Application Note: 2

PARALIAX R

599 Menlo Drive, Suite 100 Rocklin, California 95765, USA **Office/Tech Support:** (916) 624-8333 **Fax:** (916) 624-8003

Web Site: www.javelinstamp.com Home Page: www.parallaxinc.com

General: info@parallaxinc.com Sales: sales@parallaxinc.com Technical: javelintech@parallaxinc.com



Contents

Introduction to the DS1302 Trickle Charge Timekeeping Chip	1
Downloads, Parts, and Equipment for the DS1302	2
The DS1302 Example Circuit and How it Works	3
Extra Features Built into The DS1302	3
Using a Super Cap for Uninterrupted Power	3
Using The RAM	4
Automatic Time Updating	4
Testing the DS1302 Circuit	4
Program Listing 1.1 – DS1302Test	5
Using the DS1302 as a StopWatch	6
Program Listing 1.2 – DS1302StopWatch Example	7
The DS1302 class Clock Demo	9
Published Resources – for More Information	9
Javelin Stamp Discussion Forum – Questions and Answers	9

Introduction to the DS1302 Trickle Charge Timekeeping Chip

You can use the DS1302 chip with the Javelin Stamp for keeping track of the exact time and date. The DS1302 is a real-time clock that provides seconds, minutes, hours, date of the month, month, day of the week, and year with leap year compensation. This can add value to your project wherever the current time and/or date is important.

With the help of the DS1302 library, the Javelin Stamp can set the initial time and date in the DS1302 chip and then request the time/date information as needed. The DS1302 library handles the three-wire serial interface, and has many helpful methods and constants to exchange information with the chip. The DS1302 chip also features 31 bytes of static RAM that you can use for variable storage.

Downloads, Parts, and Equipment for the DS1302

The DS1302 package includes this application note, library file, javadoc, test program (Program Listing 1.1), the stop watch example Program Listing 1.2 and the comprehensive demonstration program (DS1302Demo.java) which will demonstrate all the methods available to you in the DS1302 class. All of these files are available for free download from:

http://www.javelinstamp.com/Applications.htm

You can use the AppNote002-DS1302.exe, to install the files listed below. These files must be located in specific paths within the Javelin Stamp IDE directory. Although the path to this directory can be different, the default root path is: C:\Program Files\Parallax Inc\Javelin Stamp IDE

<root path>\lib\stamp\peripheral\rtc\DS1302.java <root path>\Projects\examples\peripheral\rtc\DS1302Demo.java <root path>\Projects\examples\peripheral\rtc\DS1302Test.java <root path>\Projects\examples\peripheral\rtc\DS1302StopWatch.java <root path>\doc\DS1302.html <root path>\doc\AppNote002-DS1302.pdf

Table 1.1 lists the parts you will need for this application note. You must use a 32,768 kHz crystal oscillator with the DS1302. This oscillator is used for the time base; the more accurate the oscillator the more accurate the DS1302's timekeeping will be. For uninterrupted power you can optionally connect a Super Cap or a rechargeable battery.

Table 1.1: Parts List					
Quantity	Part Description and Ordering Info	Schematic Symbol			
1	DS1302: Parallax Part #251-03230	「Vcc2 Vcc1 8 E X1 SCLK 7 S X2 I/O 6 任 GND RST 5			
1	32,768 kHz crystal: Parallax Part #251-03230				

The equipment used to test this example included a Javelin Stamp, Javelin Stamp Demo Board, serial cable, 7.5 V, 1000 mA DC power supply, serial cable, and PC with the Javelin Stamp IDE v2.01.

Page 2 • Parallax, Inc. • www.javelinstamp.com

DS1302 Example Circuit and How it Works

The DS1302 communicates with the Javelin Stamp using a 3-wire interface, consisting of a SCLK (serial clock), I/O (input/output line), and RST (reset) pin. The DS1302 class takes care of all the signaling on these three pins. The code you write will only involve sending the initial configuration data to the DS1302 and receiving the time data from it.

Here's how you connect the DS1302 to the Javelin Stamp (see Figure 1.1):

- The power supply pin (Vcc2) of the DS1302 is connected to +5V (Vdd) of the Javelin.
- The ground pin (GND) of the DS1302 is connected to ground (Vss) of the Javelin.
- The DS1302's X1 and X2 pins are connected to the leads of the 32.768 kHz crystal. Note: it is highly recommended to make the crystal-to-pin connection length as short as possible.
- The I/O pin (I/O) of the DS1302 is connected to pin1 (P1) of the Javelin Stamp.
- The serial clock pin (SCLK) of the DS1302 is connected to pin2 (P2) of the Javelin Stamp.
- The reset pin (RST) of the DS1302 is connected to pin3 (P3) of the Javelin Stamp.



Extra Features Built into The DS1302

The DS1302 contains the following extra features which are discussed below:

- Using a Super Cap for Uninterrupted Power
- Using a Rechargeable Battery for Uninterrupted Power
- Using The RAM
- Automatic Time Updating

Using a Super Cap for Uninterrupted Power

A capacitor can be used in case there is an interruption in the main power. You will still be using Vcc2 connected to +5V (Vdd) as your primary power source. Connect Vcc1 to the positive (+) lead of the capacitor, and connect the negative (-) lead of the capacitor to ground (Vss). The capacitor will be charged through the DS1302 chip. The charge(true) method will charge the capacitor. Do NOT use the charge(true) method for rechargeable batteries. If you wish to experiment with a rechargeable battery, it will require some work on your behalf. Care must be taken regarding the speed at which you charge the battery. You will need to create a new method for the specific type of battery that you are using, the charge(true) method will only work for a

Application Note: 2

SuperCap. We recommend only using nickel-cadmium batteries. For a full list of batteries and their charging requirements please refer to the *Dallas Semiconductor Application Note #82* from www.maxim-ic.com.

Here is how you connect the DS1302 to the Javelin Stamp with the *optional* Super Cap circuit (see Figure 1.2):

- The power supply pin (Vcc1) is connected to the positive lead (+) of a Super Cap.
- The negative lead (-) of the Super Cap is connected to ground (Vss) of the Javelin Stamp.



Using The RAM

You can use the DS1302's RAM for extra storage space. The 31 bytes can be used for variable storage, but the RAM is volatile. You will lose contents if power is lost. If you are using a Super Cap, or a battery, the RAM's contents will remain as long as there is sufficient power.

Automatic Time Updating

The DS1302 chip has a built-in "auto update" feature that calculates leap years up to the year 2100. In order to make this work you must set the day of the week properly to handle the date compensation.

Testing the DS1302 Circuit

Program Listing 1.1 can be used to test the circuit in Figure 1.1 this simple program uses the DS1302 library's writeTime method to set the time and date. The **readDate** and **readTime** methods are used to display the updated date and time after a brief delay.

Once you program the Javelin with Program Listing 1.1 you should see output similar to Figure 1.3.

Page 4 • Parallax, Inc. • www.javelinstamp.com

Application Note: 2



If your output is different or there is no output at all, you will need to verify your circuit. Here is a list of items to check:

- ✓ Your circuit matches Figure 1.1
- \checkmark The Javelin's pins are correctly wired to the DS1302's pins.
- ✓ The DS1302's Vcc2 is connected to the Javelin's Vdd +5 V.
- ✓ The DS1302's Vcc1 is not connected to anything.
- \checkmark The DS1302 in the correct orientation. Double check pin1.
- ✓ Crystal is connected.

Program Listing 1.1 – DS1302Test

```
* Copyright © 2002 Parallax Inc. All rights reserved.
* This class tests the DS1302 circuit from the Application Note #002.
* Version 1.0
 */
import stamp.core.*;
import stamp.peripheral.rtc.DS1302;
public class DS1302Test {
 final static char HOME = 0 \times 01;
                                           // Position cursor upper-left
 final static char CLS = '\u0010';
                                            // Clear Screen
 public static void main() {
    // Example of the DS1302 class constructor
    // Create new DS1302 object: pin1=data, pin2=clock, pin3=reset
   DS1302 t = new DS1302(CPU.pin1,CPU.pin2,CPU.pin3);
    // Example of writeTime
    // Set time to initial state: hour, min, sec, month, date, year, day_of_week
    t.writeTime(23, 58, 15, 12, 31, 2, 3);
```

Application Note: 2

Getting Started with the DS1302

```
System.out.println(CLS);
while (true) {
   System.out.print(HOME);
   System.out.print("Date: ");
   System.out.println(t.readDate());
   System.out.println(t.readTime(true));
   CPU.delay(100); // one second
  }//end while
}// end main
}//end class: DS1302Test
```

Using the DS1302 as a StopWatch

Program Listing 1.2 will demonstrate how to use the methods available to you in the DS1302 class to create a stop watch. You will be able to start, stop and reset the clock as well as save a particular time instance to RAM for later recall. The output from Program Listing 1.2 is shown in Figure 1.4. Notice to use this menu your cursor must be positioned in the "Input Area" at the bottom of the window.



This program uses the methods below from the DS1302 library class.

• writeTime(int hr, int min, int sec, int mo, int date, int yr, int dayOfWeek) Writes the initial time and date to the clock. (1=Sun, 2=Mon, 3=Tue, 4=Wed, 5=Thr, 6=Fri, 7=Sat)

Page 6 • Parallax, Inc. • www.javelinstamp.com

Application Note: 2

•	halt(boolean)	Halts the clock, the clock will not increment time if boolean value is set to TRUE. If the boolean value is set to FALSE it will resume the clock if it has been halted.
•	readTime(boolean)	Returns a formatted string of the time based upon the boolean value passed. If the boolean value is TRUE then the string is formatted for 12hr time (am/pm), if the boolean value is FALSE then the string will be formatted for 24hr time (military time).
•	writeRam(int,int)	Writes integers to RAM. (location, data) There are 31 bytes of RAM from memory location 0-30. This method supports wrapping; so supplying memory location 31 will actually access RAM location 0.
•	<pre>readRam(int,int)</pre>	Reads integers to RAM. (location, data)

Tip For more information on the specifics of each method you can refer to the JavaDoc for the DS1302 library or the DS1302 Demo program.

Program Listing 1.2 – DS1302StopWatch Example

```
* Copyright © 2002 Parallax Inc. All rights reserved.
 * Using the DS1302 circuit from the Application Note #002 to be used as a
 * stop watch.
 * Version 1.0
 */
import stamp.core.*;
import stamp.peripheral.rtc.DS1302;
public class DS1302StopWatch {
                                          // Position cursor upper-left
  final static char HOME = 0x01;
                                           // Clear Screen
  final static char CLS = '\u0010';
  public static void main() {
    // Create new DS1302 object: pin1=data, pin2=clock, pin3=reset
    DS1302 sw = new DS1302(CPU.pin1,CPU.pin2,CPU.pin3);
    StringBuffer SB = new StringBuffer(9); // Buffer to xfer data
    System.out.println(CLS);
                                            // Clear Screen
    sw.writeTime(0, 0, 0, 0, 0, 0, 0);
                                           // Set Time to zeros
```

Application Note: 2

Getting Started with the DS1302

```
sw.halt(true);
                                           // halt clock
while (true) {
  System.out.print(HOME);
  System.out.println("DS1302 Stop Watch\n");
  System.out.println("Select 'g' to go");
System.out.println("Select 's' to stop");
  System.out.println("Select 'r' to reset stop watch");
  System.out.println("Select 'c' to clear screen");
  System.out.println("Select 'a' to archive time to RAM");
  System.out.println("Select 'd' to display archived time from RAM");
  System.out.print("\nPlease make a selction ");
  switch (Terminal.getChar()){
    case 'g':
                                                // Start clock
      sw.halt(false);
      System.out.print("\nStarted at: ");
      System.out.println(sw.readTime(true));
    break;
    case 's':
      sw.halt(true);
                                                // Stop clock
      System.out.print("\nStopped at: ");
      System.out.println(sw.readTime(true));
    break;
    case 'r':
      sw.writeTime(0, 0, 0, 0, 0, 0, 0);
                                                // Set time to zeros
      sw.halt(true);
                                                // Stop clock
      System.out.print("\nClock Reset ");
      System.out.println(sw.readTime(true));
    break;
    case 'c':
      System.out.println(CLS);
                                                // Clear screen
    break;
    case 'a':
      SB.clear();
                                               // Store time into SB
      SB.append(sw.readTime(true));
      for (int x=0;x<9;x++) sw.writeRam(x,SB.charAt(x)); // store SB to RAM</pre>
      System.out.print("\nClock Saved
                                                   ");
    break;
    case 'd':
    System.out.print("\nFrom Ram: ");
    for (int x=0;x<9;x++) System.out.print((char)sw.readRam(x)); // read RAM
System.out.print(" ");</pre>
    break;
```



```
}//end case
}//end while
}// end main
}//end class: DS1302StopWatch
```

The DS1302 class Clock Demo

The DS1302Demo.java demonstrates the methods available to you in the DS1302 class. This includes the charging of the optional Super Cap circuit from Figure 1.2. This program is heavily commented for your use and should be read while the program runs. When programming use the 'debug' feature which will allow you to set breakpoints after each section of code so you can examine the output messages. For more information on debug and breakpoints refer to the Javelin Stamp Users Manual.

Published Resources – for More Information

This class was developed to allow the Javelin to interact with a real-time clock. Much care has been taken in creating this class. Below you will find useful information that was used in creating this document.

"DS1302 Trickle Charge Timekeeping Chip", Data Sheet, Maxim/Dallas Semiconductor, 09/28/01

This document will give you information on the internal workings of the chip as well as all available commands and addresses. You can find this data sheet on-line at: http://pdfserv.maxim-ic.com/arpdf/DS1302.pdf

"Application Note 82 Using the Dallas Trickle Charge Timekeeper", Data Sheet, Maxim/Dallas Semiconductor, 05/24/02

This document will give you detailed information on the DS1302s' ability to recharge rechargeable batteries. You can find this data sheet on-line at: http://pdfserv.maxim-ic.com/arpdf/AppNotes/app82.pdf

Javelin Stamp Discussion Forum – Questions and Answers

The Parallax, Inc. Javelin Stamp Discussion Forum is a searchable repository of design questions and answers for the Javelin Stamp. To view the Javelin Stamp Forum, go to www.javelinstamp.com and follow the Discussion link. You can also join this forum and post your own questions. Other Javelin Stamp users who monitor the list will see your questions and reply with helpful tips, part numbers, pointers to useful web pages, etc.

Copyright © 2002 by Parallax, Inc. All rights reserved. Javelin, Stamp, and PBASIC are trademarks of Parallax, Inc., and BASIC Stamp is a registered trademark or Parallax, Inc. Windows is a registered trademark of Microsoft Corporation. Java and all Java-based marks are trademarks or registered trademarks of Sun Microsystems, Inc. in the U.S. and other countries. Other brand and product names are trademarks or registered trademarks of their respective holders.

Parallax, Inc. is not responsible for special, incidental, or consequential damages resulting from any breach of warranty, or under any legal theory, including lost profits, downtime, goodwill, damage to or replacement of equipment or property, and any costs of recovering, reprogramming, or reproducing any data stored in or used with Parallax products.

Page 10 • Parallax, Inc. • www.javelinstamp.com