



Creation of a Jaguar X150 ashtray OBD2 display: Software



Arduino IDE:

The Arduino IDE software is used to write the code which then is uploaded to the ESP32. An Arduino code file has the .ino extension. In the download section the prewritten code is available for download, as is a link to the Arduino software.

When the Arduino software is installed, some actions have to be done in order to recognize the ESP32 board, see [Appendix A](#) for this.

If you are running an operating system older than Windows 10, you'll need the "CP210x USB to UART Bridge VCP" Drivers.

On that webpage are also Windows 10 drivers downloadable, but are not needed since Windows 10 has these drivers built-in.

[Direct download](#) the Arduino IDE software: click on the "Windows Installer, for Windows 7 and up" link. I don't use the app.

Plugins:

In order for the ashtray code to work, some extra libraries need to be installed in the Arduino library.

In [appendix B](#) you'll find an example of how to install a library. There are 2 methods to obtain a library.

From within the Arduino program, or download a ZIP from the Github website.

Needed libraries:

Library	Method (link)
Adafruit GFX	Arduino
ELMDuino	Arduino
SSD1283A	Github
U8g2 for Adafruit GFX	Arduino

Pre-programmed code & uploading:

There is pre-programmed code available in the download section, which can be opened in the Arduino program.

Most of the code should be kept untouched. However, certain areas may be changed to your preferences:

In row 25, the name of the ELM327 dongle is defined. If you use a dongle which has a different name, you can change it there.

In rows 55 - 60 the display units can be changed from metric to imperial.

Row 61 you can define the coolant error temperature (in °C)

Row 62 defines the engine type you have.

In row 64, the "long button press" action can be defined. Below row 48 are the options mentioned.

Once the code is finalized, press the "✓" button to verify, or the "→" button to upload to the ESP32 (assuming you have it connected to your PC).

```
ESP32_OBD2_2_2_0_7 | Arduino 1.8.13
File Edit Sketch Tools Help
[Icons]
ESP32_OBD2_2_2_0_7 $ dsdigital.c ezButton.cpp ezButton.h jaguar.h movingAvg.cpp movingAvg.h
52
53 // DEFINE UNITS:
54
55 int luxMin = 20; // minimum wanted display backlight at night (0 to 255)
56 int unit2 = 1; // "1" = celsius, "2" = fahrenheit
57 int unit1 = 1; // "1" = kilometers, "2" = miles
58 int unit3 = 2; // "1" = Bar, "2" = PSI
59 int unit4 = 2; // "1" = liter, "2" = gallon
60 int unit5 = 2; // "1" = cm, "2" = inch
61 int coolError = 104; // enter the coolant error >= temperature (use only °C)
62 String MotorType = "5.0"; // enter "4.2" or "5.0" or "3.5"
63
64 int DisplayPref = 0; // change to your long button press preference (0 to 14)
65 // 0 = coolant + Voltage
66 // 1 = driving speed
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```

Pre-compiled zip file:

In order to make things easier, the above mentioned code has been pre-compiled, which will run on your computer and uploads the code automatically to the ashtray device. Imperial or metric choices can be made from within this executable. See [Appendix C](#).

Also, if there are problems with the device a “reset” executable is available. This will reset any bonded ELM327 device.

Versions:

The Jaguar XK(R) X150 changed from 4.2 to 5.0 liters in 2009 (Europe). The 5.0 editions have the ability to extract more data from the OBD2 port. These extra data I made available for the ashtray device. These will have static units: PSI, Gallons and Inches.

The 5.0 pre-programmed code cannot be tested by me since I don't own one.

I assume that the 3.5 liter models have similar electronics as the 4.2 models.

See [Appendix D](#) for a comparison.

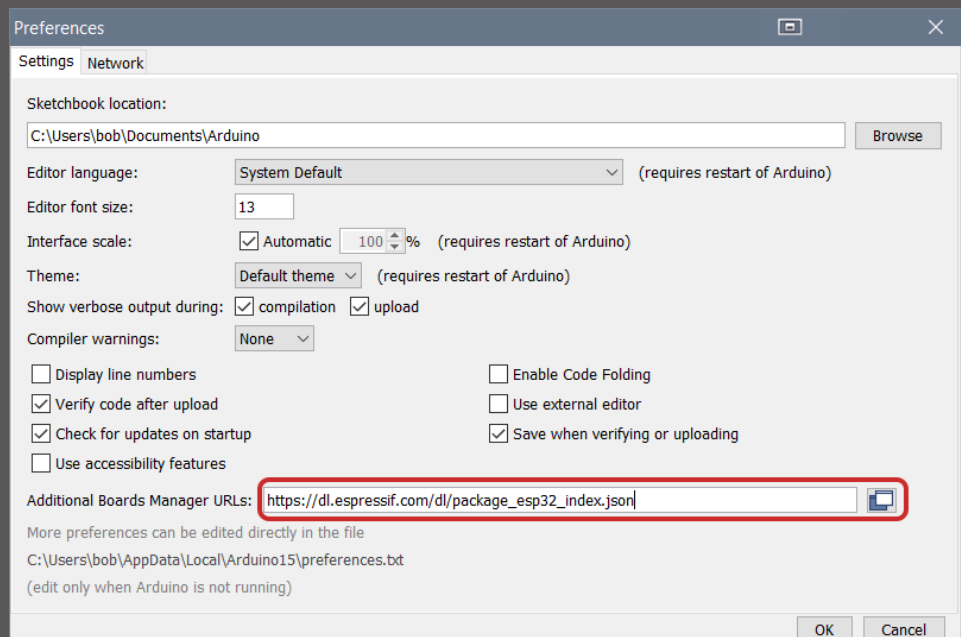
Downloads:

Visit x150.bobhome.nl in order to download all necessities:

- This and other manuals
- 3D printable (zipped) STL files
- PCB Gerber (zip) file
- firmware downloads
- Arduino and ESP32 installation files

Appendix A: Actions in order to recognize the ESP32 board by the Arduino software.

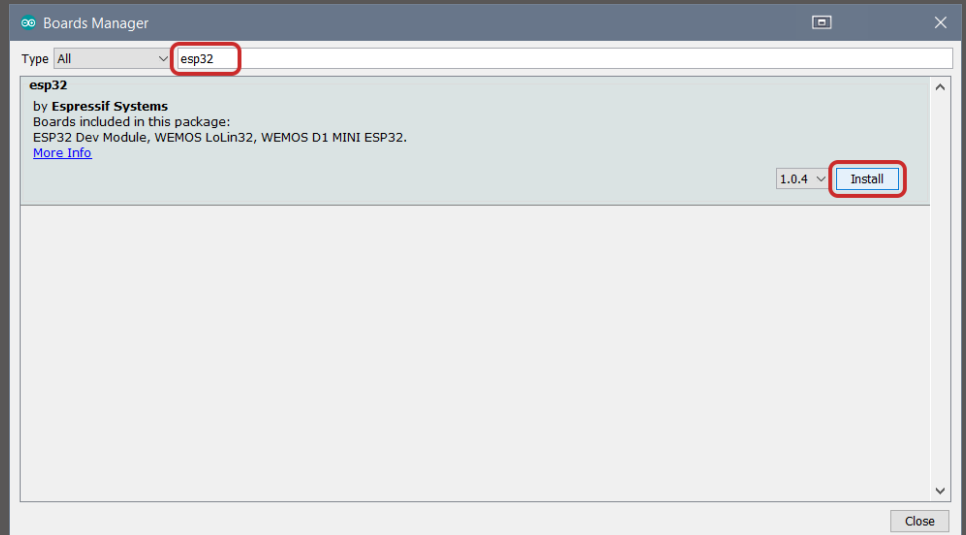
- Open the Arduino software,
- Click on File > Preferences
- In section “Additional Boards Manager URLs” paste the URL: https://dl.espressif.com/dl/package_esp32_index.json and click OK:



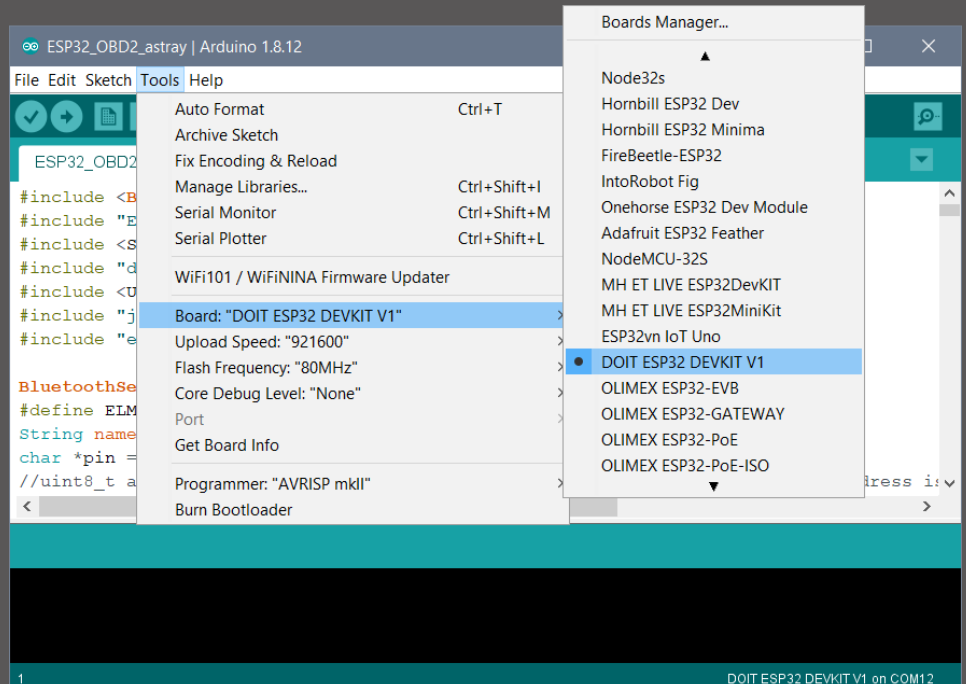


Appendix A continued: Actions in order to recognize the ESP32 board by the Arduino software.

- Open the Boards Manager. Go to Tools > Board > Boards Manager...
- Search for ESP32 and press install button for the "ESP32 by Espressif Systems":

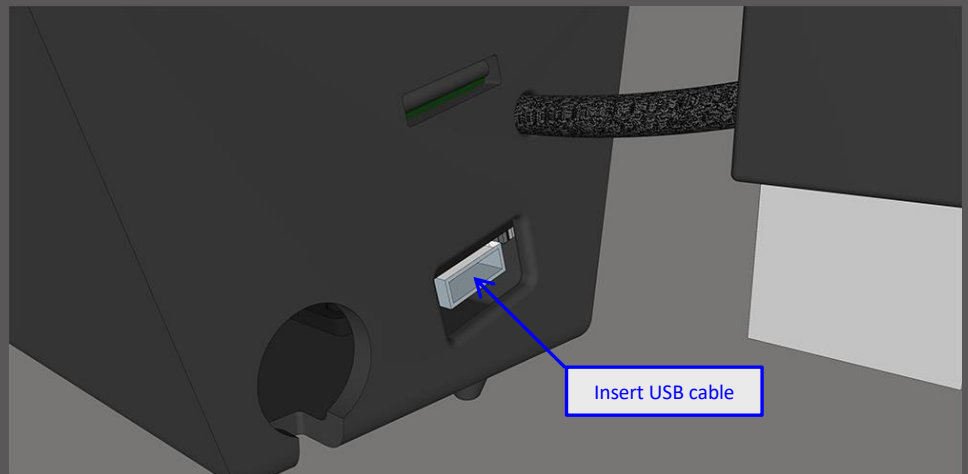


- Select the correct board: Go to Tools > Board >

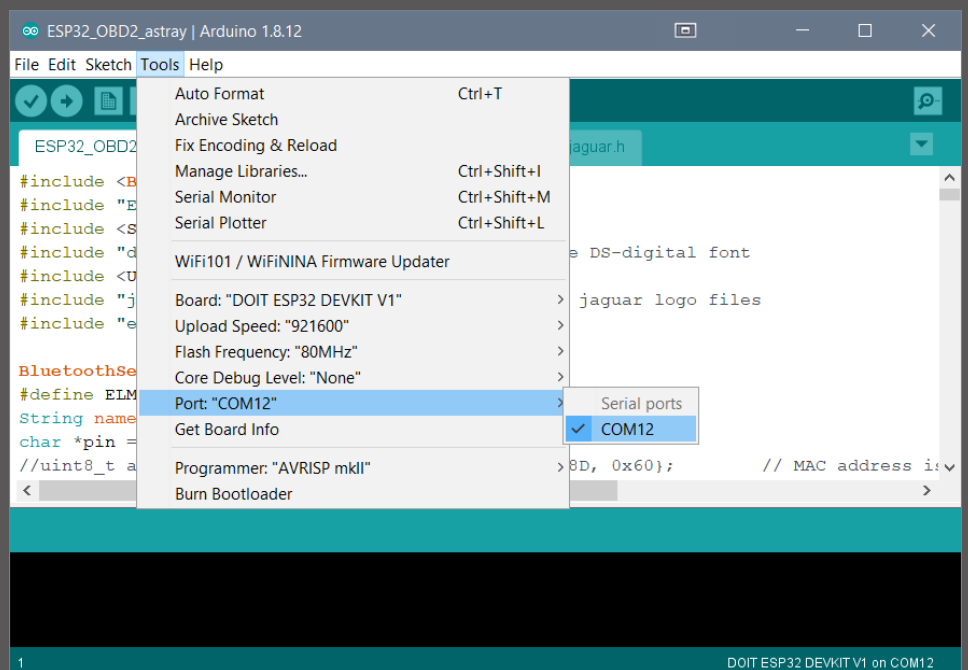


Appendix A continued: Actions in order to recognize the ESP32 board by the Arduino software.

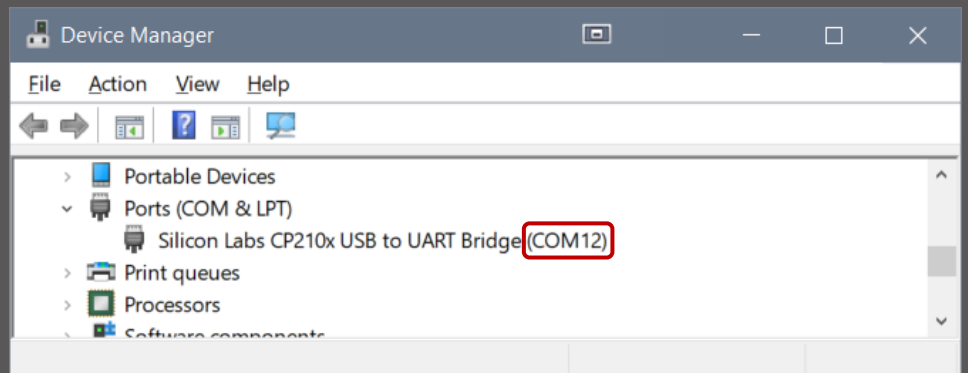
- Connect your device to the computer with a micro-USB cable:



- In the Arduino software, select the COM port:



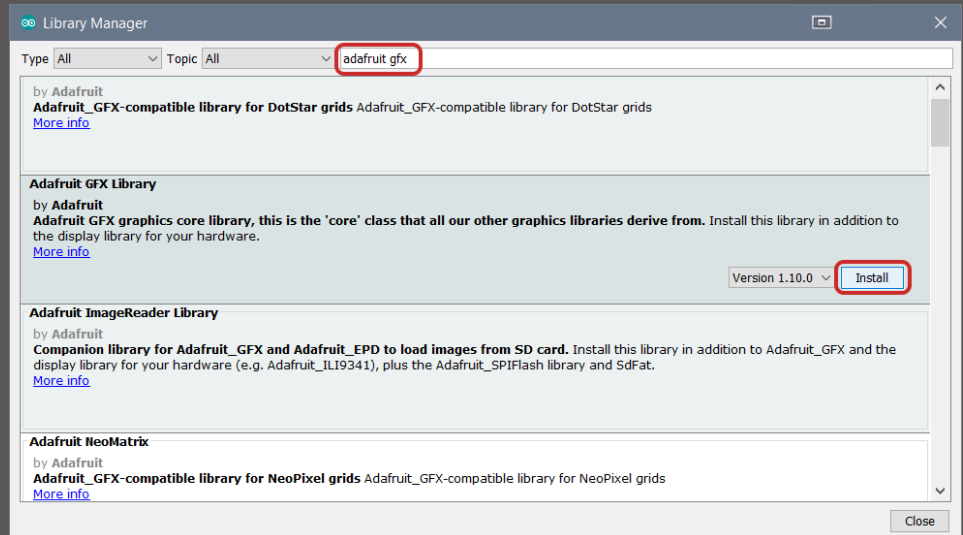
- If you have more than 1 COM port, check in [Device Manager](#) which COM port to select:
It should show the name: "Silicon Labs CP210x USB to UART Bridge".



Appendix B: Install an Arduino library. (example for Adafruit GFX and SSD1283A)

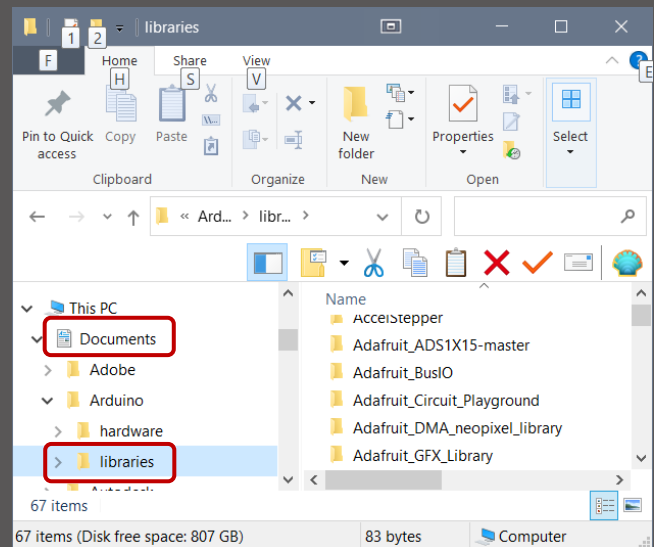
Arduino example:

- Open up the Arduino program, click Tools > Manage Libraries....
- In the search box, enter "Adafruit GFX". Once found click the Install button.



Github example:

- Open a web browser, browse to site <https://github.com/ZinggJM/SSD1283A>,
- Click the green  button and click the "Download ZIP" option, save the ZIP file to a known location on your computer.
- Find the ZIP in File Explorer and unzip the file to location: \\documents\\Arduino\\libraries\\



Appendix C: EZ-updater procedure in action.

Unzip unzip the downloaded file, go into the unzipped folder,
double click the "firmware.bat" file,
follow the on-screen instructions.

```
F:\Documents(F)\documents\filez\XKR\arduino-elm327\ESP32_final\firmware\X150_Astf\ESP32_v1.0.1.3...
Files extracted

List of COM ports available:

Silicon Labs CP210x USB to UART Bridge (COM12)

Programmed device will be: Silicon Labs CP210x USB to UART Bridge on COM12.
Press any key to continue . . .

F:\Documents(F)\documents\filez\XKR\arduino-elm327\ESP32_final\firmware\X150_Astf\ESP32_v1.0.1.3...
-----
PRESS 1, 2, 3 or 4 to select your units, or 5 to EXIT.
-----

1 - Celsius + Kilometers
2 - Celsius + Miles
3 - Fahrenheit + Kilometers
4 - Fahrenheit + Miles
5 - Exit

Type 1, 2, 3, 4 or 5 then press ENTER:
```

Appendix D: Read-out items model comparison

Engine									Imperial conversion	
4.2 / 3.5	5.0	item	unit	Equation	min	max	PID	ESP32 PID	unit	calculation
✓	✓	Driving Speed	km/h	X=Y	not checked				mph	X=Y*0.621371
✓	✓	Coolant temperature	°C	X=Y-40					F	X=(Y*9/5)+32
✓	✓	Battery voltage	V	X=Y/1000					V	X=Y
✓	✓	Driving since engine start	min	X=Y/60					min	X=Y
✓	✓	Outside temperature	°C	X=Y-40					F	X=(Y*9/5)+32
✓	✓	Intake temperature	°C	X=Y-40					F	X=(Y*9/5)+32
✓	✓	distance since codes cleared	km	X=Y					miles	X=Y*0.621371
✓	✓	engine RPM	rpm	X=Y/4					rpm	X=Y
X	✓	Boost *	Bar	X=Y*10	0	255	22033e	34, 830	PSI	X=Y*14.5038
X	✓	engine oil temp	°C	X=Y-40	-40	120	2203f3	34, 1011	F	X=(Y*9/5)+32
X	✓	engine oil volume	L	X=Y/10	0	25.5	2203f2	34, 1010	Gal	X=Y*0.264172
X	✓	gearbox temp	°C	X=Y-40	-40	120	221e69	34, 7785	F	X=(Y*9/5)+32
X	✓	Intake Air Temperature 2	°C	X=Y-40	-40	215	220520	34, 1312	F	X=(Y*9/5)+32
X	X	locking diff oil **	°C	X=Y-40	-40	150	221e8a	34, 7818	F	X=(Y*9/5)+32
X	✓	oil level	cm	X=Y/10	0	255	2203e6	34, 998	inch	X=Y*0.393701
✓	✓	Brightness level	device photo sensor							

* = Possibly only available on supercharged models.

** = proven not working on at least two 5.0 models.