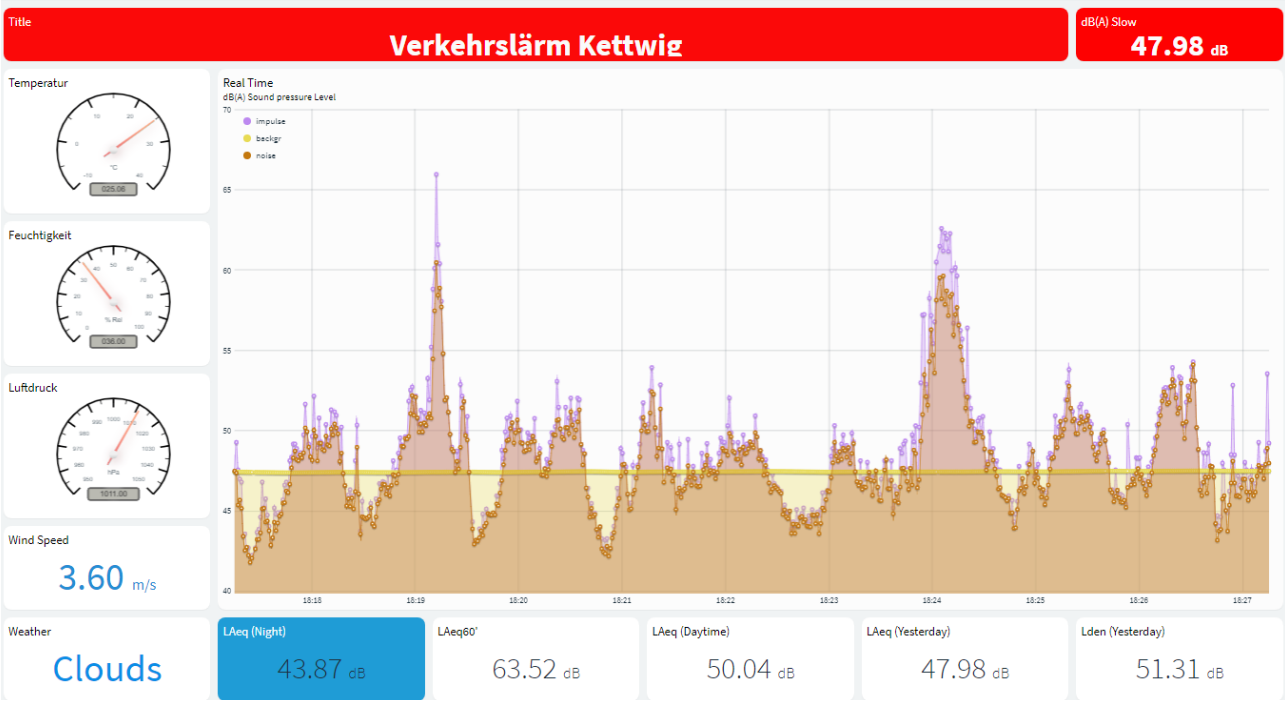
Additionally the program can grab weather information from openweathermap.org and provide the corresponding meteorological conditions.

a) You can report all this information over the USB port using a terminal program or the Serial Monitor of the Arduino IDE.
Over the Serial Plotter you can get a graphical output of the noise evolution history:

USB Plotter from the Arduino IDE:



You then can also register free to the Cloud service Thinger.io to plot noise information like the best professional devices:
Usage with Thinger.io with noise and weather report:



Title

Verkehrslärm Kettwig

dB(A) Slow

47.98 dB

Temperatur

Feuchtigkeit

Luftdruck

Wind Speed

3.60 m/s

Weather

Clouds

LAeq (Night)

43.87 dB

LAeq60'

63.52 dB

LAeq (Daytime)

50.04 dB

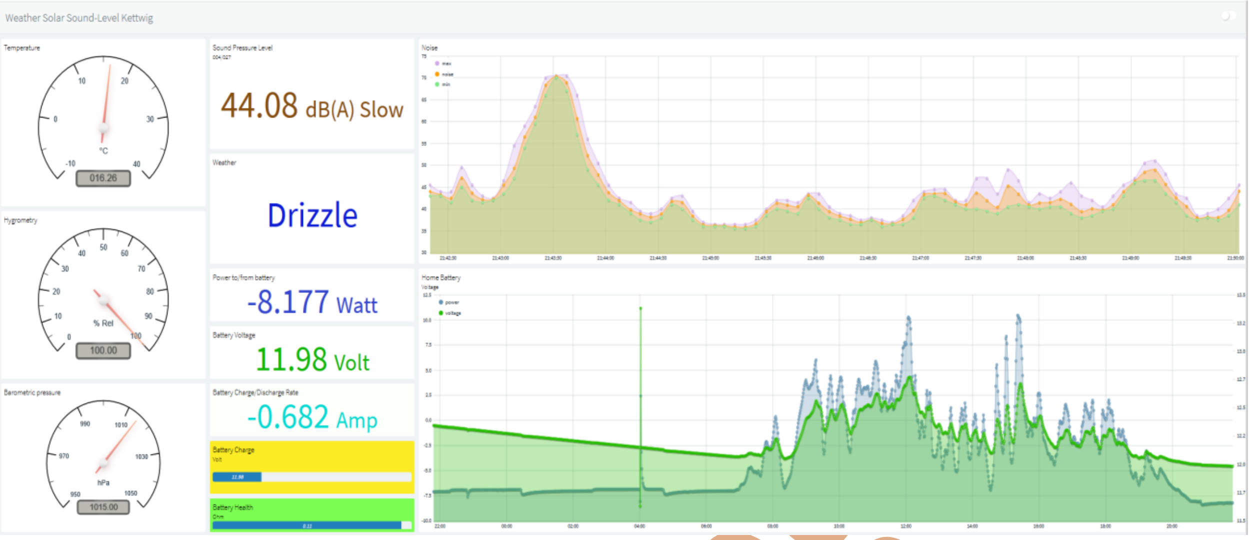
LAeq (Yesterday)

47.98 dB

Lden (Yesterday)

51.31 dB

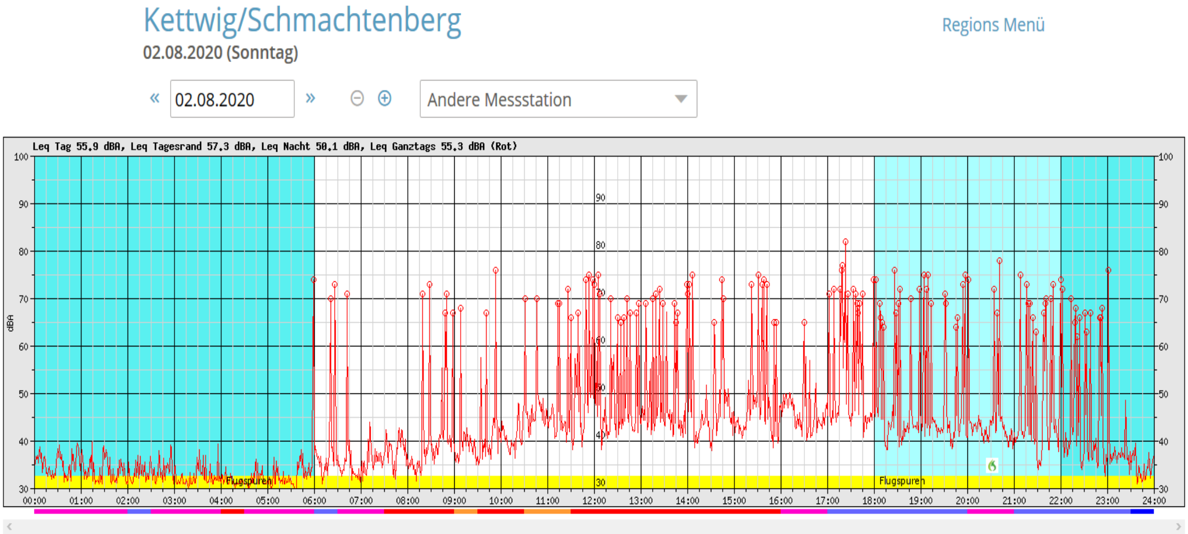
With a little more hardware and a separate casing, you may also build the system with the ability to be solar powered including a solar power monitor to report all information about the battery condition and the power fed by the solar panel.
You will then operate the system without electrical connection to your computer, using the Cloud service Thinger.io.
Full extension with weather report, solar power report, noise level (needs extra hardware):



You can also build a split system with the SPL meter (+ the solar power circuitry) being located outside gathering and transmitting the sound (and battery) values over WiFi/ UDP (Long Range LoRa is planned) to another bare ESP8266 located inside that will provide the statistics over USB.

Last but not least, and back to the historical roots of the whole concept, the system is able to transmit over USB a single byte per second according to a proprietary "AK-Modulbus protocol" to a feeder program running e.g on a Raspberry Pi forwarding hourly reports to the European aircraft noise network . http://www.eans.net/EANSindex.php
This network is providing a very long time lobby-independent storage of aircraft noise information managed by residentials, totaling about 700 privately and communal operated noise stations throughout Europa.

Example of a noise record from DFLD/EANS.


Kettwig/Schmachtenberg
02.08.2020 (Sonntag)
Regions Menü
« 02.08.2020 » ⊖ ⊕ Andere Messstation ▼
Leq Tag 55,9 dBA, Leq Tagesrand 57,3 dBA, Leq Nacht 50,1 dBA, Leq Ganztags 55,3 dBA (Rot)

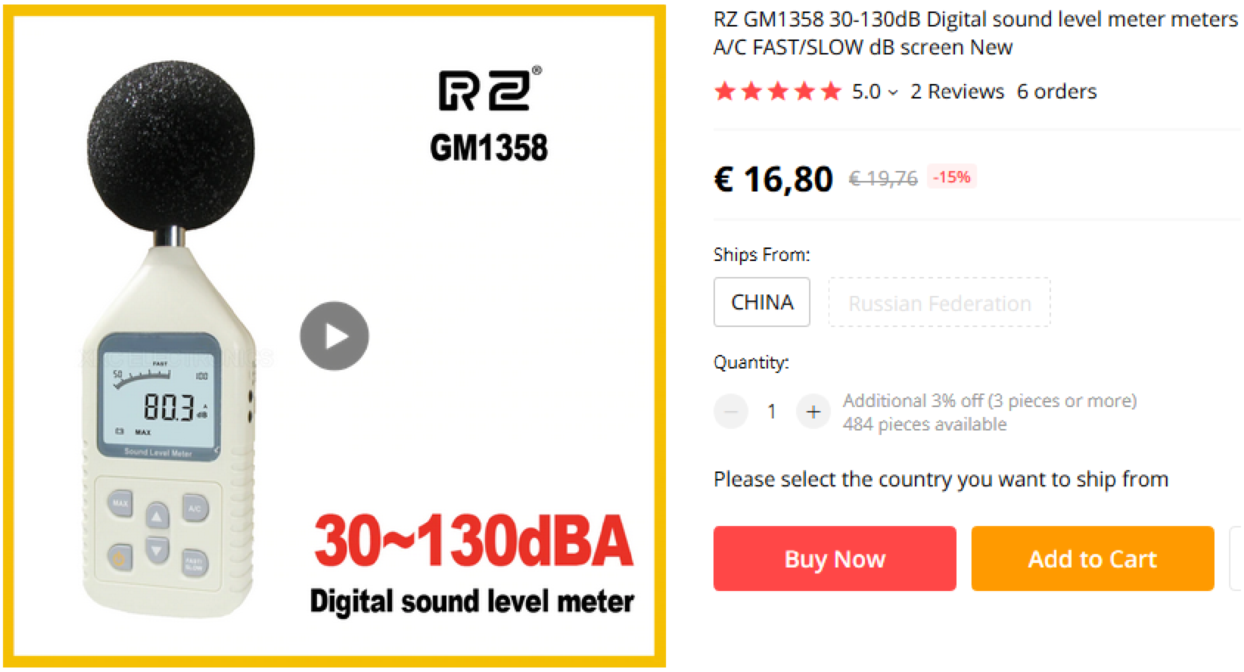
Energy considerations

The built-in 9V alkaline battery block, provides about 24 hours of operation (@ 11mA).
With the retrofitted ESP8266 the total consumption will be about 48 mA, which will drain the battery block within about 8 hours only.
Fortunately, you can also power the system over the USB socket of the ESP8266 and provide over two days of continuous operation from a 3000mA lithium 18360 battery.

If you want a 24/24/365 off-grid operation on solar power, depending on your location (e.g. at a 45° latitude) you will need a 12V 30Ah battery and (at least) a 20W solar panel, you can hardly imagine how little energy such as solar panel still delivers on a rainy winter day!

Bill of material

You will need exactly that model of Sound level meter: GM 1358
Do not order another model!
That one has the unique feature of providing a linear 0..1V DC signal output that is tied to GND and the ability to autostart when powered with 5V.
It can interface with an ESP 8266 with only 3 wires.
You can find some devices on eBay.com, but you will find the best offers on AliExpress to largely varying prices. Anything below 30€ is OK…



RZ GM1358 30-130dB Digital sound level meter meters A/C FAST/SLOW dB screen New

★★★★★ 5.0 2 Reviews 6 orders

€ 16,80 ~~€ 19,76~~ -15%

Ships From:

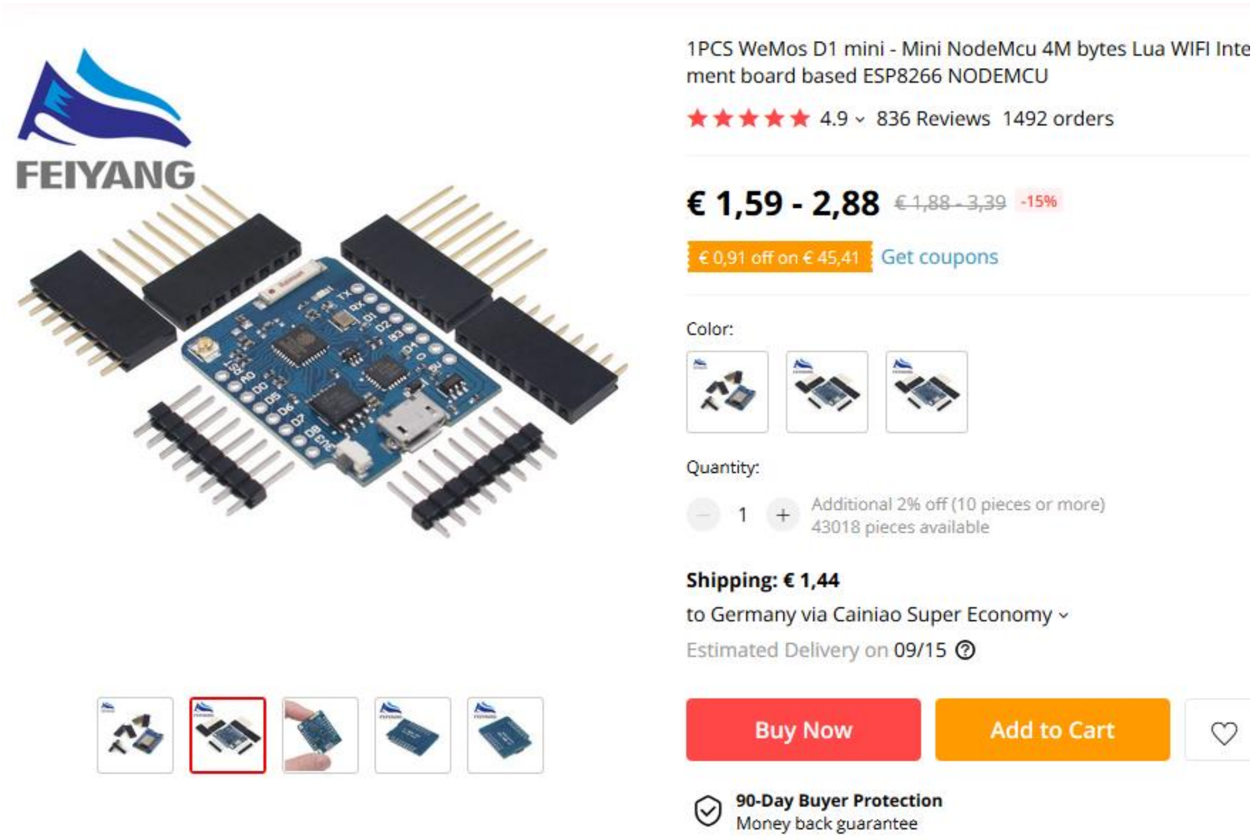
CHINA Russian Federation

Quantity:

− 1 + Additional 3% off (3 pieces or more)
484 pieces available

Please select the country you want to ship from

https://www.aliexpress.com/item/1647511133.html



1PCS WeMos D1 mini - Mini NodeMcu 4M bytes Lua WIFI Inte
ment board based ESP8266 NODEMCU

★★★★★ 4.9 836 Reviews 1492 orders

€ 1,59 - 2,88 ~~€ 1,88 - 3,39~~ -15%

€ 0,91 off on € 45,41 Get coupons

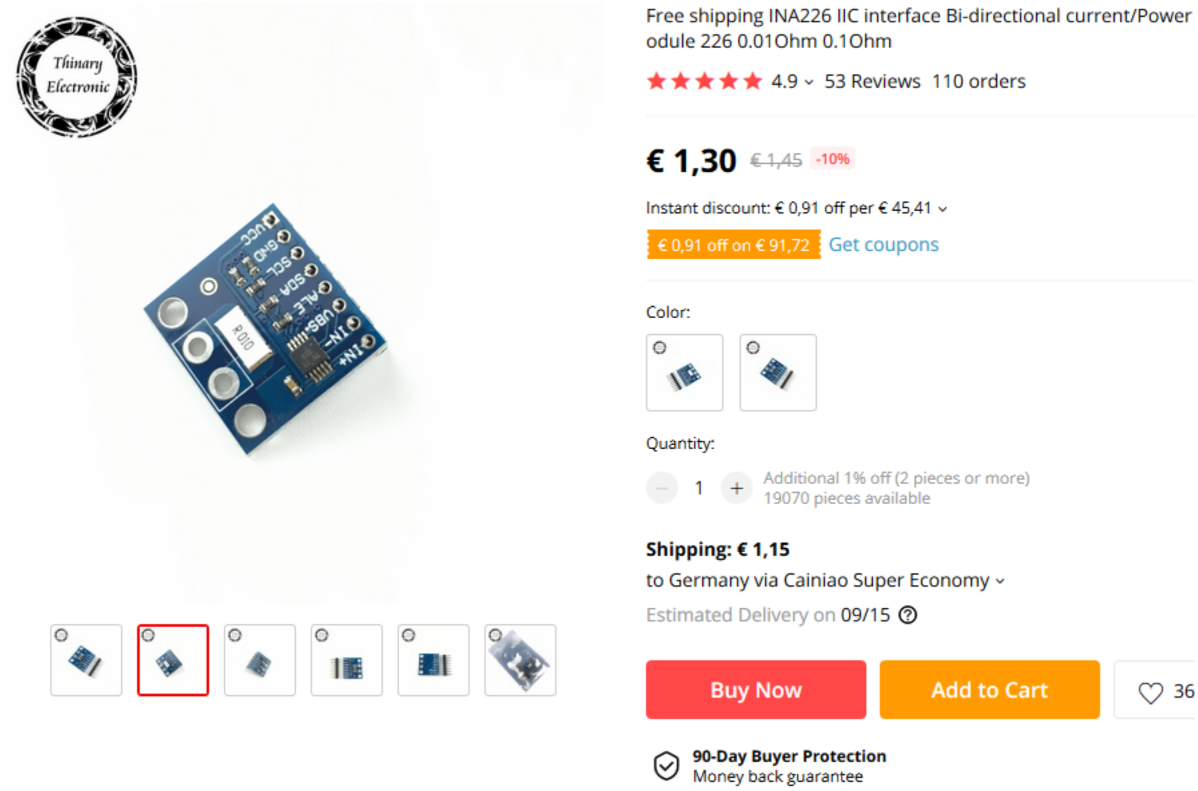
Quantity: 1 Additional 2% off (10 pieces or more)
43018 pieces available

Shipping: € 1,44
to Germany via Cainiao Super Economy
Estimated Delivery on 09/15

90-Day Buyer Protection
Money back guarantee

https://www.aliexpress.com/item/32831353752.html

Option Solar power @ monitoring



Free shipping INA226 IIC interface Bi-directional current/Power odule 226 0.01Ohm 0.1Ohm

★★★★★ 4.9 ⌄ 53 Reviews 110 orders

€ 1,30 ~~€ 1,45~~ -10%

Instant discount: € 0,91 off per € 45,41 ⌄

€ 0,91 off on € 91,72 Get coupons

Color:

Quantity:

– 1 + Additional 1% off (2 pieces or more)
19070 pieces available

Shipping: € 1,15

to Germany via Cainiao Super Economy ⌄

Estimated Delivery on 09/15 ?

90-Day Buyer Protection
Money back guarantee

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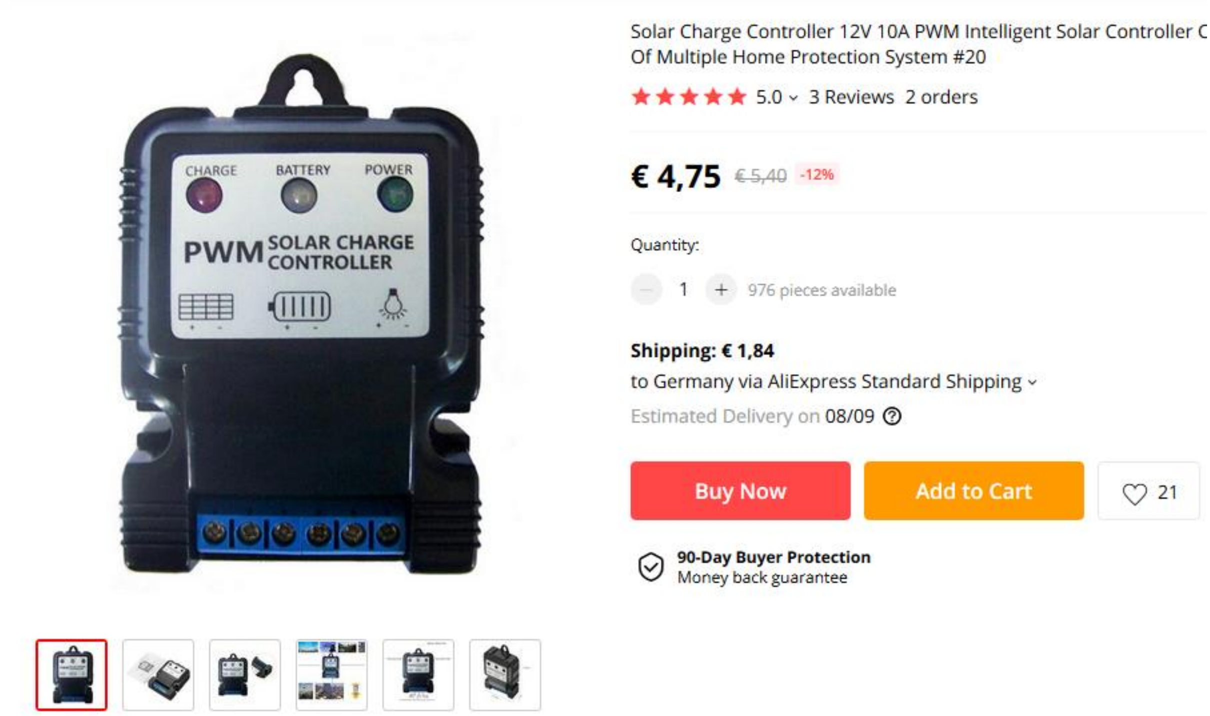


Solar Charge Controller 12V 10A PWM Intelligent Solar Controller C Of Multiple Home Protection System #20

★★★★★ 5.0 ⌄ 3 Reviews 2 orders

€ 4,75 ~~€ 5,40~~ -12%

Quantity:

– 1 + 976 pieces available

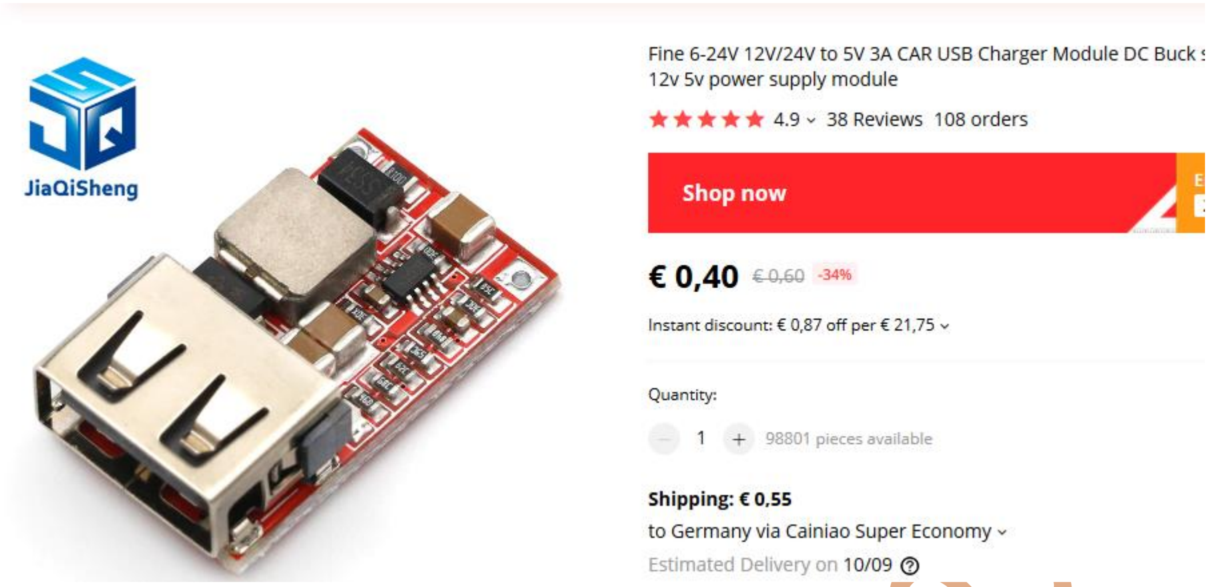
Shipping: € 1,84

to Germany via AliExpress Standard Shipping ⌄

Estimated Delivery on 08/09 ?

90-Day Buyer Protection
Money back guarantee

https://www.aliexpress.com/item/4000083888167.html



Fine 6-24V 12V/24V to 5V 3A CAR USB Charger Module DC Buck s
12v 5v power supply module

★★★★★ 4.9 ⌄ 38 Reviews 108 orders

Shop now

€ 0,40 ~~€ 0,60~~ -34%

Instant discount: € 0,87 off per € 21,75 ⌄

Quantity:

− 1 + 98801 pieces available

Shipping: € 0,55

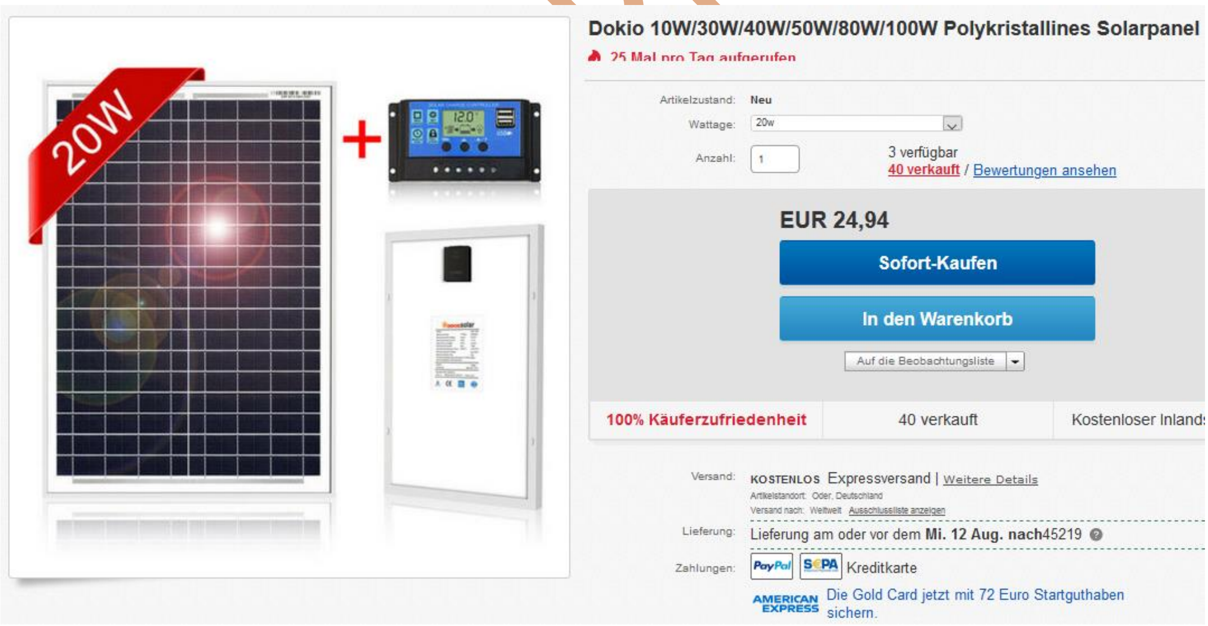
to Germany via Cainiao Super Economy ⌄

Estimated Delivery on 10/09

Order a **12V 12Ah or more lead acid battery** and a **20W or more solar panel** locally.

Take care to order solar suited batteries and solar panels with a glass front and an aluminum frame. Avoid cheap solar stuff with resin front, they will decay within a few months in bright sun.

Here are some examples from Germany:



Dokio 10W/30W/40W/50W/80W/100W Polykristallines Solarpanel

25 Mal pro Tag aufgerufen

Artikelzustand: **Neu**

Wattage: 20w

Anzahl: 1

3 verfügbar
40 verkauft / Bewertungen ansehen

EUR 24,94

Sofort-Kaufen

In den Warenkorb

Auf die Beobachtungsliste

100% Käuferzufriedenheit | 40 verkauft | Kostenloser Inlands

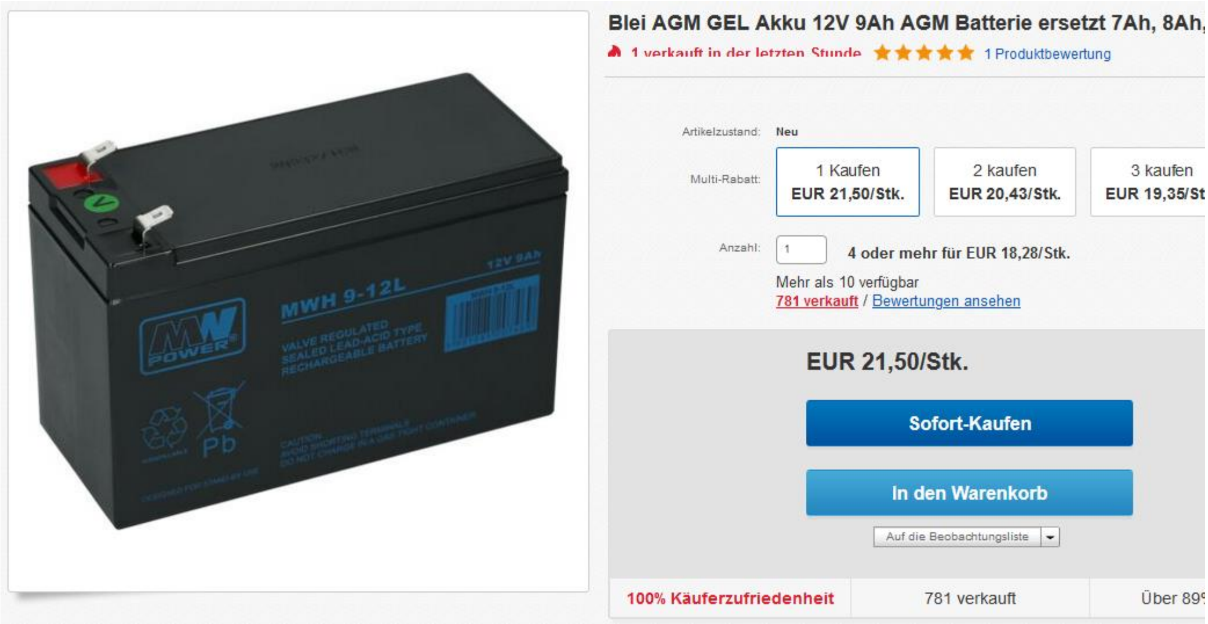
Versand: KOSTENLOS Expressversand | Weitere Details
Artikelstandort: Oder, Deutschland
Versand nach: Weltweit Ausschlussliste anzeigen

Lieferung: Lieferung am oder vor dem **Mi. 12 Aug. nach**45219

Zahlungen: PayPal SEPA Kreditkarte

AMERICAN EXPRESS Die Gold Card jetzt mit 72 Euro Startguthaben sichern.

(this combo-offer already includes the solar controller and even the USB 5V power supply)



Blei AGM GEL Akku 12V 9Ah AGM Batterie ersetzt 7Ah, 8Ah,

1 verkauft in der letzten Stunde ★★★★★ 1 Produktbewertung

Artikelzustand: Neu

Multi-Rabatt:	1 Kaufen EUR 21,50/Stk.	2 kaufen EUR 20,43/Stk.	3 kaufen EUR 19,35/St

Anzahl: 1 4 oder mehr für EUR 18,28/Stk.

Mehr als 10 verfügbar
781 verkauft / Bewertungen ansehen

EUR 21,50/Stk.

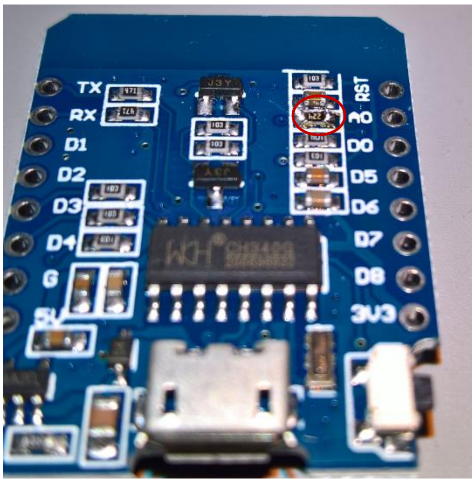
100% Käuferzufriedenheit | 781 verkauft | Über 89

You may use an existing car battery if you have one in acceptable condition, but do not buy one: car batteries are not optimized for longer periods of operation with a voltage below 13,8v.

Modification

The GM1358 is easy to dismantle, remove 4 screws: 2 at the top and 2 in the battery compartment and you can open the casing.

The first thing might sound scaring but it is easier as it looks: we need to bridge one very tiny resistor on the ESP8266 to change the input range from 0..3.3V to 0..1V.



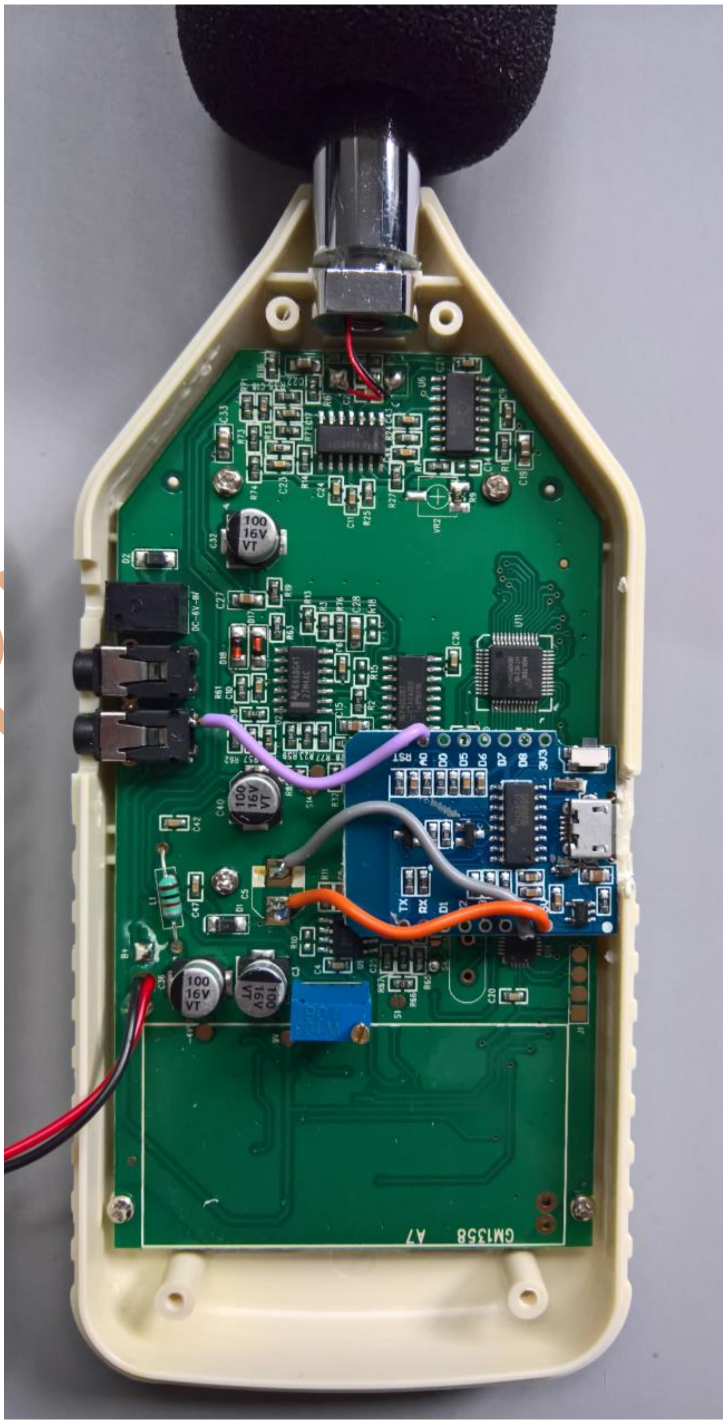
Take a single strand of electrical wire and solder it to bridge the resistor close to A0 as shown:

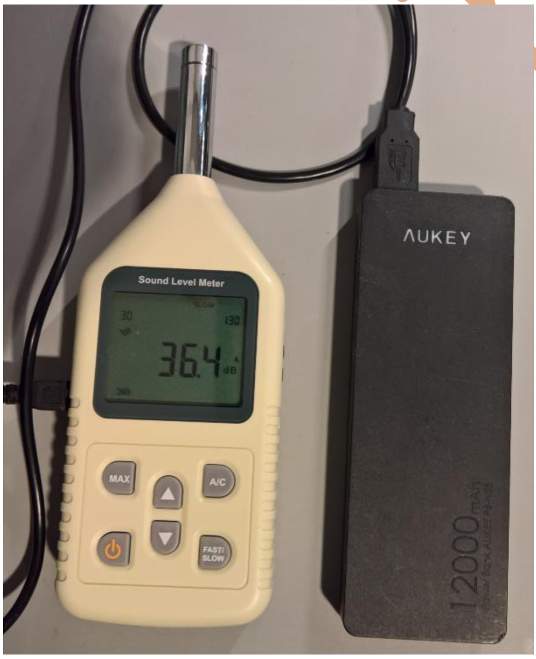
Solder the grey wire to GND and the pad on the PCB board, solder the orange wire to GND and the pad on the PCB board, solder the pink wire to A0 and the inside contact of the DC jack

Grind the plastic case to free room for the USB plug.

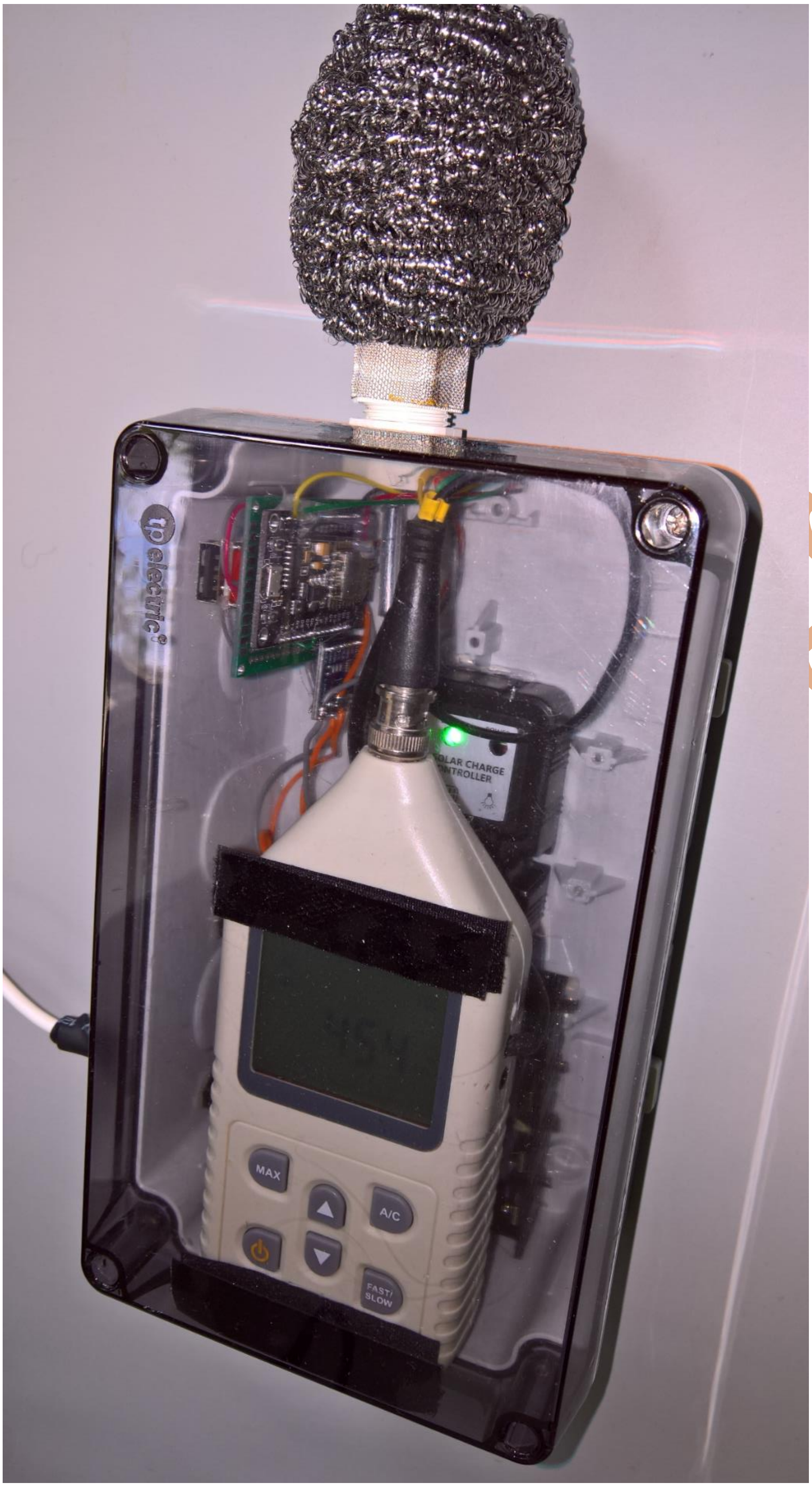
Glue the ESP8266 as shown.

Screw the case back. Done!





Outdoor / Solar Version



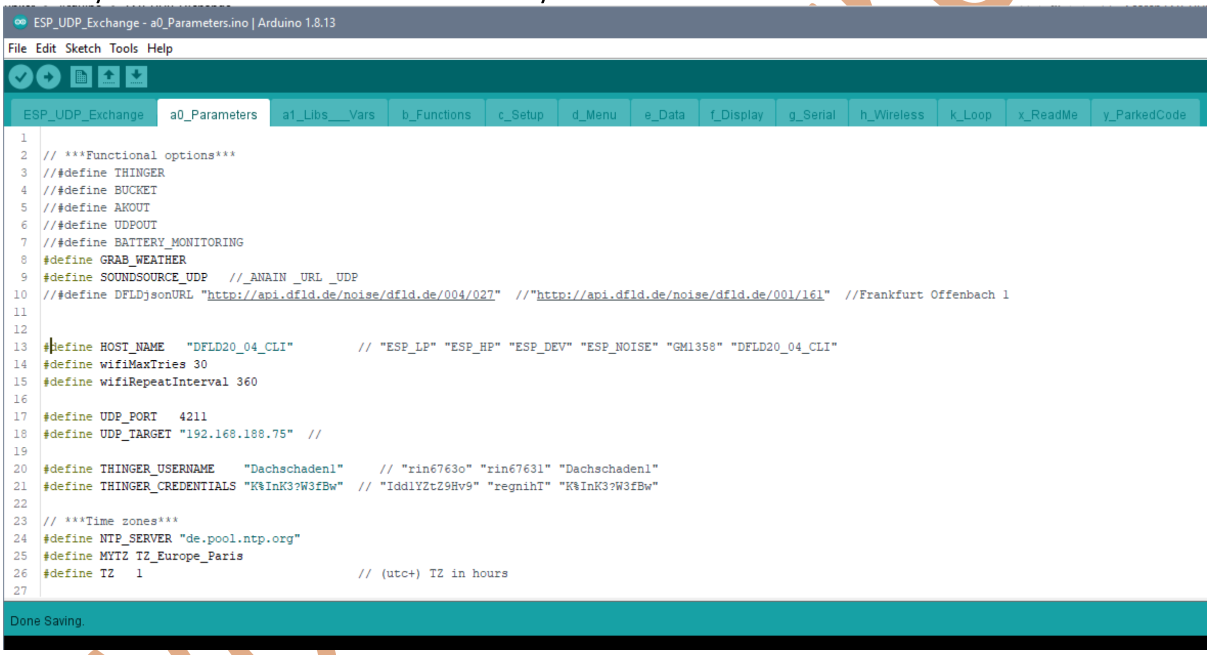
I will describe this version in detail later…

Software

To operate the noise station you will need a WLAN connection and internet connectivity.
You will need to upload the program to the ESP 8266. For that, if you don't have it already, you should install the Arduino programming Interface (IDE) from www.arduino.cc <http://www.arduino.cc>, on your favourite PC, and then install the ESP framework.
Cf: https://randomnerdtutorials.com/installing-the-esp32-board-in-arduino-ide-windows-instructions/

Optionally you could register to two free services:
The first step will be to create a free account at www.thinger.io <http://www.thinger.io> (you can manage two devices free of charge) and optionally create a free account at www.openweathermap.org <http://www.openweathermap.org> if you want to get weather information for your location.

The current files required are hosted on GitHub:
https://github.com/rin67630/Swiss-Army-Knife-for-GM1380-Sound-Pressure-Meter
You may download all .ino files in a folder of your choice and start the Arduino IDE:



```

// ***Functional options***
//#define THINGER
//#define BUCKET
//#define AKOUT
//#define UDPOUT
//#define BATTERY_MONITORING
#define GRAB_WEATHER
#define SOUNDSOURCE_UDP   //_ANAIN _URL _UDP
//#define DFLDjsonURL "http://api.dfld.de/noise/dfld.de/004/027"  //"http://api.dfld.de/noise/dfld.de/001/161"  //Frankfurt Offenbach 1


#define HOST_NAME    "DFLD20_04_CLI"         // "ESP_LP" "ESP_HP" "ESP_DEV" "ESP_NOISE" "GM1358" "DFLD20_04_CLI"
#define wifiMaxTries 30
#define wifiRepeatInterval 360

#define UDP_PORT    4211
#define UDP_TARGET "192.168.188.75"  //

#define THINGER_USERNAME    "Dachschaden1"     // "rin6763o" "rin67631" "Dachschaden1"
#define THINGER_CREDENTIALS "K%InK3?W3fBw"  // "Idd1YZtZ9Hv9" "regnihT" "K%InK3?W3fBw"

// ***Time zones***
#define NTP_SERVER "de.pool.ntp.org"
#define MYTZ TZ_Europe_Paris
#define TZ   1                          // (utc+) TZ in hours

```

Done Saving.

I have built the program on my framework ESP-Krarajan on GitHub:https://github.com/rin67630/ESP-Karajan , which takes care of ancillary tasks like, booting to the network and providing scheduling and timing functionalities.

The Arduino IDE provides tabs to split the program into well-structured subparts, so you can jump easily during development between every subpart:

a0) the parameters and options to use the program (the only part you need to modify)
a1) the libraries and global variables used
b) the different functions used in the program
c) the setup process
d) the menu
e) the data processing
f) the display (not used here...)
g) the serial reports

h) the wireless processes
k) and finally the scheduler itself which will periodically start the routines listed from d) to h).

Additionally two tabs with comments only are added for convenience:
x_ReadMe and y_ParkedCode, where you can put reminders and code examples.

In my programming style, I deliberately refrain to use too abstract c++ concepts in order to make the program accessible to the majority of people with a minimum of Arduino experience.
I also did put a great attention to comment my code indicating the reason why I have done it in that way.

Thinger and OpenWeatherMap credentials.
Then compile the program and upload it over the USB cable.

USB-Serial Menu

The Software provides a simple “single character” command-line menu over the USB serial line.
Commands are given by a single character and executed over [return]
Commands are stackable: you can give several characters then [return]; every command:
Example: U+++ means: Apply 94&47dB Defaults and Increase Offset by 3dB
Usually an upper case letter sets the function and the lower case reset the function.

Control actions

'Z': //Reset the ESP device
'C': //Apply 94dB Calibration
'c': //Apply 47dB Calibration
'U': //Apply 94&47dB Defaults
'+': //Increase Offset by 1dB
'-': //Reduce Offset by 1dB

Control Display

(yet to be re-implemented, would need a display, Thinger is more powerful)
'0': //Display mode 0
…
'3': //Display mode 3

Periodical reports over the USB serial line

'A': //serialPage AK
(this is not a printable report, it issues one byte every second to feed the DFLD website)

'P': //Periodical Reports on 'p': //Periodical Reports off

Options for periodical reports:

'D': //Day Report	'd': //no Day Report
'H': //Hour Report	'h': //no Hour Report
'M': //Minute Report	'm': //no Minute Report
'S': //Second Report	's': //no Second Report
'N': //NAT Report	'n': //no NAT Report

Example1 : PDHmsN	means: Print Daily, Hourly, no minute, no second, NAT reports
Example 2: p	means: stop printing reports.
Example 3: P	means: resume printing reports with last options
Example 4: Sd	means: now with Second reports without Daily reports.

One shot reports

'L': //serialPage Leq
'B': //Battery Report (Ah history)
'b': //Battery Report (Current)

'?': //List parameters
'~': //List WLAN / Radio settings.