SEMJR-100 / SEMJR-101
Submarine Environment Monitor
DIY Kit Description

IMPORTANT: PLEASE READ THIS DOCUMENT IN ITS' ENTIRETY BEFORE PROCEEDING TO PURCHASE PARTS OR INITIATE FABRICATION.

Overview

The SEMJR environment monitor provides real-time cabin environment information on an inexpensive LCD character display and is intended for use within 1-ATM submarines. While many specific parts are required and have no substitute, as a DIY project the user does have latitude to customize their project in certain ways. It is important therefore, for the user to spend some time thinking about how they wish to implement their project and the physical configuration that will work best for their particular application.

Sensors

Four sensors providing five environment conditions (O2, CO2, Barometer, Temperature, and Humidity) are supported by the SEMJR series. **These sensors cannot be substituted**. The sensors selected for this DIY project have been chosen because they have respectable specifications and accuracy for their intended purpose. A Bill Of Materials (BOM) is available at PSUBS.ORG with specific part numbers and suppliers for these sensors. See Table 1 for sensor descriptions.

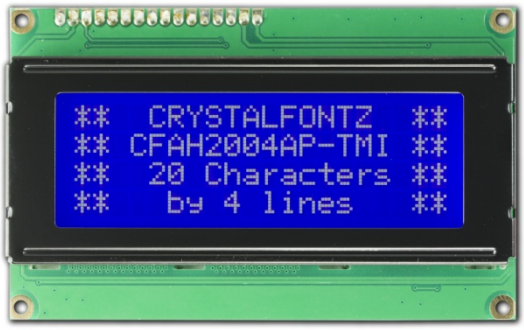
SENSOR	FUNCTION	UNITS	PCB
Luminox LOX-2	O2	Percent (%)	COZLOX-1.0
Cozir-A (10,000)	CO2	Parts per million (PPM)	COZLOX-1.0
MPRLS	Barometer	PSI or Millibar	PTH-100
SHT31-D	Temperature and Humidity	C or F / Percent (%)	PTH-100

Table 1. Sensor Description

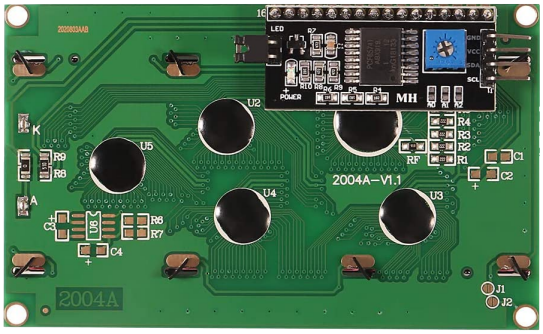
LCD Character Display

A 20x4 LCD character device with I2C capability has been chosen for display of sensor information because they are easy to implement, inexpensive, and dependable. **Note, ONLY I2C capable LCD display devices are supported.** While the 20x4 LCD display BOM suggests a specific model and supplier, the user has much freedom to select the 20x4 LCD display of their choice in terms of price, color combination, or supplier. If you have, or purchase, a parallel only 20x4 LCD display you can purchase an I2C backpack separately to make that LCD display I2C compatible. When selecting your LCD display, make sure it meets the following minimum requirements:

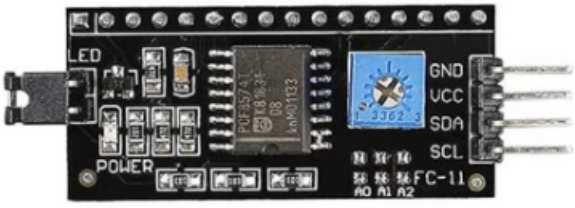
- HD44780 compatible
- I2C compatible or will accept an I2C backpack
- 20x4 character lines



Typical 20x4 LCD Character Display



I2C backpack mounted on LCD



Typical I2C backpack for LCD

Component Layout

While certain recommendations are provided in regards to component layout, ultimately the final layout is one of personal preference for a particular application. In some cases an "octopus" arrangement that the SEM100 provides (See Figure 1) may be preferable if you would like your sensors positioned in remote locations within the vessel. In other cases it may be preferable to simply locate all components in one enclosure and keep them centralized (See Figure 2). As long as all the components are connected correctly, any layout chosen by the user is acceptable. It is recommended that enclosures for all components are comprised of steel or aluminum to help reduce the effects of electromagnetic interference from other vessel systems.

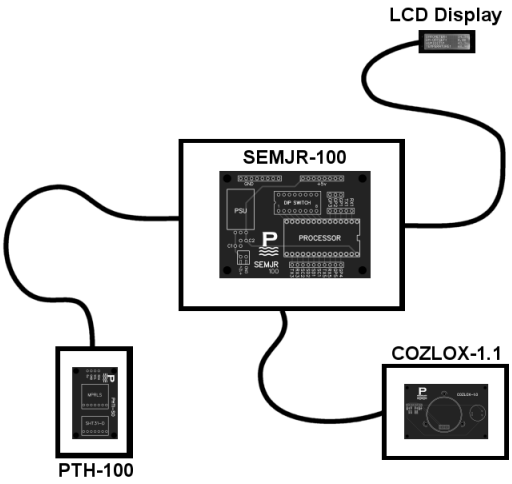


Figure 1.

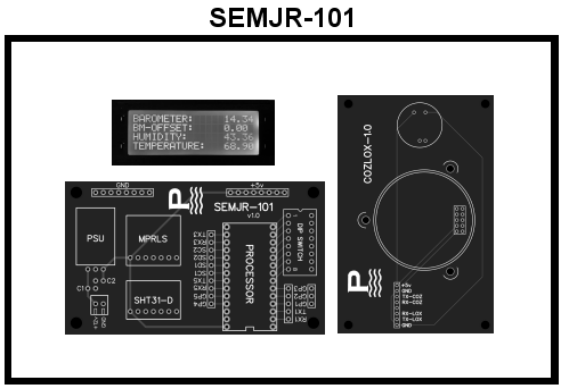
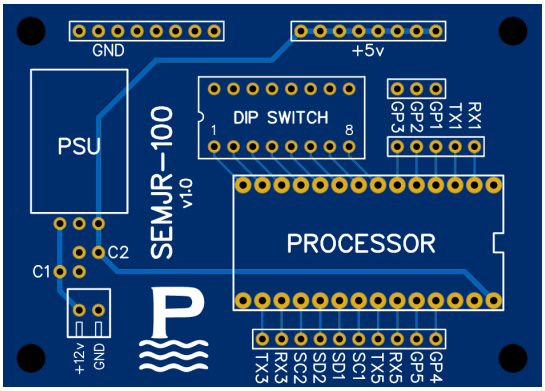


Figure 2.

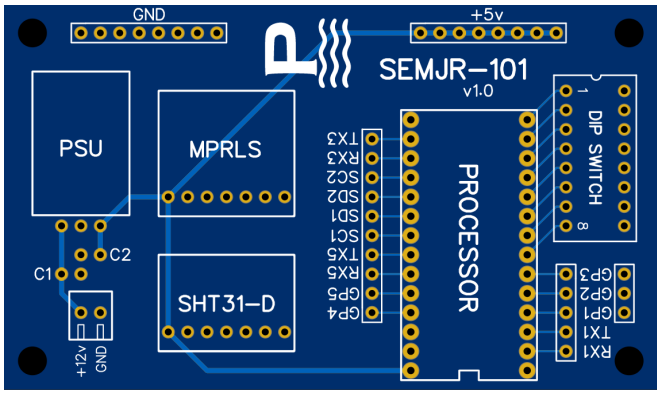
Printed Circuit Board - PCB

PCBs for sensors have been designed to reduce wiring and keep the project as clean as possible. It is highly recommended that you incorporate them into your particular application. Gerber files are available for each PCB so that you can have them manufactured by the supplier of your choice. However, since most PCB manufacturers have a minimum quantity requirement you may be able to locate and purchase a PCB from someone else in the community that has already ordered them for their own project. Additionally, you can check with PSUBS.ORG for PCB availability.

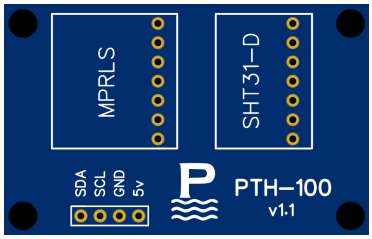
There are two motherboards available to the user, SEMJR-100 and SEMJR-101. Both of these motherboards are functionally equivalent. The SEMJR-100 provides a slightly smaller footprint for those whom may be space-conscious and desire an "octopus" type remote sensor installation, while the SEMJR-101 integrates the MPRLS pressure sensor and SHT31-D Humidity/Temp sensor directly onto the motherboard for those that might desire a more centralized sensor configuration.



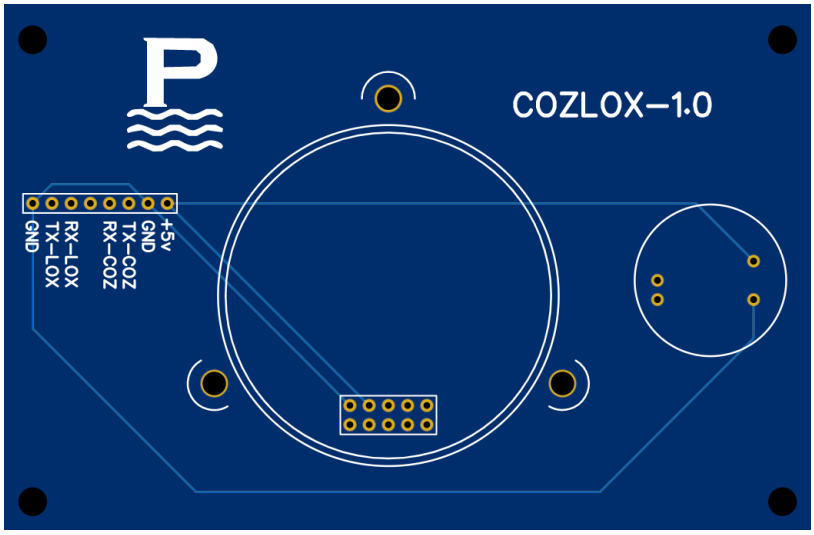
SEMJR-100
2.8 x 2.0 (in)
71.1 x 50.8 (mm)



SEMJR-101
3.375 x 2.0 (in)
85.7 x 50.8 (mm)



PTH-100
1.9 x 1.2 (in)
48.26 x 30.48 (mm)



COZLOX
4.2 x 2.75 (in)
106.6 x 69.6 (mm)

The PTH-100 PCB provides an interface for Barometer, Humidity, and Temperature sensors and is used to connect these sensors to the SEMJR-100 motherboard.

The COZLOX PCB provides an interface for CO2 and O2 sensors, and can be connected to both SEMJR-100 and SEMJR-101 motherboards.

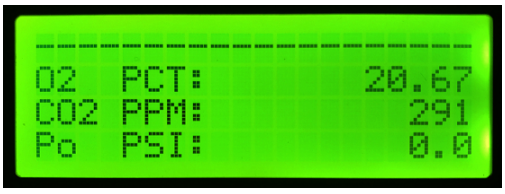
Other Configuration Considerations

The user will need to decide which run-time operations they wish to have control over via either switches or pushbuttons.

- **Barometric-Offset:** The microprocessor keeps track of and displays real-time barometric changes within the cabin which is calculated by subtracting the current pressure from the pressure that existed when the hatch was closed and sealed the cabin. This functionality eliminates the need for the crew to make this calculation manually. A momentary contact push-button is recommended to be used for clearing (zeroing) the existing offset at the end of a dive when the hatch is reopened. An alternative however, is simply to power cycle the SEMJR which will accomplish the same thing.

- **Audio Alarm:** An audio alarm in the form of a piezo type buzzer is an option for this project. If such an alarm is configured into the project the user will likely desire some method of disabling the alarm once it has been recognized. A momentary push-button is recommended for this purpose.

- **Menu Selection:** Six elements of environment information are provided by the sensors in this project, requiring two menus to observe all available information. By default, the microprocessor will automatically cycle through those two menus and display each one for four seconds, repeating indefinitely. If the user chooses, they may install a momentary contact push-button to cycle through the menus manually.



Enclosure Examples

Software

The application software for this project is open source and available for download through GITHUB. Additionally, two software development tools used to upload the application onto the microprocessor are required to be downloaded onto your local computer. Detailed instructions will be provided.