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# THE USE OF RS-485 INTERFACE FOR CONNECTING SENSORS IN AGRICULTURAL APPLICATION

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In agriculture, greenhouse complexes have been becoming increasingly popular, due to providing an opportunity to supply vegetables and fruits to consumers in cities every day, as well as silage grass to livestock farms throughout all the year, both in summer and winter. In greenhouses, plants need to be provided with optimal range of climatic conditions in order to ensure the maximum product yield. The high agricultural crops yield of is provided by: 1) ambient temperature higher than 14 $^0$C and irradiance during at least 8 hours a day [1]. Optimal conditions for plant growth are maintained by a climate control system, which includes the environmental parameters monitoring unit and appropriate actuators controlling necessary heating, an appropriate humidity level, both in the air and in the soil. It is known that modern greenhouse agricultural complexes can be localized in the area up to 30 hectares [2], which causes corresponding difficulties in using the climate control system, since the signal power decreases with increasing the cable length to provide the signal transmission in system.

To solve the problems associated with the optimal climate control system operation, the RS-485 interface was used, which is characterized by the possibility for two-way data exchange between several units using a single two-wire communication line maintained with twisted wire pair in half-duplex mode. The hardware implementation of the interface is the receiver chips with differential inputs / outputs (to the line) and digital ports (to the UART controller ports) [3] (Fig.1).

In the configuration studied, temperature and humidity sensors were installed both inside and outside the greenhouse. Inside the greenhouse, the sensors were placed one pair at ground level, the second pair at the level of the greenhouse ceiling and the third pair of sensors measured the moisture and temperature in the soil where the crops were being grown. In addition, irradiance sensors were installed at the ceiling and ground level in the greenhouse, and a light sensor was also installed outside the greenhouse. Temperature, humidity and irradiance level are monitored online with data being transmitted to a server where the information is stored and properly processed.

The temperature of the outside air significantly affects the yield of crops in the greenhouse due to the large heat losses that occur on virtue of the heat exchange between the greenhouse external and internal space the through its walls. Large sensor number appeared in the case of great agricultural complex

where large number of greenhouses were located has been found not to be connected to a network with a simple architecture. Such a consideration, in turn, has limit the choice in technical solutions to advanced interfaces. Therefore, for the case described, it is the RS-485 interface that is the most suitable, because it allows to connect a sufficient sensors number within a radius of 1200 meters around the main controller (server).

The use of RS485 interface allows in creating a reliable system resistant to external interference and malfunctions, as well as with a minimum output electromagnetic background due to differential signal transmission. Due to the "twisted pair", RS485 provides high stability to external electromagnetic interference, which can be critical in environment where many sources of noise are presented, and makes the system invisible from the outside. This ensures continuous monitoring and protection, minimizing the risk of unauthorized access. The RS485 interface allows data to be transmitted over a distance up to 1200 meters, which is ideal for greenhouses with large area. Also, the system provided with the RS485 interface can easily adapt to changing conditions. The ability to be connected up to 32 devices in one bus makes the system flexible and expandable one. This interface ensures the optimal integration of different units into one holistic system, maintaining automatic control and efficient monitoring.

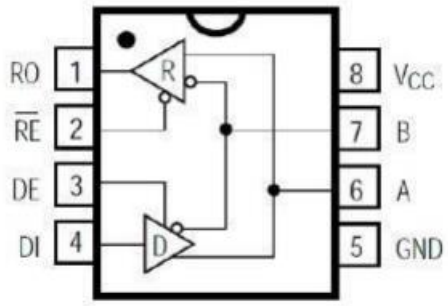


Figure 1 – Hardware implementation of the RS-485 interface

D - driver; R – receiver, DI - driver input, RO - receiver output, DE - driver enable, RE - receiver enable), A - direct differential input/output, B - inverse differential input/output.

References

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