

## PIC16F877 USE IN INDUSTRIAL APPLICATION

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**ABSTRACT.** In this paper we present the development of a real timer clock with a DS1307 circuit, this system built around a core type PIC16F877A microcontroller.

### The description of development PIC16F877A

The PIC16F877A Microcontroller is part of the 8-bit PIC microcontrollers family, has a complex internal structure, is able to acquire analog signals having constituted an analog-digital 10-bit, can generate PWM signals, can communicate with external devices lends itself particularly well in industrial applications.

High-Performance RISC CPU:

- Only 35 single-word instructions to learn
- All single-cycle instructions except for program branches, which are two-cycle
- Operating speed: DC – 20 MHz clock input
- DC – 200 ns instruction cycle
- Up to 8K x 14 words of Flash Program Memory,
- Up to 368 x 8 bytes of Data Memory (RAM),
- Up to 256 x 8 bytes of EEPROM Data Memory
- Pinout compatible to other 28-pin or 40/44-pin PIC16CXXX and PIC16FXXX microcontrollers.

It presents five bidirectional ports configurable for use by installation and can be used in very complex applications.

In the next figure shown pin assignment of PIC16F877A microcontroller.

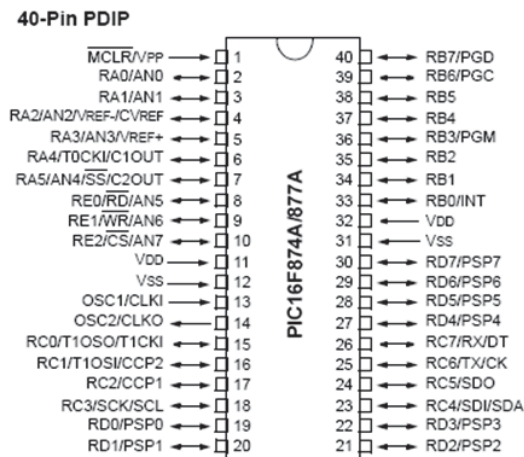


Fig. 1. Pin diagrams of PIC 16F877A

In this paper we propose creation a industrial clock application of PIC16F877A microcontroller.

The block diagram of industrial real-time clock shown in the next figure.

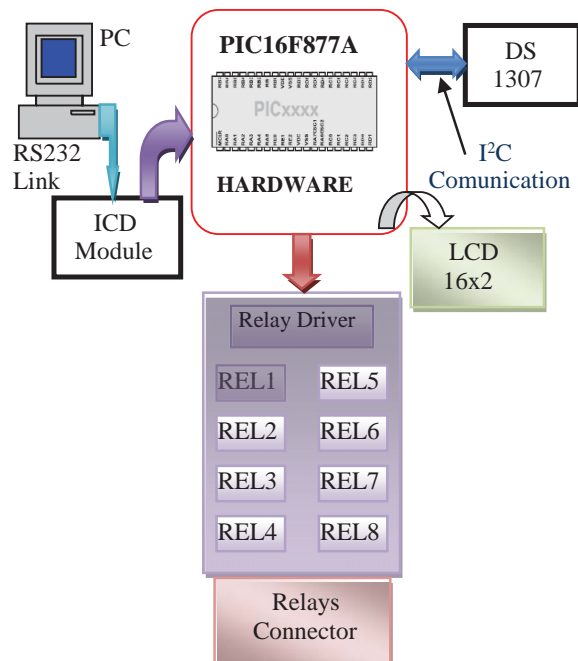


Fig. 2. Block diagram of industrial real-time clock

Some the features of this assembly we mention:

- It has 32 possible alarm set for 8 relay, but they can be extended;
- A 16x2 alphanumeric display and 5 buttons for interfacing with the user;
- Time management is done using specialized circuit DS1307 and storage data on alarm settings is in the internal EEPROM memory of the PIC16F877A microcontroller.

DS1307 is Dallas Semiconductor's serial RTC IC, that can provide full binary-coded decimal (BCD) clock/calendar plus 56 bytes of NV SRAM.

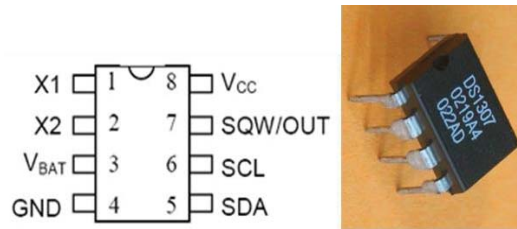
Address and data clock are transferred serially via a 2-wire, bi-directional bus.

Clock operates in either 24-hours or 12-hours format with AM/PM indicator.

DS1307 has built-in power sense circuit that detects power failures and automatically switches to battery supply mode.

This feature makes the circuit very used in real time applications, especially in industrial applications.

In the next figure shown pin assignment of DS1307 RTC.



VCC: Primary Power Supply  
 GND: Ground  
 VBAT: +3V Battery Input  
 SDA: I2C Serial Data  
 SCL: I2C Serial Clock  
 SQW/OUT: Square Wave/Output Driver  
 X1, X2: 32.768 kHz Crystal Connection

Fig. 2. Pin assignment of DS1307 RTC

I<sup>2</sup>C (Inter-IC Communication) was developed by Phillips Semiconductor and is that data transfer uses only two wires, that are SDA (Serial Data line) and SCL (Serial Clock line).

I<sup>2</sup>C Bus must be controlled by a master device, in this case the PIC16F877A microcontroller, that generates the serial clock (SCL), control bus access, and generates the START and STOP condition.

DS1307 operates as a slave device on the serial bus and are controlled by master device (PIC 16F877A microcontroller).

The following figure shows the typical mode of connecting a DS1307 circuit on I<sup>2</sup>C bus, using 2-wire protocol.

When using more than one device in the bus slave, slave can be connected to the bus parallelly, every slave communication can be separate by slave address byte will be sent after start condition.

In the next figure shown DS1307 and microcontroller I<sup>2</sup>C connection.

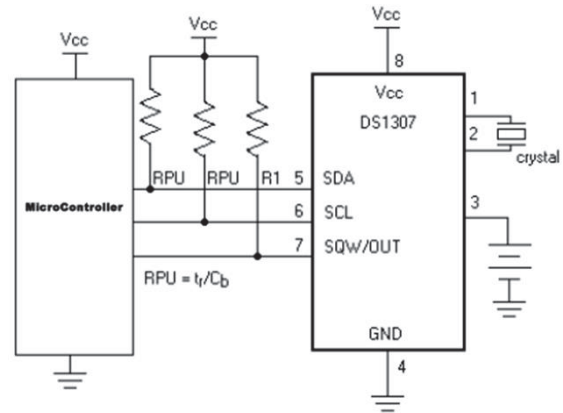


Fig. 3. DS1307 and microcontroller I<sup>2</sup>C connection

The I<sup>2</sup>C protocol is based on two important rules:

- Data transfer is initialized only when bus, is not busy;
- During data transfer, data line must remain stable whenever the clock line is the HIGH level.

Changes in the data line when the clock line is high level, is interpreted as control signals.

Next figure presented data transfer protocol I<sup>2</sup>C bus.

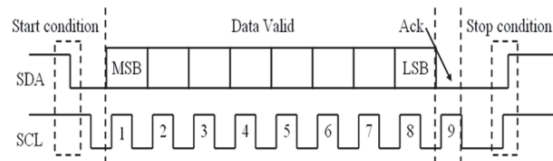


Fig. 4. I<sup>2</sup>C protocol

Each data transfer begins with START condition and ends with STOP condition.

Number of data byte transferred between START and STOP are not limited, and is determined by the master device (in this case is determined by the PIC16F877A microcontroller).

All these signals are processed by the microcontroller through the program written in his memory.

The program code running in the microcontroller is developed using the environment MPLAB programming, by which to generate hex file that is programmed into the microcontroller.

Testing program before operating the electronic device for viewing smooth operation is done in the ISIS Proteus development environment specialized in working with microcontrollers.

In the 5 figure shows the result of testing ISIS PROTEUS and hence proper functioning of electronic scheme and data transmitted via the I<sup>2</sup>C interface to the DS1307 and PIC16F877A microcontroller.

Setting the alarm is done using buttons on the D port of microcontroller and data display is via a 16x2 LCD placed on port B of PIC16F877A microcontroller.

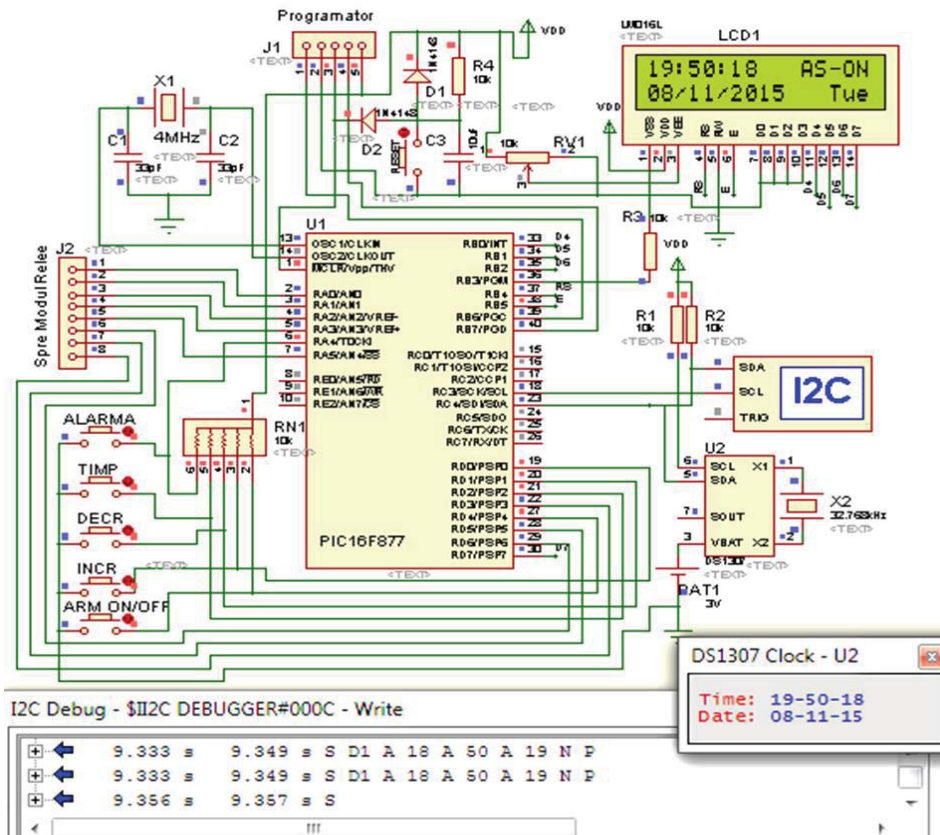


Fig. 5. Electronic scheme simulated in ISIS PROTEUS

In the 6 figure shows the result of testing ISIS PROTEUS functioning relays block (digital outputs) one of the ports connected to the microcontroller.

To generate digital outputs for process control using a module that is designed to take digital signals from port configured to generate digital outputs of microcontroller.

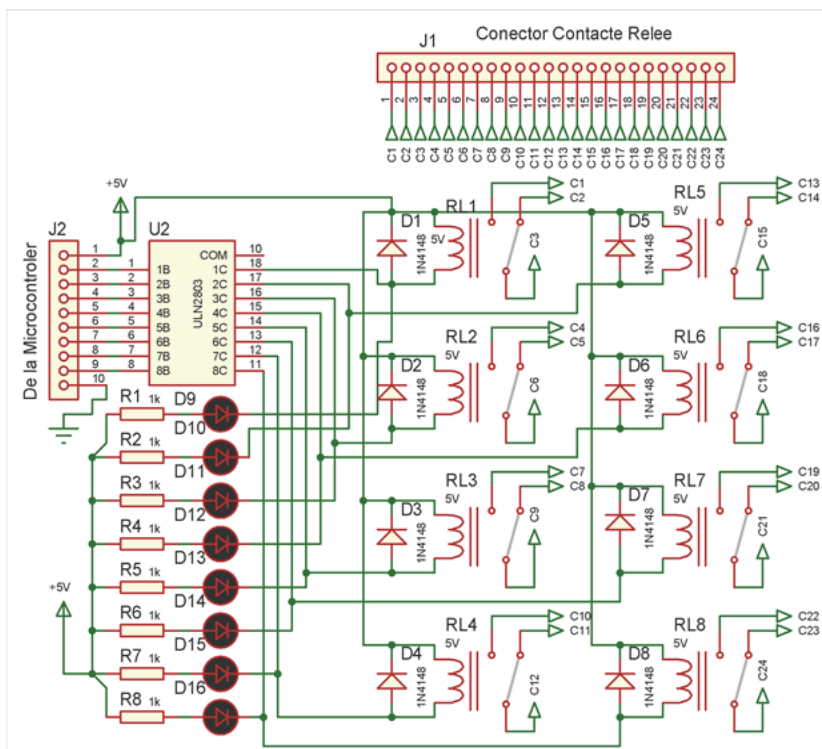


Fig. 6. Digital outputs

Digital signals from microcontroller port are taken ULN2803 chip, which functions as driver circuit for the eight relays connected to the outputs.

Connecting to the core microcontroller module is achieved through J2 connector and relay contacts can be found on J1 connector.

### CONCLUSIONS

The complexity of developing such a system does not stop here, it may be extended depending on the requirements and complexity of technological devices that must be managed. By simply removal in the external using connector of the microcontroller port, we can expand the applications that can be achieved through the platform and the possibilities, and not only, of serial communication such microcontrollers with a process computer or other such devices to be increasingly used in complex industrial applications, etc.

An important advantage of the application submitted is the discounted price of made and flexibility.

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