ARDF

A low cost timing system for ARDF

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ARDF: DEDICATED TO DF HUNTING

PHOTO 1: The iButton mounted in a key fob with a 50p piece for scale.

BACKGROUND. Electronic timing has become a familiar part of any orienteering competition. ARDF has followed this pattern at both national and international level. The established systems are seriously expensive and this article describes a low cost alternative using the Dallas iButton (iButton is a trademark of Maxim Integrated Products).

AVAILABLE STRATEGIES. In principle there are two ways in which an electronic timing system can be implemented. The first is to concentrate the technology, including the timing, in the boxes placed in the forest alongside the transmitters. Each competitor then carries a cheap and simple 'dibber' that is used to read from the box the time of the visit and the identity of the box (and hence the transmitter) that has been visited. This is the approach of the Sport Ident (SI) system used in international ARDF competitions and is sometimes called the 'smart control and dumb card' technology.

The alternative is to concentrate the clever stuff, including the clock, in the dibber carried by the competitor. This makes the boxes placed in the forest much simpler and cheaper but raises the cost to the competitor. However, theft of a timing box from the forest is much less of a financial risk as a result.

To give an idea of the costs involved, the more popular SI system used in ARDF now charge about £100 for each of the timing boxes that are placed in the forest, while the competitor must pay nearly £40 for a dibber. These prices have risen significantly since the system was first introduced.

The big advantages of electronic timing technology are that it obviates the need for manual checking of paper control cards and also records the split times at each hidden transmitter. This latter feature allows much post-race analysis to see exactly where one's peers were able to gain an advantage.

THE DALLAS iBUTTON. Although the product has been taken over by Maxim and is now marketed by them, the original Dallas system was the concept of having an electronic chip encased in a stainless steel can about the size of a 2p piece with just one data contact on the lid and the base forming a ground, **Photo 1**. An address of 16 characters forms a unique identifier for each iButton. These devices are often used in supermarkets for checkout staff to log on at a till. The iButton is on their key ring or security lanyard and it is inserted into a receptor on the till. iButtons come in different varieties to give varying functionality. In this project, the DS1904 is used to synchronise the stations in the forest while the competitor uses either a DS1992 (1kbit of memory) or a DS1993 (4 kbit) for the dibber.

PREVIOUS WORK. The application of the Dallas iButton to event timing is not new. Joe Lee Computing **[1]** has offered a commercial system for some years. The first application to ARDF event timing was by a Slovenian group (S51MO) who produced a complicated box to be placed at each transmitter.

More recently, Stipe Predanic, 9A5SP developed an incredibly simple but practical dumb card, smart control system that he called OPORCON (OPen source ORienteering electronic CONtrol).

THE 9A5SP OPORCON SYSTEM. This uses a PIC 16F628 in the control boxes. It uses the internal cycles of the PIC chip to calculate time and no additional clock is needed. The original design used a 4MHz clock but the author adopted a 4.19MHz clock so that binary division gives accurate 0.5 second interrupts and much cleaner software code.

OPORCON adopted the DS1992 iButton for use by the competitor. This is a 1kbit non-volatile memory that will store 32 Unix time codes. The control number, held in the box placed at each transmitter, defines where the time stamp is held in memory. The time at control 1 will therefore be recorded in the second memory address slot (slot 0 being the first slot). The author chose slots 30 and 31 for the start and finish times respectively. A total of 29 slots is quite sufficient even for

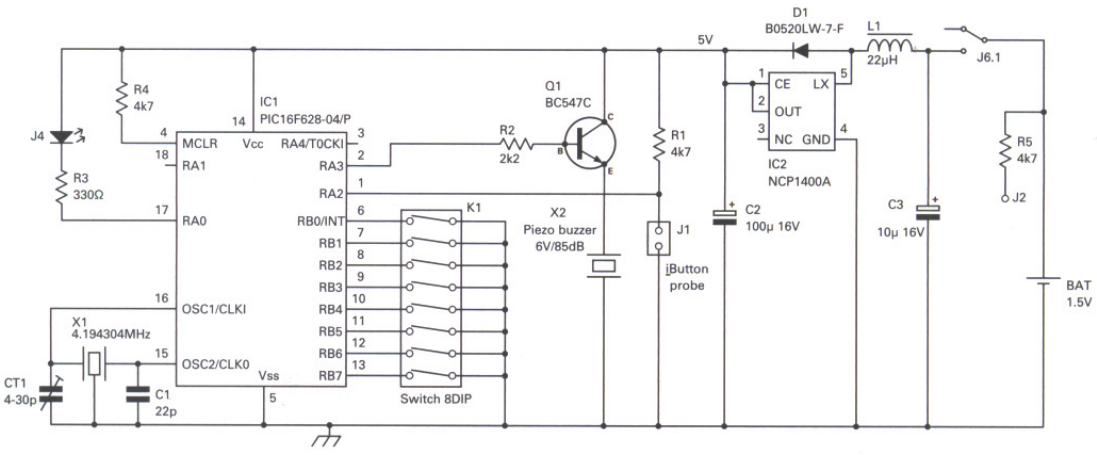

FIGURE 1: Schematic of the control unit placed next to each transmitter, the PCB track patterns are available at www.rsgb.org/radcom.

a FoxOring competition. Should capability for more control stations be required (for example for a multi course orienteering event), the 4kbit capacity of a DS1993 can be utilised.

The control units at the transmitters need to know the correct race time. The DS1904 iButton is a real time clock and this is used to set the current time. This is done by the course planner after the unit is switched on.

A number of improvements and features have been implemented in the version of OPORCON described here.

- The control units placed at each transmitter are powered by a single AA cell instead of an expensive 9V PP3. An NCP1400 step-up regulator with a diode and a choke generates the higher voltage needed.
- The control number is set by a DIP switch in the unit shown in **Photo 2**, but it can be hard wired on the PIC, allowing one software version for all control units.
- A super bright LED (visible in sunlight) and a buzzer (very loud, to be heard from inside a sealed enclosure) are flashed/sounded to give competitor feedback of a correct 'punch' at the control unit.

The commercially available probe socket into which the iButton must be placed to register a 'punch' is unsuitable for reliable operation in all weathers out of doors. A cheap but effective solution was developed using a standard 16mm key ring as the socket 'case' and a separate M3 bolt head as the centre pin. The key ring is soldered onto a 25mm square piece of single sided PCB and the key ring lightly expanded so that the top is marginally higher than the centre pin. Rainwater will therefore not build up in the socket even if it is mounted horizontally, **Photo 3**.

The control box is mounted at a 45° angle to allow water to run off easily and to allow convenient 'punching' by the competitor. The DS1992 iButton is mounted in a plastic key fob holder and attached to a nappy pin (yes – these are still available!) that allows it to be fastened to the clothing, **Photo 4**.

In addition to the two items of hardware already described, the complete system also requires a download lead to connect an iButton to the USB port of a computer.

PIC SOFTWARE IN THE CONTROL UNIT.

Software is required that maintains the UTC time, detects when an iButton is connected and then reads or writes data to the iButton, with error checking to validate the data transfer. 9A5SP developed PIC software, which was written in Mikroelektronika BASIC (free to download). The author has modified the code to accommodate the changes in the PIC port functions (eg DIP switch and buzzer).

The code was also modified so the control unit flashes the LED and sounds the buzzer when the unit is first switched on. This will continue until the user inserts a DS1904 RTC into the iButton socket. Cessation of the flashing confirms the unit is synchronised to UTC time. Thereafter the LED will flash on the minute for the first 5 minutes, then only flash when a competitor successfully 'punches' the unit with a DS1992.

ARDF EVENTS CALENDAR

April - Sunday 1st at Butterwood (M3 Junction 5)

April - Sunday 22nd at Atherstone, Warwickshire

DOWNLOAD SOFTWARE FOR A PC.

Software is required to download the data from each competitor's iButton after the event. The results can then be evaluated and printed. By 9A5SP's own admission, this is the least developed aspect of his OPORCON system.

Stripe's software is written in Borland Delphi (Pascal for Windows). Delphi was available free for non-commercial use until fairly recently and was often included on magazine cover disks. Unfortunately this is no longer the case, so readers will need to check their existing disk collection, if they want to modify Stipe's open source code.

The author has extensively modified this software in order to display and print the individual competitor's punch times using a low cost label printer and, at the same time, to save the data in text format. The data can then be later manipulated and used to publish results and analysis to the web.

Maxim's One-Wire-Viewer is also useful for displaying the raw data from iButton and for synchronising the DS1904 to UTC internet time standards.

EVENT PROCEDURE. Before the event, the master RTC iButton needs to be synchronised to a (internet) time standard using a PC, although in practice the absolute clock time is not particularly significant, since lapsed time determines the competitors' race and split times.

The battery voltage can be checked externally without unscrewing the unit. A partly discharged cell with a terminal voltage of 1.3V is sufficient to keep the unit running for at least 24 hours.

Decide which control unit is to be used for each fox location, the start and finish and home beacon (if used). Unlike the SI system, the control units do not need configuring for purpose, because this is defined in the download software (currently in an .ini file).

The control units are designed to be turned on in the field at the fox location. A latching switch is located behind a rubber blanking grommet and positioned so that it cannot be unintentionally switched off or on.

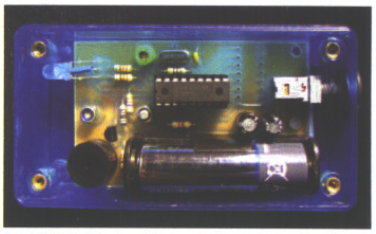

PHOTO 2: Photo of the prototype control unit.

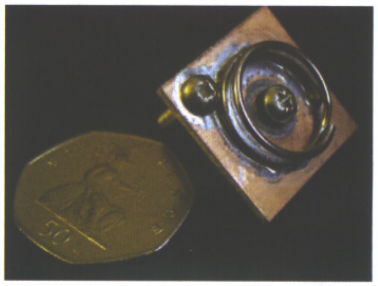

PHOTO 3: Home made probe socket, which has superior performance in wet weather compared to the commercial offering.

PHOTO 4: 'Punching' at one of the control boxes. The 45° angle makes this easy and at the same time allows rainwater to drain away easily.

A strip of red tape stuck across the control unit socket is also a good reminder to the operator that the unit has not been switched on.

The RTC iButton must not be forgotten before departing to set the course! As previously mentioned, the RTC is used immediately after switching on the control unit to set the control unit clock and silence the warning buzzer.

After a competitor punches the finish control, the iButton is read by software in a laptop PC and the punch times at each control are extracted and printed.

CONCLUSIONS. The system described is one that provides the all the essential functions of an event timing system for ARDF. Typical cost of a DIY control unit is around £12 and the iButton carried by the competitor is under £5.

WEB WATCH

[1] (www.joelee.co.uk)
http://stipe.predanic.com/?Projekti:OPORCON
www.youtube.com/watch?v=WK84V6mLdul
www.open-circuit.co.uk/ibutton.html