Sparkfun Oscilloscope Clock Operating Instructions:

The most convenient way to power the Sparkfun Clock is to use an external wall wart, 7-15V DC center positive with a 5.5 mm (OD) power plug. Most external wall warts (7-15V center positive) should fit without any problems.

Connect the probes (1X, 10X) or wires to the respective connectors/terminals marked CH1 and CH2. Set the scope in X-Y mode and connect the cables or probes to channels 1 and 2. Turn R8 TO BE UPDATED all the way counterclockwise (maximum image size). Set both channels to DC mode and the voltage range to 0.5V per division. Now turn R8 TO BE UPDATED**clockwise** to make the image fit your screen. You can tweak the image, for example to make it completely square (8 divisions), by manually reducing the voltage per division value (VAR knob.) If your scope does not support 0.5V per division, reduce the image size by turning R8 TO BE UPDATEDuntil the generated images matches your scope.
Most scopes define CH1 and the X axis and CH2 as the Y axis. Some, for example the Tektronix 485, reverse this convention. As a result, you will need to swap the probes.

Please note that, if the image looks distorted when using probes in 10X mode, you may have to adjust the probe compensation (they usually have a small adjustment screw).

Control of the clock is primarily done using the on-board push button switches S1 and S2.

S1:

Long push (> 1 second: keep the button switch pushed down).

Short push (<1 second: push and release the button switch).

S2:

Long push (> 1 second: keep the button switch pushed down)

Short push (<1 second: push and release the button switch)

The **S1 long** push enters the Time/Date Set mode, the **S1 short** push enters the Menu mode.

The **S2 long** push reboots the Sparkfun clock

Time/Date Set mode (S1 long push):

S1 short push increments the current field value by one.
Keeping S1 pushed will start auto-repeating, allowing you to increment a field value quickly.
S2 short push moves to the next field.

Menu mode (S1 short push):
S1 short push displays the next value (or activates the demo option).
Keeping S1 pushed will start auto-repeating, allowing you to advance an option value quickly.
S2 short push moves to the next option, or activates the current option value when changed.

Changing the time on the Sparkfun Clock using the push button switch:
To change the time, make sure that the Numeric Display does NOT show the current date. If so, change it using the menu. An **S1 long** push will enter the Change mode. If the Numeric Display is Off, the time will also be changed, even if the Binary Clock Display is active. The clock is stopped when changing time. The field being changed will flash at this point. If the Numeric Display is Off, one of the Clock Hands will flash in an Analog Dial Display. In a Binary Clock Display, the "lights" columns representing the value being changed will flash. An S1 short push will increment the current field (hours, minutes, seconds); keep S1 pushed for auto-repeat. An S2 short push will move to the next field, using the current field value as the new time value. Once done with the seconds field, a "**Push S1 To Start**" message pops up. An S1 short push will restart the clock at the selected time. However an S2 short push will cancel your changes and restart the clock at the actual time, as kept by the on-board Real Time Clock. This is handy if you entered the Change mode by accident or if you changed your mind. Change mode times out after 30 seconds of inactivity.

Changing the date on the Sparkfun Clock using the push button switch:
To change the Date, make sure that the Numeric Display shows the current date. If not, change it to display the Date using the menu (**Menu-Num:Date**). An S1 long push will enter the Change mode. The field being changed will flash. An S1 short push will increment the current field (year, month, day); keep S1 pushed for auto-repeat. An S2 short push will move to the next field. The clock leaves Change mode automatically after finishing the Day value. The order of change is Year, Month, Day. This way, the clock can verify the date validity better (number of days per month, leap years etc.) Change mode times out after 30 seconds of inactivity.

Options available on the on-screen menu firmware V3.6:

Option	Values	Function	Option	Value	Function
Num	**12hr**	Select Numeric Field	**Dial**	**12hr**	Select Clock Dial to

	24hr **Hex** **Date** **Off**	to Display		**24hr** **Rom** **Bin** **Min**	Display
GPS	**Off** **-12 ..** **+12**	Select GPS NMEA input using the selected local time zone offset	**DST**	**USA** **EU** **Off**	Select Automatic Daylight Saving Time for USA or EU
App	**Clock** **Term** **Gen** **Demo** **Boot**	Select application to run	**PPS**	**4096Hz** **1Hz** **-4..** **+4**	Set PPS mode and apply software accuracy correction.
Chrono	**Off** **On**	fractional seconds display	**Cal**	**Off** **On**	Turn Calibration Screen On and Off
Led	**On** **Off**	Controls on-board Led	**BurnIn**	**On** **Off**	Turn BurnIn Prevention Off and On
Play	**Off** **Rev** **FF** **FR**	Fun modes: Reverse, Fast Forward and Fast Reverse	**Reset**	**Off** **On**	Re-initialize the EEProm area of the Atmega328p to "virgin" state.
Baud	**19200..** **14400**	Set Baud Rate on Serial Interface	**Name**	**On** **Off** **Edit**	User Name Display
		Current User Name is displayed below the Menu			

Changing an option on the Sparkfun Clock using the push button switches:

An S1 short push will enter the Menu Mode. The option being updated/selected is flashing. Move to the next option by an S2 short push. All options are selection values. A S1 short push will show the next selection value; keep S1 pushed for auto-repeat. Moving to the next option (using an S2 short push) when the selection value has changed, will activate the selected value and the clock will leave the menu mode.

To leave the menu quickly, just do short pushes on S2 or 1 long push on S2 which will reboot the clock

The Sparkfun clock FAQ provides much more information on how to use the clock and currently serves as the manual.

Sparkfun Oscilloscope Clock Hardware 1.1 FAQ
Dutchtronix Firmware Version 3.6ds
September 18, 2009

Sections:

The following description applies to the Sparkfun Oscilloscope Clock board. This board allows the user to display various clocks on an analog CRT device, like an oscilloscope or an X-Y monitor, and control the options using the on-board push buttons S1 and S2 using on screen menus, all powered by an external wall wart (user provided). A true RS-232 level Serial Interface is also included. The board has footprints for two BNC connectors.

Introduction.

Sparkfun is proud to present a new hardware version of the Dutchtronix AVR Oscilloscope Clock, version 1.1. Some of the features of this board are:

Equipped with the Atmega328p AVR, providing twice the code space and memory of the Atmega168 used in earlier versions.

Use of the **Analog Devices AD7302 DAC** with built-in OpAmp. This DAC has low output impedance while generating an excellent image. The low output

impedance allows the use of regular BNC cables or even wires to connect the Clock board to a display device like an oscilloscope, an X-Y monitor or even a home made CRT device. Probes are still supported.

Use of the industry standard ds1307 Real Time Clock plus a replaceable backup battery.

On board power supply. Allows the use of an 8-15V wall wart with a standard DC connector (5.5mm outside diameter Barrel Jack, center positive) to power the AVR Oscilloscope Clock. A LED indicates the presence of power and there is an On-Off switch.

Probe connectors ("turret terminals") are present on the board, as are footprints for two **BNC connectors** for use with standard BNC cables.

On board trimpot to set the output voltage range of the DAC. Maximum voltage range is 5V.

Intensity control with both positive (Z) and negative (ZINV) drive levels.

True **RS-232 level Serial Interface** with DB-9 female connector using a MAX232A compatible IC. This allows you to connect the AVR Oscilloscope Clock to a computer using a standard serial cable. Since the level converter is truly RS-232 compliant, you can also connect the AVR Oscilloscope clock to an electronics project that uses a parasitic level converter, using the built-in terminal application.

Connector for an FTDI USB to serial converter cable or the Sparkfun FTDI breakout board

The Oscilloscope Clock is preloaded with **firmware V3.6ds**.

Image quality varies from scope to scope of course. X-Y monitors, which are like oscilloscopes but without the time-base section, work best. All pictures showing the Sparkfun Oscilloscope clock with V3.6ds firmware were taken on a Tektronix 608 X-Y monitor using the Intensity Control output ('Z') available on the board.

Features of the **V3.6ds firmware**:

Select on the menu from 3 different applications: **Clock**, **Terminal** or **Function Generator**

User control with 2 push button switches, including **auto-repeat operation**

Selectable Baud Rate setting for the Serial Interface

Select **PPS** (Pulse Per Second) mode: either 4096Hz (default) or 1 Hz (for use with an external 1 PPS signal.

Ability to do time accuracy correction in software.

Binary Clock Display option (**Menu-Dial:Bin**). This is a BCD binary clock. Show them you are an ubergeek! Try changing the current time when the **24 Hour Clock Dial** option (**Menu-Dial:24hr**). To see the exact time on an analog dial, when no numeric date is being shown (for example when the current date is

More into a classical clock dial? Use **Roman Numerals Dial** option (**Menu-Dial:Rom**). The proper symbol for the number 4 is now used.

More into a classical clock dial? Use **Roman Numerals Dial** option (**Menu-Dial:Rom**). The proper symbol for the number 4 is now used.

Date Display (**Menu-Num:Date**). The date can be changed using an S1 long push when the date is being displayed in the Numeric Display.

Hexadecimal Numeric Time Display (**Menu-Num:Hex**). This option was designed to work together with the Binary Clock Display to form a "Bi-Hex" clock.

Fractional Seconds Display option (**Menu-Chrono:On**). This mode will add a display of 1/100 of a second unit to either the 24 hour Numeric Display or the Hexadecimal Numeric Display

The AVR Oscilloscope Clock supports a total of **30 different display combinations**.

GPS device NMEA parsing ($GPRMC records) allows you to connect your GPS device to the AVR Oscilloscope Clock and always display the correct Date and Time. You select the correct Local Time Offset (-12 to +12) when enabling this option in the Menu. If Automatic Daylight Saving Time Adjustment is enabled (see below), you don't have to worry about that either.

Automatic Daylight Saving Time Adjustment is supported for two zones: USA and EU for the years 2008 to 2014. Not only will the AVR Oscilloscope Clock set the time forward or backwards at a transition, it will also apply the proper adjustment when the clock has been turned off for a while and is turned on when Daylight Saving Time is active, and it will only do it once. Keep in mind that the Real Time Clock present on the AVR Oscilloscope Clock knows nothing about Daylight Saving Time.

User Name Display on the clock face is now supported. This User Name can be up to 20 characters in length. By default the name "Sparkfun" is displayed but you can edit the User Name in the menu, now using auto-repeat on switch S1. Spaces can be used in the User Name, but 2 adjacent spaces indicate the end of the User Name. The User Name Display can be turned off.

Need to return the clock to its original state? Select the **Menu-Reset:On** option. This will **clear the EEProm configuration** data. Handy if the EEProm configuration data ever get messed up. This option requires an explicit ON value to prevent the user from accidentally erasing the EEProm configuration data.

Play option**: Menu-Play:Norm/Rev/FF/FR** where FF means Fast Forward and FR means Fast Reverse.

Handy **Serial Command Line interface**; some commands require sub-values. For example to set the Numeric Display to show the date, enter "xn", followed by "03". The clock will prompt for the sub-values, showing the valid range.

Demo mode allows you to demonstrate many of the features of the AVR Oscilloscope Clock to friends and family.

On-screen menu using push button switches S1 and S2. Using the S2 short push to move from field to field makes going through all 14 fields a breeze. If you enter the menu by accident, just do an S2 long push; the clock will restart instantly.

The **bootstrap loader** uses the stk500v1 protocol and works with avrdude (from WinAvr). This bootstrap loader is permanently present in the

Atmega328p microcontroller and uses just 512 words of memory.

AVR Clock Interfacing

Q: What kind of oscilloscope can I use?
A: Any analog scope with X-Y mode should work without problems. Low-end digital scopes will surely not work, High-end digital scopes may work (Tektronix 2014B works ok, HP54600B works well) . High-end analog scopes (400 MHz or better) like the Tektronix 7904 or 7854 will have some flicker because their phosphor decay time is so short; this will make the picture look less stable, even at a refresh rate of over 150 times a second. On scopes like the Tektronix 465 and 475, the picture is rock solid. Please let me know if you've been successful with a digital scope.

Q: What kind of cables should I use to connect the clock to the oscilloscope?
A: The easiest way to connect the Sparkfun clock to your scope is to use probes with pincer tips. The CH1 and CH2 turret terminals were selected to be easily useable for probes with pincer tips. When the BNC connectors are installed (user option), regular BNC cables can be used. The AD7302 DAC is a low output impedance DAC which allows the use of 1X probes, BNC cables or straight wires; 10x probes will also work. Connect the scope's intensity control to the Z or ZINV output of the Sparkfun clock to improve the image even more.
Set the scope in X-Y mode and connect the cables or probes to channels 1 and 2. Turn R8 (TO BE UPDATED) all the way counterclockwise (maximum image size). Set both channels to DC mode and the voltage range to 0.5V per division. Now turn R8 (TO BE UPDATED) **clockwise** to make the image fit your screen. You can tweak the image, for example to make it completely square (8 divisions), by manually reducing the voltage per division value (VAR knob.) If your scope does not support 0.5V per division, reduce the image size by turning R8 (TO BE UPDATED) until the generated images matches your scope.
Most scopes define CH1 and the X axis and CH2 as the Y axis. Some, for example the Tektronix 485, reverse this convention. As a result, you will need to swap the probes.
Please note that if the image looks distorted when using 10x probes, you may have to **adjust the probe compensation** (they usually have a small adjustment screw).

Q: How do I power the Sparkfun clock?
A: Use a standard wall wart which generates somewhere between 8 and 15V DC and has a 5.5mm outside diameter DC power plug, center positive. This is the most common DC power plug used. The kit includes such a plug. The **Sparkfun** Clock has protection against reverse polarity.

Sparkfun Clock User Interface

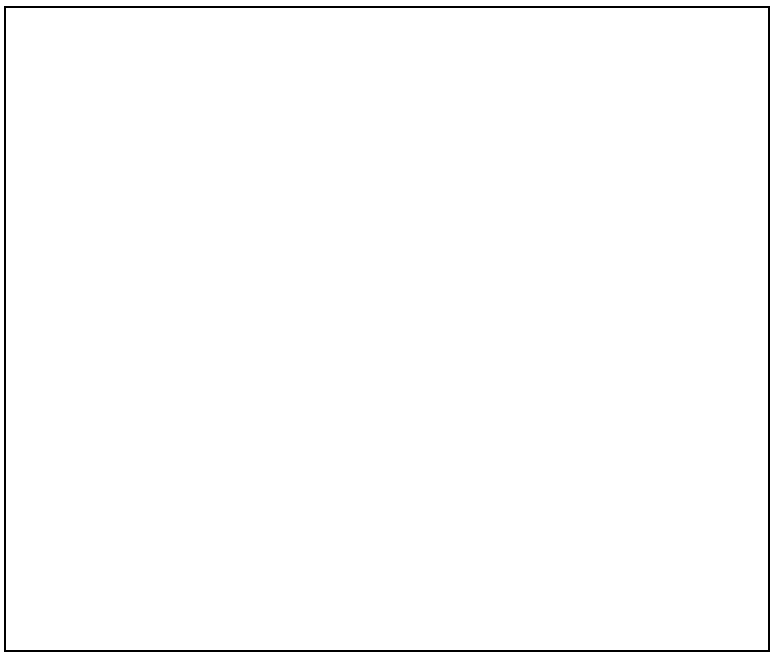
Q: How are the on-board button switches operated?
A: There are 2 push button switches, S1 and S2. Each switch has 2 actions: **long** push (> 1 second, hold until you see a change) and **short** push (<1 second, push and release). Switch S1 also has auto-repeat capabilities when in Time/Date Change or Menu mode. An **S1 long** push enters the Time/Date Change mode, an **S1 short** push enters the Menu mode. An **S2 long** push reboots the AVR Clock

Time/Date Change mode:

- **S1 short** push advances the current field one
- **S1 long** push will auto-repeat
- **S2 short** push moves to the next field.

Menu mode:

- **S1 short** push selects the next value.
- **S1 long** push will autorepeat
- **S2 short** push activates the current option if changed or moves to the next option .



TO BE UPDATED

Sparkfun Clock Operation

Q: How do I change the time on the Sparkfun Clock using the button switch?
A: To change the time, make sure that the Numeric Display does NOT show the current date. If so, change it using the menu. An S1 long push will enter the Change mode. If the Numeric Display is Off, the time will also be changed, even if the Binary Clock Display is active. The clock is stopped when changing time. The value being changed will flash at this point. If the Numeric Display is Off, one of the Clock Hands will flash in an Analog Dial Display. In a Binary Clock Display, the "lights" columns representing the value being changed will flash. A S1 short push will increment the current field (hours, minutes, seconds); keep S1 pushed in to auto-repeat. An S2 short push will move to the next field, using the current field value as the new time value. Once done with the seconds field, a "**Push S1 To Start**" message pops up. An S1 short push will restart the clock at the selected time. You can cancel the Time Change operation using an S2 short push; this will restart the clock at the actual time, as kept by the on-board Real Time Clock. Change mode times out after 30 seconds of inactivity.

Q: How do I change the date on the Sparkfun Clock using the button switch?
A: To change the Date, make sure that the Numeric Display shows the current date. If not, change it to display the Date using the menu (**Menu-Num:Date**). An S1 long push will enter the Change mode. The value being changed will flash. An S1 short push will increment the current field (year, month, day); keep S1 pushed in to auto-repeat. An S2 short push will move to the next field. The clock leaves Change mode automatically after finishing the Day value. The order of change is Year, Month, Day. This way, the clock can verify the date validity better (number of days per month, leap year etc.) Just FYI, years divisible by 4 are leap years, except when also divisible by 100. But the year 2000 is a leap year in the Gregorian Calendar because it is divisible by 4, 100 and 400. Change mode times out after 30 seconds of inactivity.

Q: What options are available using the on-screen menu?
A: An S1 short push will enter the Menu Mode. Once the Menu mode is entered, you'll see the following menu on the screen:

Option	Values	Function	Option	Value	Function
Num	**12hr** **24hr** **Hex** **Date** **Off**	Select Numeric Field to Display	**Dial**	**12hr** **24hr** **Rom** **Bin** **Min**	Select Clock Dial to Display
GPS	**Off** **-12 ..** **+12**	Select GPS NMEA input using the selected local time	**DST**	**USA** **EU** **Off**	Select Automatic Daylight Saving

		zone offset			Time for USA or EU
App	**Clock** **Term** **Gen** **Demo** **Boot**	Select application to run	**PPS**	**4096Hz** **1Hz** **-4..** **+4**	Set PPS mode and apply software accuracy correction.
Chrono	**Off** **On**	fractional seconds display	**Cal**	**Off** **On**	Turn Calibration Screen On and Off
Led	**On** **Off**	Controls on-board Led	**BurnIn**	**On** **Off**	Turn BurnIn Prevention Off and On
Play	**Off** **Rev** **FF** **FR**	Fun modes: Reverse, Fast Forward and Fast Reverse	**Reset**	**Off** **On**	Re-initialize the EEProm area of the Atmega328p to "virgin" state.
Baud	**19200..** **14400**	Set Baud Rate on Serial Interface	**Name**	**On** **Off** **Edit**	User Name Display
		Current User Name is displayed below the Menu			

Q: How do I change an option on the Sparkfun Clock using the S1 button switch?
A: An S1 short push will enter the Menu Mode. The option being updated/selected is flashing. Move to the next option by an S2 short push. The options are selection values: an S1 short push will show the next selection value; keep S1 pushed to auto-repeat. Moving to the next option (using an S2 short push) when the selection value has changed, will activate the selected value and the clock will leave the menu mode. Menu mode times out after 30 seconds of inactivity.

Q: What does the the S2 tactile switch do?
A: The S2 switch is currently programmed to reboot the Sparkfun Oscilloscope clock when doing a long push. Use an S2 long push if you want to leave the menu quickly. When in Time/Date Change mode or on the Menu page, the S2 short push is programmed to move from field to field. This allows you to move very quickly through the menu. An S2 short push when not in Time/Date Change mode or outside of the Menu page has no effect.

Q: How do I tell the Sparkfun clock to display only the analog clock?
A: Select the **Num** option, set the value to **Off**. This mode is persistent.

Q: How do I tell the Sparkfun clock to display a minimal dial on the analog clock?

A: Select the **Dial** option, set the value to **Min**. Only 4 hour numbers will be displayed. This mode is persistent.

Q: How do I tell the Sparkfun clock to display a dial with Roman Numerals on the analog clock?
A: Select the **Dial** option, set the value to **Rom**. Roman Numerals will be now be displayed on the dial. This mode is persistent.

Q: How do I tell the Sparkfun clock to show a Binary Clock Display ?
A: Select the **Menu-Dial** option, set the value to **Bin**. The clock will switch to a Binary Clock Display. This clock will display 24 Hour time in a BCD Binary fashion. You will see 6 columns displaying from 2 to 4 on-off "lights". The left-most 2 columns show the hours, the middle 2 columns show the minutes and the right-most columns show the seconds. Each column represents **one** digit, together they form a value. The lowest position in each columns represents bit 0, the highest can be bit 2, 3 or 4. The size of each column was selected to represent the full range for each digit in its position. For example, the lowest digits for seconds can range from 0..9 so we need 4 bits to display the number 9 in binary. The highest digit for hours can range from 0..2 so we only need 2 bits to display the number 2 in binary. When you select a hexadecimal Numeric Display (**Menu-Num: Hex**) with this Binary Clock Display, you are looking at a Bi-Hex clock. This mode is persistent.

Q: How do I read the Numeric Time in Hex?
A: The Numeric Time in Hex is a binary representation of the values of the time components, in 24 hr format. Convert each field from hexadecimal to decimal (0..59) and you'll see the current time. There is no separate BCD Hex Numeric Display since such a display is identical to the regular 24 hr Numeric Display since each digit is in the range 0..9 (identical in decimal and hex)

Q: How do I tell the Sparkfun clock to display the Numeric Display in AM/PM mode?
A: Select the **Num** option, set the value to **12hr**. This mode is persistent.
Q: How do I change the Clock Face to something more serene?
A: The AVR clock provides 3 different controls to change the clock face, providing a total of 30 different combinations. Use the **Num** option to turn the numeric display **Off** . Use the **Menu-Dial:Min** option to remove most digits from the clock face. The combination of no numeric display and fewer digits provides a minimal but elegant display. You can select the Numeric Display format with the **Num** option, value **12hr, 24hr**, **Hex, Date, or Off**

Q: What is PPS and how do I change the PPS frequency?
A: PPS refers to "Pulse per Second". The Real Time Clock (RTC) interrupts the AVR at precise intervals. The AVR keeps track of time by counting these pulses. For the Sparkfun clock, which uses the ds1307 RTC, it was determined that the clock runs more accurately when the RTC interrupts the AVR 4096 times per

second. After 4096 pulses, 1 second has elapsed.
However, the user may want to use an external signal to advance the time, for example using a GPS device based 1PPS (1 pulse per second) signal. In that case, the AVR needs to know that every pulse indicates a new second and the PPS value needs to be set to 1. When setting the PPS value to 1, the RTC is also reprogrammed to generate 1 PPS so the clock will stay accurate.

When using an external PPS signal (usually from a GPS device), the solder joint JP4 needs to be opened (remove the solder) and a 3-pin 0.1" header needs to be soldered into JP4. It is then possible to connect the external signal using header pins marked "GND" and "PPS", or a shunt can be installed on the header pins "PPS" and "PPS RTC" to use the RTC again. When using an external 1 PPS signal, the clock must be changed to 1 PPS mode using the on-screen menu (field PPS)

Keep in mind that the 4096Hz PPS mode will require a little bit more power from the backup battery when the clock is turned off, than the 1Hz PPS mode.

The values -4 to +4 are used to apply a software time accuracy correction, see the next entry.

Q: How do I change the accuracy of the Sparkfun Clock using the PPS field?
A: It is possible to apply a software accuracy correction using the PPS field. What this means is that the clock must be fed a 4096Hz pulse signal from the RTC but NOT an external 1Hz signal. The AVR will internally use a different count to determine when a second has passed based on the following table:

PPS Value	AVR Count	result	result
-4	4092	run 0.097656% faster	3.52 sec/hour faster
-3	4093	run 0.073242% faster	2.64 sec/hour faster
-2	4094	run 0.048828% faster	1.75 sec/hour faster
-1	4095	run 0.024414% faster	0.88 sec/hour faster
1	4097	run 0.024414% slower	0.88 sec/hour slower

2	4098	run 0.048828% slower	1.75 sec/hour slower
3	4099	run 0.073242% slower	2.64 sec/hour slower
4	4100	run 0.097656% slower	3.52 sec/hour slower

If you find that the clock runs 1 second per hour too fast, select PPS option 1; this will slow the clock down by about 1 second per hour.
Keep in mind that the correction is only applied when the clock has power. When the power is turned off, the RTC maintains its own time (powered by the on-board battery) and NO correction can be applied.

Q: How do I change the User Name to my own preference?
A: The current User Name is displayed at the bottom off the menu page, but is not a normally selectable field. Select the "**Edit**" option in the "**Name**" field to change the User Name. The actual edit process, once a User Name edit has started, is simple: the character being changed flashes. An S1 short push "increases" the char in an ASCII sequence (ASCII 127 is the highest char available, after which rotation to SPACE (ascii 32) occurs; keep S1 pushed to auto-repeat.
An S2 short push advances to the next char in the name. Two spaces in a row complete the edit. For example to change the user name to "John Doe", enter "John Doe ". This method allows for single spaces inside a name. The maximum length of a name is 20 positions. Editing will stop once the 20 positions have been reached.
If you are impatient like I am, you will be happy to know that as of firmware V3.5, auto-repeat is supported when changing a name. Very nice if you just pushed the button one too many times, and ended up with the next character!
The desired User Name is stored in the AVR EEprom memory. Flashing (aka blinking) may obscure the current char for a very short time (1/2 second) so be patient when incrementing a character: use the S1 auto-repeat feature to get close to the desired character value, then use S1 short pushes for the last strech.
If you entered the edit mode by accident, you can either advance to the end of the name using S2 short pushes, followed by 2 spaces, do an S2 long push to reboot the clock or you can just wait 30 seconds and the clock will time-out the edit mode.
Display of the User Name can be turned off using the "**Off**" option the "**Name**" field.

Q: What is the "Automatic Daylight Saving Time" feature all about?

A: Daylight Saving Time, called "Summertime" in the European Union, is a time system where time is advanced by one hour sometime early in the year and time is set back one hour near the end of the year (in the Northern Hemisphere.) When you live in the USA or Western Europe, you won't have to change the clock to correct for Daylight Saving Time (DST) until 2015! The dates when DST takes effect and ends are programmed in the Sparkfun clock for the years 2008-2014, based on the most recent laws, both for the USA and the European Union. Look at this website for all the details.
Not only will the clock automatically set the time one hour forward (and one hour back) when transitioning in and out of a DST window (the combination of date and time for which DST is active), the clock will also set itself to the proper time if it has been turned off for a while. Even though the Real Time Clock (RTC) on the AVR clock keeps running when the clock is turned off, it is not aware of DST so the RTC time will be off by one hour if it was turned off before a DST window, then turned on within such a window. The AVR clocks make the necessary adjustment when turned on. The clock keeps track of the adjustments made for each of the 7 supported years so that adjustments (forward and backward) are only applied once.
If the user manually changes the date, the clock will check if this new date requires a DST adjustment and will do so, if needed.
If the user manually changes the time, the clock assumes the user knows best, will not do an DST adjustment but will mark that a DST adjustment was made for the current year (if appropriate).
The time at which DST starts and ends is fixed at 2:00 AM. This is valid for the USA and most of Western Europe. However in the United Kingdom (which has UTC time), DST starts and ends at 1:00AM. There is no separate UK zone so the AVR clock is not 100% accurate for those living in the United Kingdom.
The automatic DST feature also works with the GPS NMEA input mode, again assuring you accurate date and time. Combine GPS NMEA input mode with Automatic Daylight Saving Time and you'll have the correct date and time until March 8, 2015, 01:59 AM, accurate to within 10 milliseconds (when also using the GPS 1 PPS input.)

Q: What does the "Chrono" Menu option do?
A: The Chrono option in the menu enables a fractional seconds display in the 24 hrs and hexadecimal numeric display modes. This fractional seconds display shows the current time in 1/100 of a second increments.

Q: Why does the clock display jump ever so slightly every 5 minutes?
A: The Sparkfun clock offsets the display slightly every 5 minutes to prevent screen burn-in on your oscilloscope. You can toggle this burn-in prevention feature on or off using the **BurnIn** option, value **On** or **Off**. This mode is persistent.

Q: What does “this mode is persistent” mean?

A: It means that the mode is remembered when the power is turned off, and the clock will start in the same mode when the power is turned back on. This is achieved by setting status bits in the EEProm section of the Atmega AVR.

Q: How do I align the clock properly on my scope?
A: Select the **Cal** option, set the value to **On** , which will display a Calibration Pattern on the scope, to adjust the display. While in Calibration Mode, use the Volts/Div VAR knobs together with the position knobs to get the best square possible; this screen can also be used to fine-tune the probe compensation adjustments. Get back in the Menu mode (S1 short push), Select the **Cal** option, set the value to **Off** , to return to the normal clock display.

Q: Why doesn't the Calibration Screen change location to prevent Burn-in?
A: This is a design decision. Having the Calibration Screen move while you are aligning the screen doesn't seem to be a good idea. Keep in mind when aligning that the actual screen will move by a very small amount every 5 minutes unless burn-in prevention is turned off

Q: How do I tell the Sparkfun clock to start and stop blinking the LED?
A: Select the **Led** option, set the value to **On** or **Off** to toggle the LED blinking. Stopping the blinking LED will also suppress the valid NMEA record received notification on the display ('G') if GPS mode is enabled. This mode is persistent.

Q: How do I reset the Sparkfun clock without disconnecting power?
A: An S2 long push will reboot the AVR clock.

Q: Is there another way to communicate with the Sparkfun Clock?
A: Yes, you can also use the serial interface to communicate with the Sparkfun Clock. This requires a standard Serial cable with DB-9 connectors and a terminal, usually a terminal program on a computer. Use the letter "x" to obtain a prompt. This interface is completely optional.

Q: How do I know which version of the firmware my clock is running?
A: Enter menu mode using an S1 short push. The top line shows the current firmware version. The serial connection will also display the firmware version, both when starting up and when using the status command ("s").

Using an External Clock Source

Q: How do I apply an external clock source to the Sparkfun clock?
A: The Sparkfun clock normally receives a 4096Hz signal from the Real Time Clock (RTC); after 4096 pulses, one second has elapsed. This signal can be intercepted and replaced at the header with pins marked "PPS RTC", "PPS" and "GND". The "PPS RTC" and "PPS" pins are normally shorted by solder joint JP4, but you can feed your own external 1 PPS signal (usually from a GPS device) to the pin marked "PPS".

To achieve this, the solder joint JP4 needs to be opened (remove the solder) and a 3-pin 0.1" header needs to be soldered into JP3. It is then possible to connect the external signal using header pins marked "PPS" and "GND".When using an external 1 PPS signal, the clock must be changed to 1 PPS mode using the on-screen menu (field PPS)
Once the solder joint has been opened, a shunt must be installed on the header pins "PPS" and "PPS RTC" to use the Real Time Clock again (as opposed to an external 1 PPS signal).

Q: How do I hook up the AVR Clock to my GPS unit? TO BE UPDATED
A: Connecting your GPS unit to the AVR Clock is simple once you get the correct cabling. This step may be frustrating though.

Serial Communication can electrically be done in at least 2 ways:
using TTL levels (5V)

using the RS-232 convention (-12V to -5V)

The pin marked "RX" in the USB header accepts incoming serial communication and expects 5V (TTL) level signals. Make sure the switch below this header is set to USB. Check what voltage level your GPS unit generates on its outgoing serial port. A bare GPS chip/board usually generates 5V (TTL) levels (but may also be 3.3V levels), a more extensive board may generate the RS-232 levels. If your GPS unit generates these RS-232 levels, connect it to the DB9 connector.
Serial communications is based on a TX line and an RX line. You need to make sure that the TX line of the GPS unit is connected to the RX line on the AVR Clock. A standard serial cable used to communicate with a computer will not work! The easiest way is to connect a cross-over cable to your existing cable to switch the RX and TX lines. Make sure you pay attention to the DB-9 connectors used on your cabling: there are male ones and female ones. Combining a "gender changer" and a cross-over cable is a good option.

You can use the built-in Terminal application, already present on the AVR Clock (**Menu-App: Term**), to test out the serial communication between a GPS device and the AVR oscilloscope hardware! Don't forget the set the proper baudrate in the menu (**Menu-Baud:4800.**) Once the connection is working, configure the GPS unit to send out NMEA $GPRMC records at 4800bps; this is the default on most units.
The GPS device may send out lots of NMEA information every second. The AVR clock will have to process every record, discarding most of them. Even though the Serial Input on the AVR Clock is completely interrupt driven and buffered, it does take some time to find the individual NMEA records, time during which

the oscilloscope screen cannot be refreshed and you will see an intensified dot on the screen when a lot of unwanted NMEA records are streamed by the GPS unit. If possible, disable the sending of other records and set the send frequency of the $GPRMC record to no more than once every 5 seconds; this is not required but makes it easier for the AVR Clock. If necessary, also select UTC time, not GPS time. Do not connect the cable to the AVR Clock yet at this point.
Start the menu on the AVR Clock and advance to the "**GPS**" field. The default value is "**Off**". S1 short pushes will cycle you through the possible options; keep S1 pushed for auto-repeat. These numbers indicate your "local time zone offset" from UTC (Greenwich time). For example, the local time zone offset here in the Northwest is -8. For the United Kingdom, the offset is 0. Activate the selected option and connect the cable. If all is well, you will see the letter 'G' appear in the status field every 4 to 5 seconds, lasting 1 second. This indicates that the AVR clock has found a valid $GPRMC record. The 4 to 5 seconds is because the AVR clock will wait 4 seconds after finding a valid $GPRMC record before accepting another one. Parsing these records costs time, including several ASCII to binary conversions, so the AVR Clock waits 4 seconds after receiving a valid record. If the AVR clock determines that its time and/or date differs from the time and/or from the GPS device (after adjustments for the local time zone offset and possibly Daylight Saving Time), it will update itself and start a 5 second warning (flashing 'G'). This should be infrequent. The display of a 'G' every time the AVR Clock receives a valid $GPRMC record can be turned off using the **Menu-Led:Off** option.
Please disconnect the GPS cable before changing the "**GPS**" field in the AVR Clock menu to "**Off**". First of all the baud rate of the serial port is changed to 19200 bps and secondly, the AVR clock will try to interpret the incoming data (from the GPS device) as commands.
Combining the 1PPS signal from a GPS unit with NMEA parsing will give you an extremely accurate clock which will continue running even if you lose the GPS satellite signal (displaying the 'P' warning); the clock will correct itself, if necessary, once another lock is obtained.

Serial (RS-232) interface

Q: Do I need the use the Serial Interface?
A: No, use of the Serial Interface is optional. The Sparkfun oscilloscope scope clock uses the on-board pus button switches S1 and S2 to set the time and has an on-screen menu to set options, using the same switches.

Q: What is the hardware connection between the AVR clock and the RS-232 interface on the computer?
A: You can use a standard serial cable. Such a cable has one female DB-9 connector and one male DB-9 connector. The male DB-9 connector plugs into

the female DB-9 connector on the clock. These cables also connect the proper RX and TX pins on each side of the cable (crossover cable.)

Q: What baud rate do I set for the Serial interface to my computer (or some other terminal)?
A: The Sparkfun clock uses a default baud rate of 19,200. Other values are default (8 bits, 1 stop bit, no parity, and no handshaking). You can change the baud rate using the on-screen menu.

Q: How do I change the baud rate on the Serial Interface?
A: Use the on-screen menu (S1 short push) to change the baud rate: **Menu-Baud:value**. Supported values are 19200 (default), 28800, 38400, 57600, 115200, 4800, 9600, 14400. The Sparkfun Clock will automatically set the baud rate to 4800 bps when enabling GPS input mode but you can then change it to another value, if so desired. The Sparkfun Clock will reset the value to 19200 when disabling GPS input mode. The selected baud rate value is persistent, meaning the value is retained after a reboot or power cycle.

Q: How can I check the current baud rate setting on the Serial Interface?
A: Select the on-screen menu (S1 short push) and the current baud rate is shown in the field called "Baud"). Use S2 short pushes to quickly exit the menu.

Q: How do I communicate with the Sparkfun clock using the Serial interface?
A: Using the proper serial cable, as described above, you can use your favorite terminal program, such as HyperTerminal or Bray's Terminal, and set it to use a 19,200 baud rate, 8 char, 1 stop, no parity, and no handshaking (default baud rate). Make sure you select the proper COM port, where the cable is plugged in, usually COM1. If the connection is good, the Sparkfun clock will display a sign-on message when it starts. You can communicate by using the 'x' key. The Sparkfun clock will show a command prompt with all available commands. Type 'h' for more details. All command keys can be either upper or lower case; the Sparkfun clock will treat them as identical. Prompts will time out after 30 seconds.
Note that the Serial Command Line interface is not available when the GPS NMEA parsing option is enabled since that feature uses the same serial port. The same applies when running other applications like the Terminal or the miniDDS function generator since these applications use the serial ports themselves.

Q: How do I send commands to the Sparkfun clock using HyperTerminal?
A: HyperTerminal sends each character typed immediately to the Sparkfun clock, which will prompt you for the next character, if needed. You can always type another 'X' to cancel a command. Please double check that hardware handshaking is turned **off** because it is the default in HyperTerminal.

Q: How do I send commands to the Sparkfun clock using Bray's Terminal?

A: Bray's Terminal does not send each character typed immediately, as HyperTerminal does. You must select the white "send" line near the bottom of the window (transmit section) with the mouse and type the characters to send there. Do not add any CR or LF characters. Use the "send" button to transmit the characters, one at a time or all at once, whatever you prefer. The Sparkfun Clock can buffer up to 128 characters at a time. For example to change the clock to 2PM, you can type "XT140000" in the send line and then hit the ->send button.
Bray's Terminal also allows you to assign macros containing multiple characters. If you use those, you can send multiple commands in rapid succession. You'll see that the Sparkfun clock is incredibly responsive without affecting the display.

Q: Can I send commands to the Sparkfun clock any other way?
A: Sure, you can use the "copy" command in a DOS box to control the clock. For example, you can make a script to pull the current time from the internet (using an NTP server), create a text file with a clock command and send that file to the AVR clock to set the time, like this:

```
copy settime.txt com1:
```

Where settime.txt would look like this:

```
xt12:00:00
```

Using this technique, you can also use the AVR clock to display a text based slide show. Check out the file below for an example

ClockMessage.zip

Please note that there are trailing spaces in the files line1.txt to line7.txt

Q: My laptop does not provide an Serial interface. What can I do?
A: The best solution is to use an FTDI USB to serial converter cable or the Sparkfun FTDI breakout board. One thing to keep in mind with the USB interface is the fact that you will need to communicate with a USB Host, usually a computer. The USB interface cannot be used to communicate with another USB client (aka slave), unless you use some kind of bridging device. A USB only GPS device cannot be directly interfaced; use a serial GPS receiver instead.

The use of the RS-232 interface is optional. It can be used for firmware upgrades, a very fast user interface, GPS device input and other applications.

Q: If my oscilloscope is not near my computer, what should I do?

If you want to use the serial interface away from your oscilloscope, you can disconnect the Sparkfun clock from the oscilloscope and check its operation near the computer independently (except for the Calibration Screen). The LED on the AVR clock will blink every second if it is operating properly. The Sparkfun clock will also communicate its status through the RS-232 interface; you don't need a hookup to an oscilloscope to change settings using the serial interface.

Q: What commands are available using the Serial interface?
A: Once the cable is connected properly, the clock will display a sign-on message on the terminal when it powers up. The command 'X' is used to get the clock's attention (interactive mode). A prompt will show:

```
Command(A,B,C,D,F,G,H,I,K,L,M,N,P,R,S,T,U,V,W):
A: Change Application
B: Toggle Burn-in Prevention
C: Toggle Calibration Output
D: Set Date
F: Set Clock Face Mode
G: Toggle GPS NMEA input Parsing
H: Show extended Help
I: Start Demo mode
K: Toggle the Fractional Seconds Display
L: Toggle LED Blinking
M: Toggle 1PPS Trigger Mode
N: Set Numeric Display Mode
P: Set Clock Play Mode
R: Reset the EEProm Configuration Data
S: Show Status info
T: Set Time
U: Set Automatic Daylight Saving Time Adjustment
V: Toggle Verbose Output
W: Enter User Name
```

Execution of any of these commands, or another 'X' will end the interactive mode. Prompts will time out after 30 seconds. Note that the commands can be given in either upper or lower case.

Q: How do I tell the Sparkfun clock to change the Clock Face?
A: Use the 'F' command followed by a 2 digit numeric value.
The full list of options is:

00 12 hr dial
01 24 hr dial (can show numbers 13..23 on the dial)
02 Roman Numerals Dial
03 Binary Clock Display
04 Minimal dial

Q: How do I tell the Sparkfun clock to change the Numeric Display?
A: Use the 'N' command followed by a 2 digit numeric value.
The full list of options is:

00 12 hr (AM-PM)
01 24 hr (International/Military Time)
02 Hexadecimal
03 Date
04 No Numeric Field

Q: How do I tell the Sparkfun clock to display just the dial on the analog clock?
A: Use the 'F04' command to select a dial with just 4 numbers. This mode is persistent.

Q: How do I tell the Sparkfun clock to display the Numeric Display in AM/PM mode?
A: Use the 'N00' command to set the Numeric Display to AM/PM mode. This mode is persistent.

Q: How do I tell the Sparkfun clock to start and stop blinking the LED?
A: Use the 'L' command to toggle the LED blinking. This will also suppress the 'G' notifications on the screen when a valid $GPRMC record has been received (in GPS mode). This mode is persistent.

Q: How do I tell the Sparkfun clock to send the current time and date to the Serial interface every minute?
A: Use the 'V' command to toggle Verbose mode. This mode is persistent.

Q: How do I align the clock properly on my scope?
A: Select the Calibration Mode, command 'C', which will toggle between the regular clock and a Calibration Pattern on the scope, to adjust the display. While in Calibration Mode, use the Volts/Div VAR knobs together with the position knobs to get the best square possible; this screen can also be used to fine-tune the probe compensation adjustments.

Q: How do I set the time on the Sparkfun clock using the Serial interface
A: Type 'X' on the terminal. Once you get a command prompt, type 'T'. The Sparkfun clock will prompt you for the time. The hours info must be entered in the 24-hour format. Here is the conversion from the US standard to 24-hour format:

US Regular Time	24 Hour Time	US Regular Time	24 Hour Time
12:00 a.m.	00:00	12:00 p.m.	12:00

1:00 a.m.	01:00	1:00 p.m.	13:00
2:00 a.m.	02:00	2:00 p.m.	14:00
3:00 a.m.	03:00	3:00 p.m.	15:00
4:00 a.m.	04:00	4:00 p.m.	16:00
5:00 a.m.	05:00	5:00 p.m.	17:00
6:00 a.m.	06:00	6:00 p.m.	18:00
7:00 a.m.	07:00	7:00 p.m.	19:00
8:00 a.m.	08:00	8:00 p.m.	20:00
9:00 a.m.	09:00	9:00 p.m.	21:00
10:00 a.m.	10:00	10:00 p.m.	22:00
11:00 a.m.	11:00	11:00 p.m.	23:00

You can also send the new time in one command, for example 'xt130000 will set the time to 1:00 PM

Q: How do I change the Clock Face to something more serene?
A: The Sparkfun clock provides 3 different controls to change the clock face, providing a total of 30 different combinations. Use the ‘N’ command to select the Numeric Display mode (00-04). Use the ‘F’ command to select the Dial Display mode (00-04).
The combination of No Numeric Display and Minimal dial (XN04XF04) provides an serene display.

Q: How do I change the Triggering method for the 1PPS signal? TO BE UPDATED
A: The AVR triggers by default (when in a clean state) on the falling edge of the 1PPS signal because the Real Time Clock, which is the default 1PPS signal generator, produces a negative going signal. An external 1PPS signal may require a trigger on the rising edge of the signal, for example if it is a long positive going signal or the return to GND level is very slow. You can toggle the 1PPS trigger mode using the 'M' command. The Sparkfun Clock will reboot after this command since the INT0 interrupt needs to be reinitialized.

Q: How do enter a User Name using the Serial Interface?
A: Use the 'W' command. You will be prompted for a the name. Enter the desired name followed by 2 spaces, a CR, an LF or use all 20 available characters. Trailing spaces will automatically be removed.

Q: How do I change application using the Serial Interface?

A: Use the 'A' command. You will be prompted for a 2 digit value (0..3). 0 selects the Clock application, 1 the Terminal application, 2 the Function Generator application and 3 reboots the clock.

Sparkfun Clock Warnings

Q: Why does the AVR clock display a flashing letter P?
A: This happens when the Sparkfun clock is in back-up mode, i.e., it does not receive the proper PPS signal (Pulse per Second) from the RTC (or another external source). The Sparkfun clock has a countdown timer that is activated after roughly 1 1/30 second (based on its own crystal oscillator), and it advances the time if no PPS signal was received.
This will most likely happen when a GPS device feeds the 1PPS signal and the device looses its satellite lock. The clock will keep going in that case, though running a little slow. If you have the NMEA output of the GPS device connected to the Serial Port (and the GPS option is selected with the proper local time zone offset), the Sparkfun clock will automatically set the proper time and date once the GPS device gets another lock. A flashing letter "**G**" indicates the the time or date was changed based on the incoming NMEA records.
The RTC has its own backup battery and is always powered. To reset the RTC, please remove the battery temporarily (with the power disconnected, of course) The time and date will be random if this happens, so please Reset the EEProm configuration data or set the correct time and date immediately.

Q: Why does the Sparkfun clock display a flashing letter G?
A: This happens when the Sparkfun clock determines that its time and/or date is different from the time/date obtained from the NMEA output of a GPS device connected to the Serial Port (and the GPS option is selected with the proper local time zone offset). The Sparkfun clock will update its time (and the on board Real Time Clock) to the time/date obtained from the GPS device and will display a flashing letter "**G**" for 5 seconds.

Q: Why does the Sparkfun clock display the letter G once?
A: This only applies when the NMEA output from a GPS device is connected to the Serial Port and the GPS option in the menu is enabled. When the Sparkfun clock receives valid NMEA data from the GPS device (but no more frequent than once every 5 seconds), it will display the letter G for 1 second.

Multiple Applications

Q: How do I run one of the other preloaded applications ?
A: Select the menu (S1 short push), move to the "App" field (S2 short push), advance to the application of your choice (S1 short push) and activate it (S2 short push). You can choose from Terminal ("Term"), Function Generator ("Gen"), Clock ("Clock"), Demo ("Demo") or reboot the AVR clock ("Boot").

Q: How do I exit the other applications?
A: When running the terminal program, just select the menu again (S1 short push) and go to one of the other apps, as described above. From the Function Generator, you must power cycle the board. Trick: pushing S2 while sending data using the DDSControl.exe program will also reboot the Sparkfun clock.

Q: Which application runs when the Clock board starts up?
A: The Clock and Terminal application are persistent, meaning the board will start them again after a reboot (incl. a power cycle.) The Function Generator application is not persistent since the only way to exit it is through a reboot (incl. a power cycle)

Q: How do I operate the Terminal Application?
A: Please read this page.

Q: How do I operate the Function Generation Application?
A: Please read this page.

Q: How do I reboot the Sparkfun clock from the menu?
A: The "App" field has a choice "boot" which will reboot the AVR clock when selected. You can also do a long push on switch S2 to reboot at any time.

Q: Will the clock lose time when running one of the other applications?
A: No, the on-board Real Time Clock keeps accurate time while one of the other applications is running. The Sparkfun Clock will reload the current time from the RTC when starting the clock application again.

Sparkfun Clock Hardware Issues

Q: Why are there 3 pins on the connector marked Ground?
A: These three pins are all Ground pins. They are there to give you more freedom hooking up ground wires.

Q: The clock dial and or digits seem distorted. Is there a way to fix this?
A: This can happen if you are using 10x probes and the probes aren't properly compensated for your scope. Find the adjustment screws on each probe and adjust them until the image is clean. This should not happen with 1X probes or direct wires (incl. BNC cables)

Q: How does the Sparkfun clock trigger on the 1 PPS signal? TO BE UPDATED
A: By default the AVR clock uses a 1PPS signal generated by the on-board RTC. This is a negative going pulse so the AVR clock triggers on the negative going edge. Most GPS units have a TIMEKEEP signal that is normally low and pulses high for 200 mSecs every second; by default, the AVR clock triggers on the

negative edge at the end of this pulse. You can use the Serial Command 'M' to toggle the trigger mode of the AVR clock.
Please note the following. The AVR Clock has an internal pull-up resistor enabled on this pin so that the pin is HIGH when not connected (e.g., when the shunt is removed from JP6). If your 1 PPS signal is normally low, it will have to PULL DOWN the signal to LOW, and a small current will run from the AVR to your signal source.

Q: What is the purpose of the push button switches S1 and S2 on the Sparkfun clock?
A: It is the user input interface. As S1 short push will enter the Menu mode. An S1 long Push will enter the Change Mode. The S1 push button switch is also used to allow firmware upgrades using your PC (see firmware upgrade).

Q: What is the purpose of the 'Z' pin on the Sparkfun clock?
A: The Z (Intensity) output on the Sparkfun clock dims the beam at the appropriate moments. This output will decrease its voltage towards 5V to *decrease* the scope intensity. Please connect this signal to your oscilloscope intensity control input, if present. It is very effective in suppressing highlighted dots on the screen.

Q: What is the purpose of the 'ZINV' pin on the Sparkfun clock?
A: The ZINV (Inverted Intensity) output on the Sparkfun clock dims the beam at the appropriate moments. This output will increase its voltage towards 5V to *decrease* the scope intensity (Tektronix 400 scopes convention). Please connect this signal to your oscilloscope intensity control input, if present. It is very effective in suppressing highlighted dots on the screen.

Q: What are the voltage levels present on the CH1 and CH2 terminals?
A: The voltage levels on the CH1 (X) and CH2 (Y) terminals range from 0 to 5 Volts. This range can be reduced using the on-board trimpot R8 TO BE UPDATED.

Q: I'm seeing a pattern on my scope but no clock display. What is wrong?
A: Make sure your scope is in X-Y mode and that the proper Vertical Mode is selected. On many Tektronix scopes this is the CH2 Vertical Mode. Also double check the probe connections, as well as their Ground.

Q: I'm seeing an uneven line at the edge of the scope screen. What is wrong?
A: You have only one channel properly connected to the scope. Make sure both channels are properly connected to the Sparkfun clock CH1 and CH2 terminals.

Q: My Tektronix 7000 series oscilloscope and its plug-ins have no X-Y mode. Can I still use it with the Sparkfun clock?

A: Yes, but you will need two separate vertical plug-ins, one in the usual vertical slots on the left and one in one of the horizontal slots (on the right).

Q: Is the oscilloscope I use permanently dedicated to this clock?
A: No, the only connections are the 2 BNC cables or probes and possibly the Intensity Control. Just unhook the probes/cables (and Intensity Control cable), and you can use your scope for its intended purpose.

AVR specific Issues

Q: How do I update the firmware of my Sparkfun Clock?
A: Please read this page.

Q: How do I know which firmware version my Sparkfun clock is running?
A: The current firmware version is shown on the options menu, top line. Enter the menu using a short push (push and release) on the S1 button switch.

Q: Where can I find the firmware for the Sparkfun Oscilloscope Clock 3.6ds?
A: The firmware for version 3.6ds is available on the main Sparkfun Oscilloscope Clock page, under "Technical Information", link "Flash Image V3.6ds (Serial Download)" TO BE UPDATED. This firmware version is the clock application itself (excluding the boot loader) and can be downloaded to the clock using the serial cable, as described here.

Q: Can I use my official AVR programmer (like the STK-500) to reprogram the AVR?
The flash memory on this ATmega328p AVR is configured into two areas, the clock application (word address 0x0000-03DFF) and the boot-loader (word address 0x3E00-0x3FFF). Using the boot-loader to reprogram the AVR will ONLY update the first area, which is all you need to get an updated clock version. Programming the flash memory using this "clock only" firmware with an official AVR programmer, will reprogram all the flash memory, in effect clearing the boot-loader area. **Turn off the "Boot Reset Vector Enabled" fuse (BOOTRST)** and the clock will work just fine. However, you won't be able to update the firmware using the serial link anymore (you still can use the AVR programmer.) To maintain the ability to update the flash memory using the serial link, you will need a flash image of the combined "clock+boot loader", which is available on request.
You are advised to first save a copy of the entire Flash area and store this copy in a safe place before updating to another application without a boot-loader. This way you can restore the AVR Clock incl. the boot-loader later.

Q: My AVR fuses are set incorrectly. How should they be set?
A: First of all, be very careful because you may make the AVR inoperable by setting the wrong fuse, especially the “Use External Clock” fuse. Finally, in the AVR world, UNPROGRAMMED fuses (i.e., disabled) have a ‘1’ value, whereas

PROGRAMMED fuses (i.e., enabled) have a 0 value. It's easy to get confused, depending on the program being used to modify the fuses. Here is a list of PROGRAMMED fuses for the Atmega328p AVR used in this scope clock:

Boot Flash size=512 words (BOOTSZ)

Boot Reset Vector Enabled (BOOTRST)

SPI (Serial Program downloading) enabled (SPIEN)

Preserve EEPROM memory through the Chip Erase cycle (EESAVE)
Brown-out detection level at VCC=2.7V (BODLEVEL)

Ext. Crystal Osc; Frequency >= 8.00 MHz. 16K CK/14 CK + 65 ms. (SUT_CKSEL)

Programming an AVR microcontroller and setting the fuses need to be done using an AVR programmer. Popular models are the STK-500 compatible types, a USB based programmer like the USBTinyISP or the AVR Dragon from Atmel (highly recommended for its in-circuit emulation support). Check out the Atmel or AVRfreaks websites for more information.

Fun

Q: This Sparkfun clock is too serious. Can't it do anything fun?
A: Do you wish time was passing faster, or do you want to go back in time? Try the **Play Rev** or **Play FF** menu options (or use the P command (00-03)). You'll see the clock obeying your wishes! Try them together using **Play FR**! Note that for either of these fun modes, the Real Time Clock (RTC) will not be updated; once you exit the Play Mode, the **Sparkfun** clock will read the actual time and date back from the RTC.

Q: How do I show the capabilities of this Sparkfun clock to my spouse?
A: Run the clock in **DEMO** mode. You can select this form the on-screen menu: S1 short push to select the menu, advance to the App field by issuing S2 short pushes, select the Demo option using S1 short pushes, then activate it with a short S2 push. The **Sparkfun** clock will enter demo mode. No user settings will be changed by the demo, nor will the time in the Real Time Clock be changed. At the end of the demo, the clock will automatically restart in normal operation mode.

Back to Sparkfun Oscilloscope Clock