**PCB and Schematics Technical Report.**

The organization scheduled a few days to get in touch with the customer, the customer presented several characteristics that determine the functionality of its machinery. One of the first footsteps is to turn on the compressor, which prepares the pneumatic valves in the workbench to position the cylinders and start working.

The organization labeled each cylinder with letters, PA to PD to distinguish between them and its components that composes the control and sensors.

The workbench consists in a set of three identical double effect cylinders, PA, PB, and PD which handles two sensors determining the limits of movement, marked as A1 for the non-active state or A2 for the active state, in the other hand the control supports a single two-way quintuple valve with a spring determining the initial state as normally open, the valve stays as non-active.

In the other hand the cylinder PC handles a different valve, it carries the same sensing attributes as the others, but it carries a three-way quintuple valve, carrying a normally sealed sate, both coils that handle its control are labelled as PC1, and PC2.

The workbench carries a set of sensors labelled as their names, SF for the Fiber Optic Sensor, SI for the Inductance Sensor, SC for the Capacitive Sensor, and SL for the Lux Sensor. It also handles a Variable Frequency Drive that supports the motor control for a band that carries the entire process, the label MT represents the coil that controls the band.

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AC Mains voltage

The organization arranged with the customer an RS-232C adapter, which will carry a RS232 communication with microcontroller to handle data transmission over internet, which in this case, the ESP32 fits perfectly. The RS232 communication will be handled by the MAX3232 chip, that transform the RS232 into 3.3 volts logic TTL, an UART module inside of the ESP32 will interface with it.

The ESP32 will handle a Deep Sleep mode to save energy while the workbench is processing nothing, the FL817 optocoupler will trigger the external wake up pin of the micro to determine when is going to be used the workbench, the CPU will last ON until the process finishes.

In the other hand the mains voltage will provide the power supply to power the entire circuit, the internal current will be measured with a current sensor and by analyzing the current consumption while on we can determine how much energy uses the circuit to work. The ESP might be sourced by a LDO regulator that handles the less power as possible.

Current sensor

ESP32

MAX3232

FL817

AC-DC HLK PM01 5VDC

3.3V LDO regulator

The resulting system perform the integration of both diagrams.

Imagen que contiene Diagrama

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AC Main voltage

According to the customer, the requirements extended different changes, the current sensor might be a non-invasive sensor, which might carry different technologies to deploy the best approach for achieving the solution, the current sensor ACS7141 will be changed to a sct01 non-invasive current sensor with an ADS1115 12-bit ADC and PGA for measuring the power consumption in the system regarding the safety.

The organization thought that the customer would consider the usage of a predesigned board to manage the process, but the requirements stated that the best approach might be a simple ESP32 without the development board, because normally it carries other different components that usually consumes power.

At first, the organization considered to include the AMS1117 LDO 3.3V regulator, nevertheless the customer required an ultra-low power device that such components could not handle. The PCB must include the 3.3V low power regulators for sourcing the different components for the PCB, the MCP1700 LDO achieved the best approach to the problem. In the other hand the customer gave to the organization different options to vary from different power sources, that’s why the organization decided to include its own DC power supply board which carries an HLK-PM01 required to provide a stable 0.6A 5V power source.

The organization considered to include the RS232 to TTL module to simplify the manufacturing process of the physical connection between machine to machine.

The power module might be composed by a single DC power supply attached to the mains voltage, by implementing a set of predefined components we can ensure the noise and EMI interreference dissipation for stablish a stable power line.

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Slow blow 0.5A Fuse used to protect the circuit from damage when the module is abnormal.

10D561 Metal Oxide Varistor used to protect the electronic devices against overvoltage.

0.1uF/275Vac safety capacitor that provide filtering safety protection by an EMC certification.

10mH Choke mode Inductor that carries EMI filtering over 70 to 500 mA.

The MCP1700 is a low drop out regulator that handles a 1.6 μA Typical Quiescent Current, which is suitable for ultra-low power devices.

Un reloj con fondo blanco y letras negras

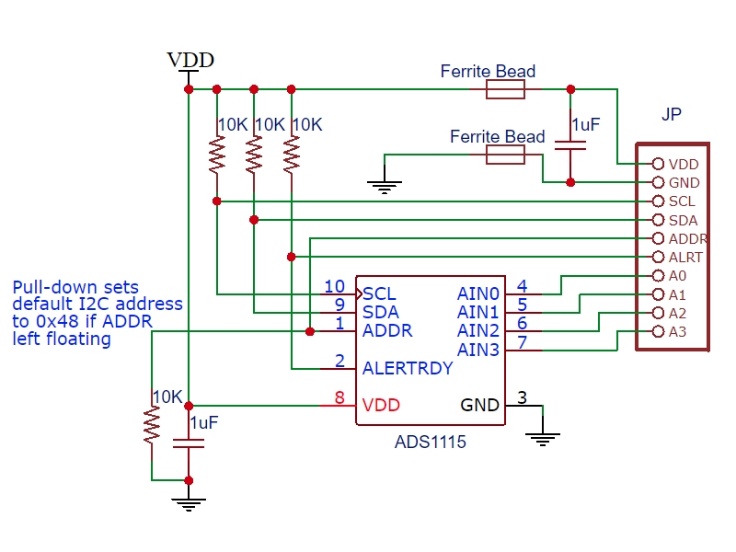
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The maximum current is 250mA, that’s why the organization stated that two regulators might be useful due normally the ESP32 could achieve a 240mA current consumption peaks that might be critical for the regulators if its normally shared.

In the other hand, the ESP32 must have the minimum circuit to operate properly without any intervention of other device that does not follow the main idea in this project. That’s why the organization recreated its own development board to handle the proper dimensions and connections for the minimum circuit of the ESP32, to being connected to the different modules and regulators to perform the functionality.

The SCT-013 current sensor might include the ADS1115 ADC + PGA board that carries the measurement of the differential voltage of the current sensor when is powered.

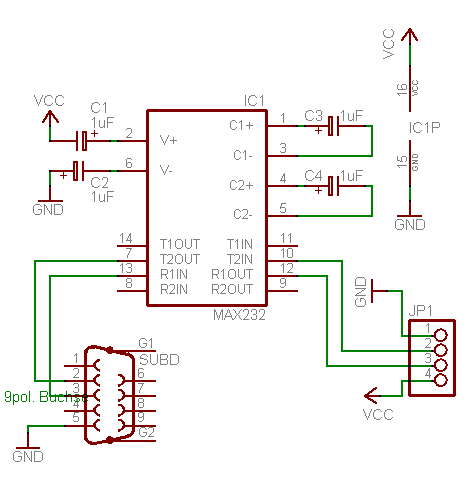
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A1

A0

In the other hand, the RS232 to TTL converter was obtained by a development board that might ease the speed of the project, the scheme involved in the board follows the same basic idea to transform RS232 signals to TTL levels that could handle the microcontroller, in this case into 3.3v levels using the MAX3232 module.



The system includes an optocoupler to interface a single digital pin from the PLC to the ESP32, which might serve to enable the ESP32 from the deep sleep mode that may ensure the ultra-low power consumption.

All the boards must be interconnected in the same boards that’s why the organization might design a board that could carry the connection of all the different components required for this project.

The power source diagram of the PCB might be left as:

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And the functional diagram of the PCB as:

Diagrama

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According to the defined functional and power source diagrams, the schematics could be designed to follow the requirements shown previously, the organization gathered all the required components according to the diagrams.

The main schematics might include the required components which composes the boards in the PCB, those components are found according to the datasheets as discussed previously.

The board will be composed by a set of different boards that will interconnect the system into a multiboard system.

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The ESP32 was used in manufactured boards that could carry the tiny connections that require for accessing to the different pins, that’s why it is allocated in a single PCB, the organization can provide a board that fulfills the necessities which handle a fixed connector that will interface everything.

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The RS232 module was previously considered to be made by the organization in the main board, but there was a better alternative to save time by using a predesigned board to provide a fast solution to the customer, that’s why it was considered to be implemented in this second board. In the other hand the Deep Sleep wakeup section might be composed by a set of resistors and an optocoupler respectively.

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The different connectors used in the board might be represented as single trough hole connectors, which will carry the TTL, the power sensor, the ADS1115, the external wakeup and the interface connector for the ESP32.

![Imagen que contiene Patrón de fondo

Descripción generada automáticamente](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAHsAAABaCAYAAACYNynsAAAAAXNSR0IArs4c6QAAAARnQU1BAACxjwv8YQUAAAAJcEhZcwAADsMAAA7DAcdvqGQAAADsSURBVHhe7dGxDcAwDMAwt/8fnKGAu+QLkYsO0LPf2SHhvSXA7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTvE7BCzQ8wOMTtj5geLdgSmfYZRAQAAAABJRU5ErkJggg==)![Imagen que contiene Patrón de fondo

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Descripción generada automáticamente

The main power sources are represented as well the necessities, the datasheets for the MCP1700 ensures that the proper connection might be done by implementing a set of 1uF capacitors.

Both voltage regulators might be sourced by a 5V 0.6mA AC – DC converter provided principally by the 4x2 header that interfaces the power source board from the system.

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The AC power source PCB is composed by the recommended circuit found in the HLK-PM01 datasheet that recommends the usage of a set of components that ensures the safety and filtering from the AC mains voltage, it provides a stable 5V 0.6A power source and it carries a 4x2 header that interfaces the power source board and the system.

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The ADS1115 was obtained in a predefined board as well as the RS232 module, that might be considered as a 10-pin header that interfaces the ADC + PGA with the different sensors with the microcontroller by implementing an I2C communication and a 4-pin header that provides a RS232 to TTL conversion.

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The power source board was designed previously by the organization, and it carries the components described above, it handles the 4x2 connector and it ensures the proper handling of an AC source, it isolates all high voltage signals and ensures the safety to the customer and to the organization as well.

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The ESP32 is used in the board provided by the organization, it was easy to implement due the organization had designed the ESP’s minimum circuit boards previously. Also, by recycling the PCB, the organization can help the environment in some way and providing a fast solution to the customer.

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The entire system might be interconnected by the mains board, that handles the connectors to interconnect the different components and will provide the power source to every section according to the power source and functional diagrams.

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All boards might be allocated in the top side of the mains board. It will carry the enough isolation to provide a clean source with the different connectors and might compose the entire system as a single board which handles different modules.

Imagen de la pantalla de un video juego

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