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LEARN·DESIGN·BUILD

RFID Systems

EB829-80-03

MATRIX

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EB829

RFID Solution

Instructor Guide

Student Course Notes

About this course

Aims: The principal aim of this course is to introduce the student to the concepts involved in RFID.
On completing this course the student will have learned:

- the basic components of a RFID system;
- common applications for RFID;
- techniques to configure the RFID reader to enable communication with either ICODE or Mifare transponders;
- the commands and syntax used to read and write data from and to RFID transponders.

What the student will need:
To complete this course the student will need the following equipment:

- Flowcode software
- E-blocks including:
    - a PIC or AVR multiprogrammer with a microcontroller device
    - an RFID E-Block (EB052) with an RWD-ICODE reader module
    - an LED E-Block (EB004)
    - an LCD E-Block (EB005)
    - a Keypad (EB014)
    - ICODE RFID transponders
    - Mifare RFID transponders.

Using this course:
This course presents the student with a number of tasks listed in the exercises in the following text. All the information needed to complete the labs is contained in the notes.

Before starting any exercises, the student should spend some time familiarising him/herself with the material on this course so that (s)he knows where to look when stuck.

Time: If you undertake all of the exercises on this course then it will take you around twelve hours.

Course conventions:

In this course we will use the following conventions:

- The main font type is Arial 11 point.
- All acronyms will be fully spelt out the first time they are mentioned.
  For example
    - EPROM (Electrically Programmable Read Only Memory)
- Matrix Multimedia products are capitalised on the first word.
  For example:
  Multiprogrammer,
  Prototype board,
  Flowcode
- Flowcode menu instructions will be fully capitalised.
  For example:
    - FILE...OPEN

Scheme of work

Section	Notes for instructors	Timing (minutes)
1. Introduction to RFID		
1.1 The RFID system	Students familiarise themselves with the hardware components that make up a typical RFID system. They can use websites such as www.rfid.co.uk, or use a wider internet search to learn more about hardware specifications and costs.	10 - 30
1.2 RFID applications	This section outlines areas of use for RFID technology. Students should be encouraged to explore some of these applications through an internet search.	10 - 30
2. RFID system components		
2.1 Reader	Examples or photographs of a range of RFID readers could be made available for students to examine.	5
2.2 Transponders	Again, examples or photographs of the different types of transponder could be provided. Students could use the internet to find information about devices and operating frequencies, and their relative advantages.	5 - 20
3. Anatomy of a passive RFID transponder		
3.1 Transponder communication	Implicit in this section is knowledge about electrical resonance. Students may need support with, or encouragement to research into, this topic. Equally important is the concept of Load Modulation. More information can be obtained from sources such as the RFID handbook (Wiley & Sons).	10 - 30
3.2 The structure of a transponder	Students need familiarity with types of electronic memory, and with interpreting memory maps. This may require intervention by the Instructor.	5 - 20

Section	Notes for instructors	Timing (minutes)
4. The RFID reader module		
4.1 Host communication	The text refers to the following RS232 signals – TXD, RXD and CTS. Depending on previous experience and desired outcome, it may be beneficial for the Instructor to provide more information about the RS232 protocol at this point. The protocol is now also known as the EIA/TIA232 protocol, (and has been further extended into EIA/TIA 422 and 485 protocols). Alternatively, the students could be directed to web-sites such as Wikipedia (http://en.wikipedia.org/wiki/RS-232) or http://www.inetdaemon.com/tutorials/wan/serial/eia/eia232.shtml.	5 - 20
4.2 Command sequences	The role of the status byte as an acknowledgment and in fault-finding should be emphasised here	5
4.3 Reader module configuration	A datasheet for the RWD-ICODE reader module can be found on the ibtechnology website -(www.ibtechnology.co.uk)	5 - 20
4.4 Transponder type selection	The student should appreciate that the Init_RFID macro, reading the Protocol selected on the Properties page of the RFID component, controls location 3 and hence transponder type selection.	5
4.5 Authorised UID list	The exercises in this course do not use this function	5

Section	Notes for instructors	Timing (minutes)
5. The RFID E-Block		
5.1 Connecting the RFID E-Block	In some situations, the course will be delivered using a pre-assembled set of E-Blocks, secured to the metal backplane. In others, the students will be required to build up the system from individual E-Blocks, in which case the diagram shown in this section will be essential. Regardless of which path is followed, the student must take care to identify the Port connections on the Multiprogrammer board, and the power supply connections from the Multiprogrammer board to the LCD and RFID boards	5
5.2 RFID E-Block configuration	The options for configuring the RFID E-Block are spelled out in this section. Antenna selection is controlled by jumper J1: The 13.56MHz option uses the integrated antenna. The 125KHz option uses the EXT 125KHz Antenna connections on J2. Reader-to-host communication is configured using jumper links J5, J6, J7, J8 and J9. Jumpers J5 and J7 allow selection of various default RS232 Tx and Rx signal connections (A, B, C, D). J6 allows selection of various RS232 CTS signal connection (1, 2, 3, 4) Selection of the Tx/Rx option D and CTS option 4 causes the signals to be routed through the patch system formed by jumpers J8 and J9. This allows wire links to be used to connect the signal lines (J9) to any of the 8 data lines from the host system (J8). For more information, see the E-Block EB052 datasheet.	10 – 20

<table>
<tr><th colspan="2">Section</th><th>Notes for instructors</th><th>Timing (minutes)</th></tr>
<tr><td colspan="4">6. Using ICODE mode</td></tr>
<tr><td colspan="2">6.1 Overview</td><td>The important ideas here are:
data is stored in the ICODE memory in 4-byte blocks;
the UID for these transponders is eight bytes long, and so occupies the first two blocks;
ICODE tags support multiple transponder operation, so that several transponders can be identified in the RF field and can be in communication with the reader module.</td><td>5</td></tr>
<tr><td colspan="2">6.2 ICODE mode status byte</td><td>The information conveyed in the status byte is invaluable in troubleshooting. Students should be familiar with the significance of bits 1 and 2 in particular.</td><td>5</td></tr>
<tr><td colspan="4">7. Exercise 1 – Reader module communications in ICODE mode.</td></tr>
<tr><td colspan="2">7.1 Introduction</td><td rowspan="8">This is the first of a series of practical assignments using Flowcode to control the RFID reader module and its communication with transponder cards. Its aim is to detect the presence of an ICODE transponder.
The Flowcode RFID component provides all the functions needed to control the RWD-ICODE reader module. This exercise introduces two of these:
• the Init_RFID function which configures the communication link between the host controller and the RFID reader module;
• the Get_RFID_Status function, which obtains the current value of the reader module status byte.
Students design and test a Flowcode program to establish communications between the host controller and the RWD-ICODE reader module. This involves configuring the hardware, including the Flowcode RFID component, and then writing configuration data to the RFID reader module, which then replies with status information, the status byte.
Detailed instructions on how to build the Flowcode program are given in the ‘What to do’ section. It is assumed that students already know how to:
• add a new variable to a program;
• add a LED array to the program, and configure its properties;
• output a the value of a variable to the LEDs;
• create a program loop incorporating a time delay.
A suitable Flowcode program is described in the ‘Solutions to Exercises’ section.</td><td rowspan="8">30</td></tr>
<tr><td colspan="2">7.2 Objective</td></tr>
<tr><td colspan="2">7.3 Requirements</td></tr>
<tr><td colspan="2">7.4 The Flowcode program in detail</td></tr>
<tr><td colspan="2">7.4.1 Init_RFID function</td></tr>
<tr><td colspan="2">7.4.2 Get_RFID_Status function</td></tr>
<tr><td colspan="2">7.5 What to do</td></tr>
<tr><td colspan="2">7.6 Further work</td></tr>
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