The ECM Rally Timer

User Documentation

Software Version 5.V onwards

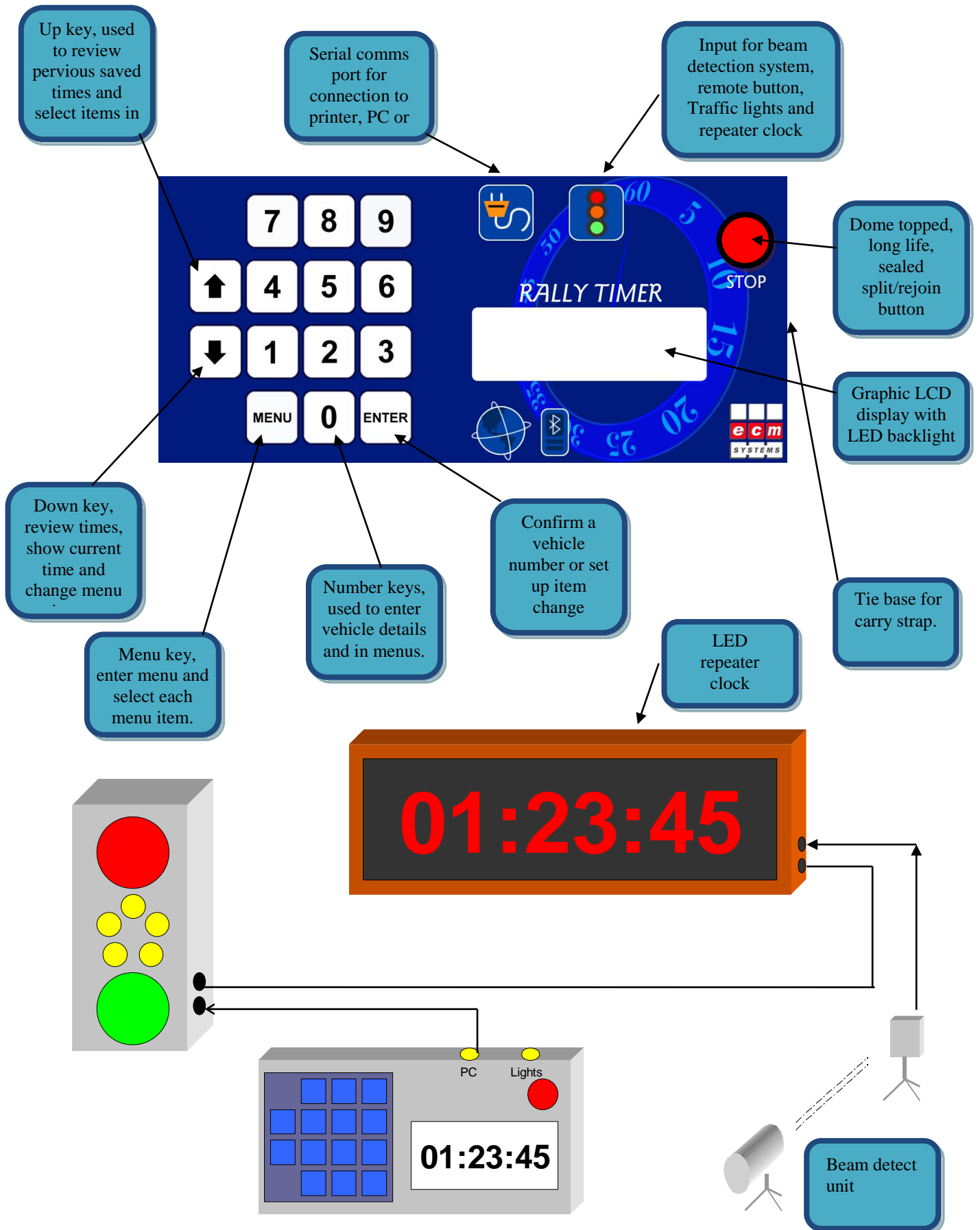## September 2020
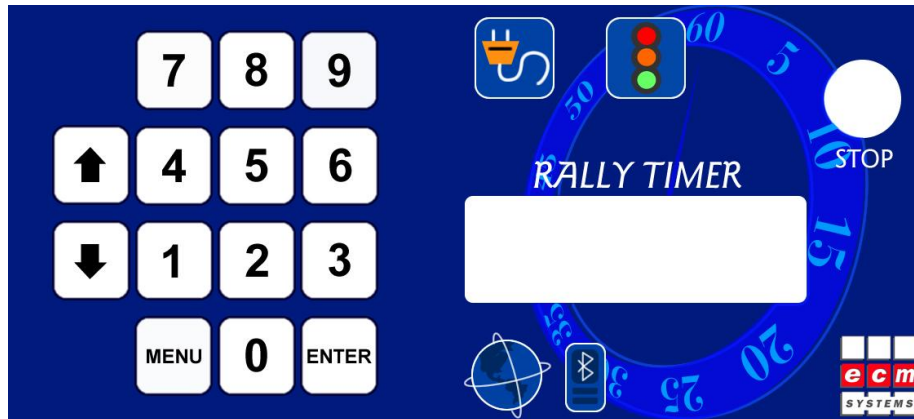
Contents

Controls and Equipment

Up key, used to review pervious saved times and select items in

Serial comms port for connection to printer, PC or

Input for beam detection system, remote button, Traffic lights and repeater clock

Dome topped, long life, sealed split/rejoin button

Graphic LCD display with LED backlight

Down key, review times, show current time and change menu

Menu key, enter menu and select each menu item.

Number keys, used to enter vehicle details and in menus.

Confirm a vehicle number or set up item change

Tie base for carry strap.

LED repeater clock

Beam detect unit

7 8 9
4 5 6
1 2 3
MENU 0 ENTER

RALLY TIMER

STOP

ecm SYSTEMS

01:23:45

PC   Lights

01:23:45

Overview

The Rally clock is a high accuracy microprocessor controlled timer specifically designed for use in motorsport applications. It is water and impact resistant and can be operated when wearing gloves or when very cold. It has been designed to exceed all current motorsport UK requirements for timing accuracy and functionality, however it must be tested for calibration and certified before it can be used in the UK.

The clock has several modes of operation to allow for differing requirements, skill of operation and ease of use. Each is described later. Additional timing modes can be added at the request of a user provided they fall within the specification of the unit capabilities.

In all operation modes data is logged in the internal memory and can be printed or retrieved onto a PC.

The basic clock consists on a large LCD display, a membrane keyboard and a high reliability waterproof STOP button.

Two ports are provided to allow connection to a printer, PC or other computer, remote clocks, Traffic light displays, repeater clock displays and a beam break input.

The unit can also be fitted with an internal GPS receiver to allow quick and accurate setting of the time.

Wakeup sequence

When supplied the clock will be in deep sleep mode to save power. To wake up the unit enter the following key sequence:

      STOP   MENU   ENTER

Each key will beep as pressed, the STOP key may take 2 seconds before it responds from sleep, and the full sequence must be completed within 5 seconds.
Pressing an incorrect key or too slowly will result in the unit remaining asleep.

Suggested operating procedures.

The timer is equipped with 18 operating modes described in detail in the next section. This table gives the recommended configuration for varying timing requirements.

IN ALL CASES USE THE SIMPLEST MODE OF OPERATION FOR THE REQUIRED FUNCTIONALITY.
Current recommended mode is highlighted

Rally events:
Stage Start

Countdown	Data collection	Mode	Use
Manual	No	1	SS
Manual	Yes	2	SS
Lights	No	3	SS
Lights	Yes	3	SS
Lights - start on beam	Yes	4	SS

Flying Finish

Input	Data collection	Mode	Resolution	Use
Manual	No	1	1s	FF
Manual	No / Yes	2	<1s	SF
Beam	No / Yes	2	<1s	SF

Stage Stop

The stage stop clock can be linked to the flying finish by either wiring the beam or remote button directly into the clock input. 2 or more clocks can be triggered in this way. Alternatively the clocks can be linked using the comms port.

Input	Data collection	Mode	Resolution	Use
Manual local	No	1	1s	FF
Manual remote	No / Yes	2	<1s	SF
Beam	No / Yes	2	<1s	SF
Linked to FF	Yes	5	<1s	SF

Arrival time control (ATC)

Used to check the time taken by a vehicle over a road stage. Times should only be displayed to 1s unless specifically required to a higher resolution.

Data collection	Mode	Use
NO	1	SF
Yes	2	ATC
Yes	6	ATC

Modes of operation

1. Basic Compatibility mode

This mode is intended to enable anyone who has previously used a Wharton clock to be able to operate the ECM clock without further instructions. It gives the largest possible clock display.

In this mode the time will always be shown in whole seconds, the traffic lights will free run at whatever time interval is set in the menu (clock must be configured as Stage Start (SS)), the number keys are not used.

03:12:45   Normal time display

If the STOP button is pressed or the beam input is activated the display will freeze and change to:

03:12:45 HELD   Frozen time display

Pressing the STOP button again will cause the display to resume displaying real time.
If the display remains frozen for more than 13 seconds it will start flashing to alert the user to restart it.

If a beam break occurs while the clock running or is frozen, the time will be displayed immediately and recorded internally. The LCD will change to the following:

03:12:45 BEAM   Frozen time from external input

Pressing ⬇ will display the previously held time

The clock will also drive a large LED clock display showing the same time as on the display.

 If the clock is configured as a stage start unit it will not record presses of the STOP button, instead it will record each time the traffic lights are operated and allow a vehicle number to be entered against each.
When the STOP button is pressed the current time will be frozen and the lights will go to RED or remain off. The sequence will not restart until STOP is pressed again and the next available time slot is reached.

Accessing previous stop times.

All previous times on which the clock has been frozen can be accessed using the arrow keys. Each stop event is given a number that is cleared down at the start of the event. Up to 450 times can be recorded. To avoid any confusion between a new time and a recorded time a smaller font is used for the display. The text gives the event number and if it was generated manually or from the beam input.

03:06:22
STOP # 12 M Vh. xxxx

Recorded time, STOP timer

A vehicle number may be entered at this point and confirmed using ENTER.
Pressing ⬆ after the latest time will return the display to the clock.

> #nnn is the sequence number, starts at #1 after clearing the memory and goes up by 1 each time STOP is pressed or beam broken

> M – Manual STOP
> B – Beam break
> R – Time from remote

> Vehicle number entered manually

2. Enhanced rally timer

In this mode the operation of the stop button is changed from a toggle to a single press function.
Each press of the button or beam break will record a time.
This is to allow the clock to record several vehicles passing in a short period of time.
The clock can be set to run in seconds, $1/10^{th}$ second, $1/100^{th}$ or minutes.
This mode also allows entry of vehicle numbers against each time.

This mode of operation is very dependent on the "stage use" setting

2.1 ATC or FF

Each time the button is pressed or the beam input is used a new time will be displayed. The stop number will be increased for each one recorded. Vehicle numbers can be input as they happen, or after the event by using the arrow keys to access old data.

03:06:42.1
STOP #15 M. V. xxxx

Frozen time, waiting for car no

The ⬆ and ⬇ keys can be used to access all previous times. The vehicle number can be entered at any time AFTER a time has been recorded. Vehicle number can be changed is incorrect.

Data will normally only be printed / transmitted if a vehicle number is entered. If a duplicate number is entered it will be assumed to stage 2, 3 etc. A number can be corrected if an error is made by using the cursor keys and re-entering the data. It will be retransmitted and flagged as a correction.

2.2 Stage Stop (SF)

In this mode only the time of the first vehicle is shown on the display, any further vehicles will be recorded and held internally until accessed by pressing the arrow keys. This allows the correct vehicle number to be entered when the car arrives at the stop line, the clock can then be shown to the driver if required, and the next time called up when the next car arrives. If a false beam trigger occurs it can be left unassigned or a specified error code entered.
Once a time has been dealt with, press ⬆ to access the next recorded time. This will be the time for the next vehicle to reach the stop line. If no further times are available the clock will revert to displaying the real time.
This mode takes any pressure off the stop crew to record times as they happen but requires some practice to make sure the correct time is allocated to each driver.

If more than one vehicle time is available a ⬆ will be displayed in the bottom right hand corner of the display. This will clear when all times have been viewed.

Pressing STOP, or a beam break will always generate a new time.
Pressing ↑ on the most recent time in the list will revert the display to the real time.

The clock will also drive a large LED clock display showing the same time as on the display.

2.3 Stage Start (SS)

The traffic lights will free run at whatever interval is set in the configuration menu.
The display can show 0.1 or 0.01 seconds but this is unnecessary for clocks at the start.
A vehicle number can be entered up to the point at which they leave the line. All times will be recorded in memory even if no number is entered. The ↓ key can be used to access and enter numbers against any times missed.
Start times will be printed or transmitted only when a vehicle number has been entered.
If the same number is entered more than once it will be assumed to be for stage 2, 3 unless the stage number is changed in the menu.

```
┌─────────────────────────┐
│ 03:06:42                │
│ NEXT VEHICLE XXXX       │
└─────────────────────────┘
```
Free running clock waiting for car number.

If the display is configured for whole seconds only a countdown of the time to go will be displayed for the last 10s.

```
┌─────────────────────────┐
│ 03:06:52          08    │
│ NEXT VEHICLE  21        │
└─────────────────────────┘
```
Vehicle confirmed, countdown showing.

Pressing STOP will display

```
┌─────────────────────────┐
│ 03:06:58                │
│ START HELD              │
└─────────────────────────┘
```

The lights will show RED and the clock will remain frozen until ↑ is pressed

An LED repeater clock can be configured to show the start time or countdown the seconds until the start.

3. Start timer

This mode should be selected when the clock is required to operate traffic lights on the start of a stage and automated data collection is required.
When configured as a start unit the clock will not record presses of the STOP button.
Times are only displayed to whole seconds; if timing is being done to $1/10^{th}$ or greater accuracy the times should be written down as xx.00, however jump starts will always be recorded to $1/10^{th}$S.

To enable a start sequence a vehicle number must be entered:

> **12:10:24**
> **START CAR xxxx**

Start timer, waiting for vin

On pressing ENTER the clock will calculate the next available time to operate the lights based on the current time and the run interval set in the menu.

Run times available are:
        Every 15 seconds
        Every 30 seconds
        Every minute, on the minute
        Every minute on 30s
        Every 2 minutes (even)
        Immediate (6s countdown)

If a longer time delay is required the operator should wait until within 1 minute of the required start time.

On pressing ENTER after entering a vehicle details the display will change to:
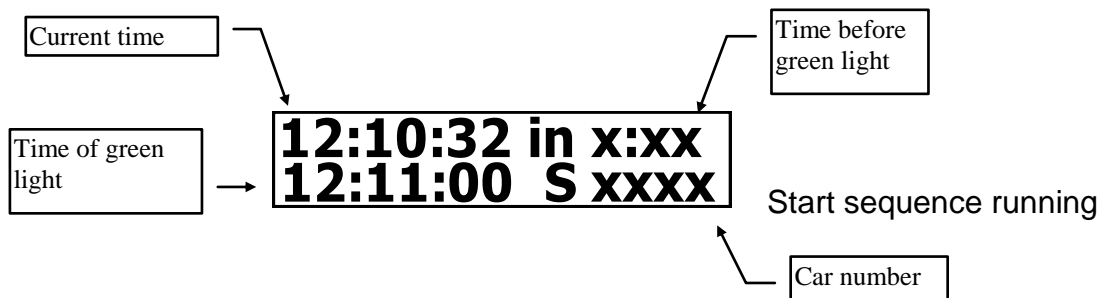
| Current time |
| Time before green light |
| Time of green light |

> **12:10:32 in x:xx**
> **12:11:00 S xxxx**

Start sequence running

| Car number |

Pressing the STOP button at any time will abort the countdown. If the light sequence has already started the RED light will be displayed until STOP is pressed again. Ensure the driver is fully aware that the sequence has been cancelled before switching off the red light.

Each vehicle started will be logged in the clocks memory and can be accessed using the arrow keys. As soon as the green light is displayed the next vehicle number can be entered.

In immediate mode, the last 5 seconds of the countdown will start immediately not linked to the current time.

3.1 Jump start detection

In start timer mode the beam input can be used to detect vehicles leaving the line before the green light. Care must be taken in positioning the car on the start line so that it is not breaking the beam while waiting, and not too far back that it could get a run up.

The beam input will only be activated 5 seconds before the green light. This is so that vehicles crossing the line while lining up, or spectators wandering about do not record spurious events. If the beam is broken before the green light the following will be displayed:

```
JUMP START xxxx
@ 12:10:59.5
```
Jump start display

If the time is equal to or after the allowed start time no message will be displayed.
The beam break time will be stored in memory along with the expected time.
Press ↑ to clear the jump start message and enter the next vehicle start details.

The beam will be de-activated immediately after a start time has been recorded.

The GREEN light will normally be removed after 6s.

The LED clock drive can be configured to show the real time, the time until green light or the actual start time.
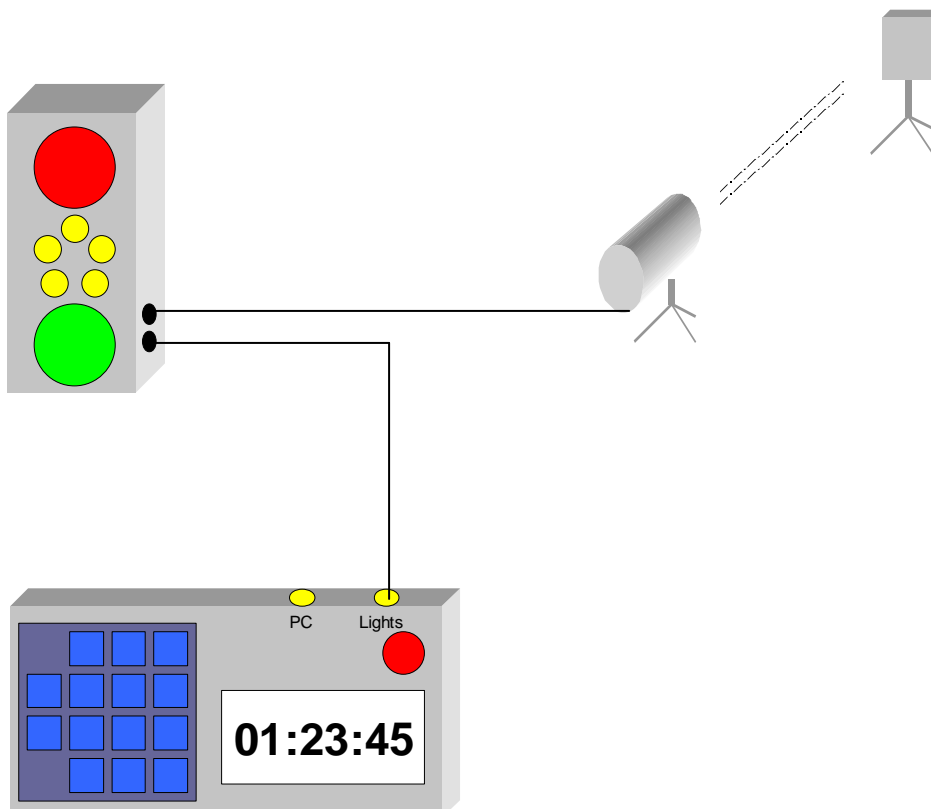
4. Sprint start timer - Class R

This is similar to the previous mode but intended for use in events where the GREEN light is used as a "go when ready" signal and the timing is taken from the point where the vehicle crosses the start line. A similar mode exists for class F timing where the clock starts at 00:00 on the Green light

12:10:24
START CAR xxxx   Start timer, waiting for vehicle number (vin)

Pressing Enter will confirm the start sequence. The lights will operate as per the selected sequence.

Current time

Time of green light

Time before green light

12:10:32 in x:xx
12:11:00 S xxxx   Start sequence running

Car number

The beam detector will be activated 5 seconds before the green light time and will remain active for 10s after unless a vehicle is detected.

When the car crosses the line the following will be displayed:

Car xxxx start
12:11:03.22   Sprint start display

Actual start times are given to whatever accuracy the clock is configured for.

If the time is ahead of the nominated start time the word "JUMP" will appear on the display next to the time.

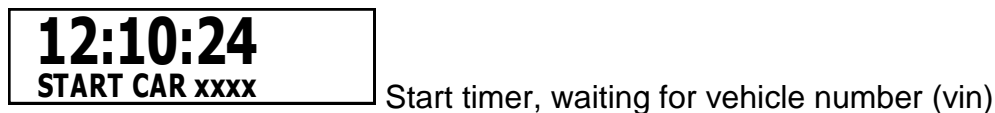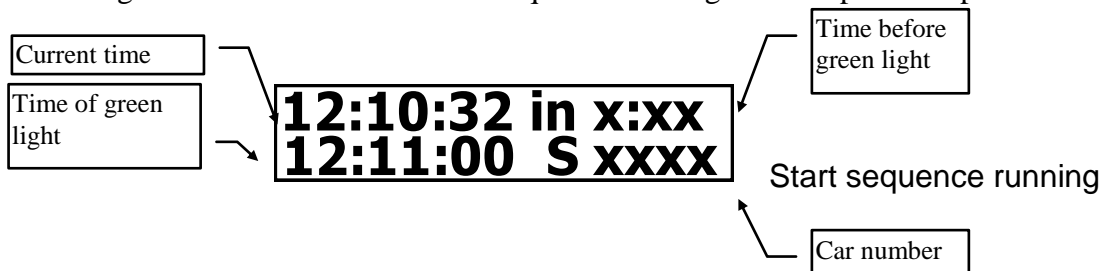Pressing the STOP button at any time will abort the countdown. If the light sequence has already started the RED light will be displayed until STOP is pressed again. Ensure the driver is fully aware that the sequence has been cancelled before switching off the red light.

Each vehicle started will be logged in the clocks memory and can be accessed using the arrow keys.

The LED clock drive can be configured to show the real time, the time until green light or the actual start time.

Alternative operation – casual start.

The above assumes the clock use is configured as SS (Start). A slightly different operation can be achieved by configuring as ATC.

In this mode the lights are a guide, but the competitor can start 10s early or 10s late without a penalty. Enter the rider number as before which will start the sequence, but if they cross the beam before the green light the time is recorded as their start time and the sequence is stopped.
In this mode any beam breaks are recorded.

5. Stage stop timer / Clock mimic / display driver

In this mode the clock displays and stores all data sent to it by another clock. The clock acting as a mimic must have its comms permanently enabled. The master clock can be running any other operation mode; however this mode is intended to be used to pass times from the flying finish to the stop control.
Data received by a mimic clock will be re-transmitted out of its comms port. This allows several clocks to be used in a chain.

If LNK or RF comms mode is used at the master clock, the slave clock can be configured in any of the available modes. This allows data to be printed locally or sent to a results system is appropriate format.

Special filers when using RF comms
All units plugged into an RF receiver will receive all information sent in range. This means that a stop line would receive information from the start and ATC which could lead to incorrect times being issued. The stage use menu is used to set the filter as follows:

Use	Filter
ATC	Only receives times from flying finish in FF or SF mode
SS	RF comms repeater mode. Sends any received data onto another timer using the retry mechanism.
FF	Receives all data, shows it immediately.
SF	Receives all data, manual selection of time using arrow keys.
RG	Use when mode 10 clock on finish (comp, sprint etc) only receives calculated run times.

The flying finish and stage stop can be covered using modes 1 or 2, however two clocks can be connected together using a suitable cable (3 core or 2 core speaker cable), so that the time recorded at the finish can be passed automatically to the position where the paperwork will be done.

If the vehicle number is not entered at the finish it can be entered as soon as it is known.

> **03:06:42.1**
> **STOP #15 R. V. xxxx**

STOP timer display

The STOP button will operate in this mode as a backup in case the main timer fails and will display a 'M' in place of the 'R' from the remote clock.

This mode will also drive a large LED type clock that will show the driver his finish time.

Comms breakout cable

2 core wire

Comms breakout cable

01:23:45

PC   Lights

Flying Finish clock

PC   Lights

01:23:45

Stop Line Clock
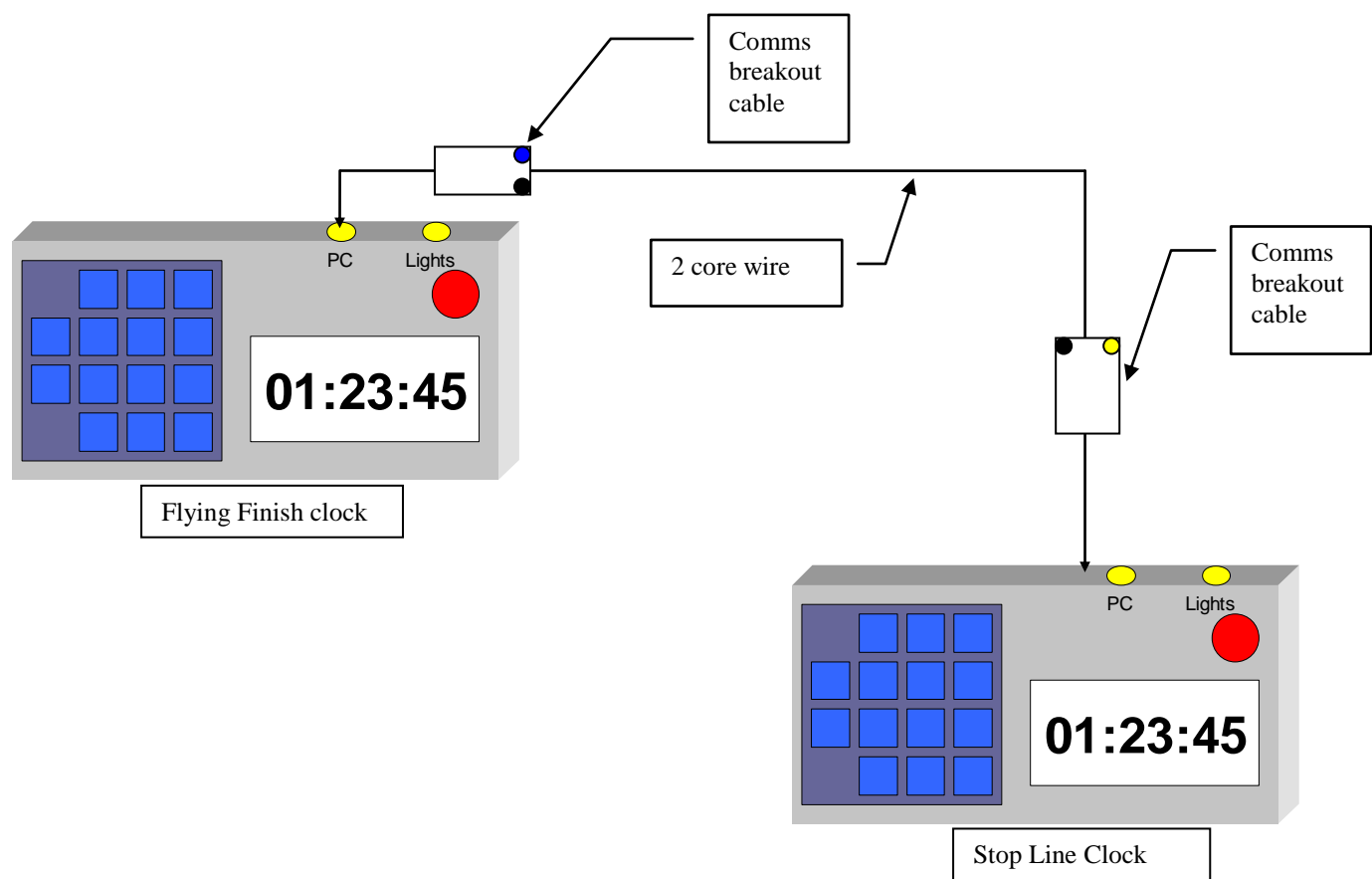
6. Arrival time control / Service out

An arrival time control (ATC or MTC) or Regroup exit can be done using compatibility mode or enhanced mode however if it can also automatically collect all the data for results using this mode

The clock should be configured as an ATC in menu 2.

 Idle mode, ATC timer

The time can be displayed in seconds or minutes.

On pressing STOP the clock will freeze and request a car number to be entered:
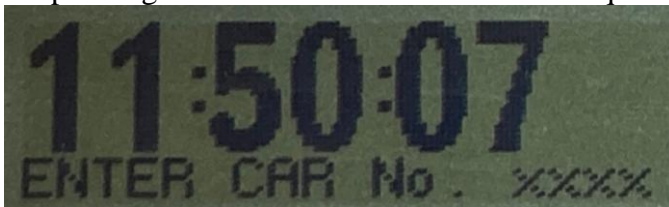
 ATC stopped, waiting for car number
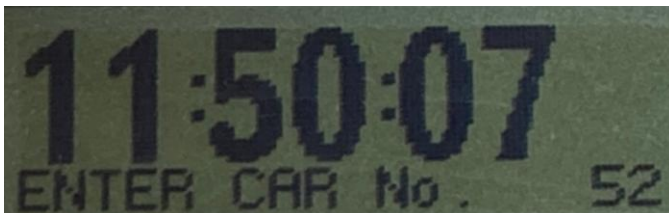
Once a car number is entered the seconds are cleared to 00 and the minutes can be adjusted using the ↑↓ keys to allow for any known holdup with the arrival process.
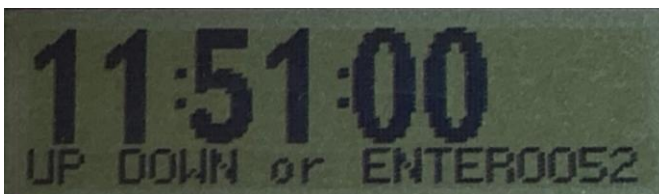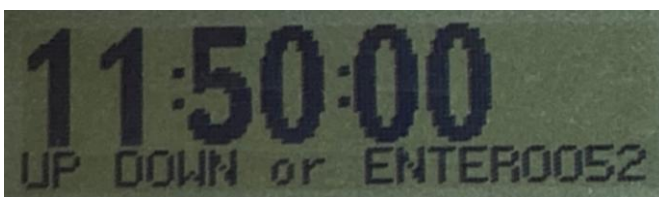
 Up pressed to add 1 minute
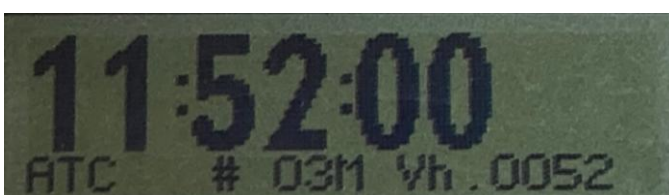
 time agreed with competitor and confirmed with ENTER

The unit will then give the time to write on the driver log book. Both times are recorded internally and can be recovered or printed.

The LED clock drive can be configured to the times.

The next start time and service min times in the menu are not used in this mode.

7. Regroup in / Passage control.

This mode is used to issue restart times to competitors in a controlled manner at either 30s or 1 minute intervals. This mode does not operate as a timer.

On each press of the STOP button, sequential times are issued to the vehicle number entered.
This gives an electronic checksheet of arrival times/exit times issued which can then be downloaded to a computer. This eliminates the need to type in all the issued ATC arrival times.
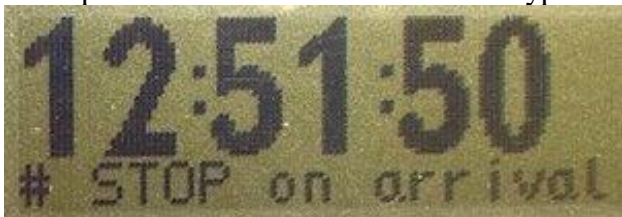
 Running clock, waiting for car

 STOP pressed, first time issued

 Car number entered

The initial out time is entered in the menu 4 and the minimum service time, in the event of a delay is set in menu 4. The clock will not issue a time less than the set minimum from the real time.
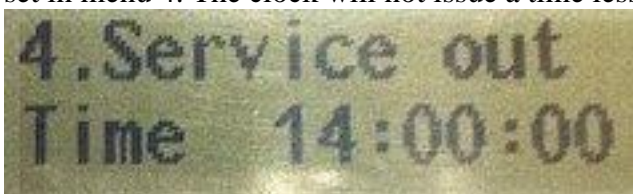
 Service out / restart time in menu 4
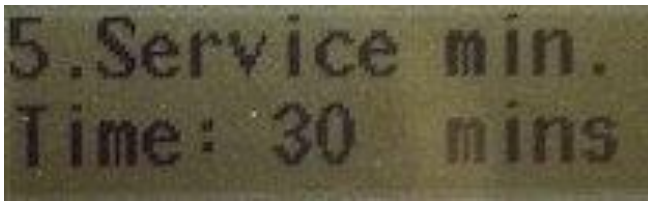
Set this minimum to 00 to operate as an absolute regroup or the required service time

The start interval, menu 9, is used to determine how the time in increased with each competitor. Where 30s starts are used, the external display only shows whole minutes.
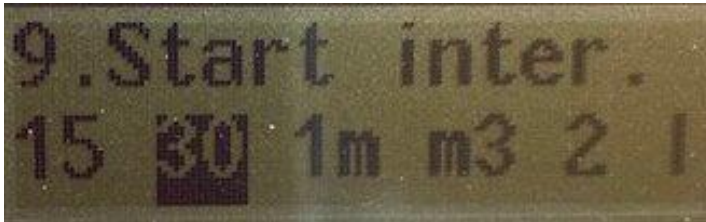
An led display can be used to show the assigned time to a competitor.
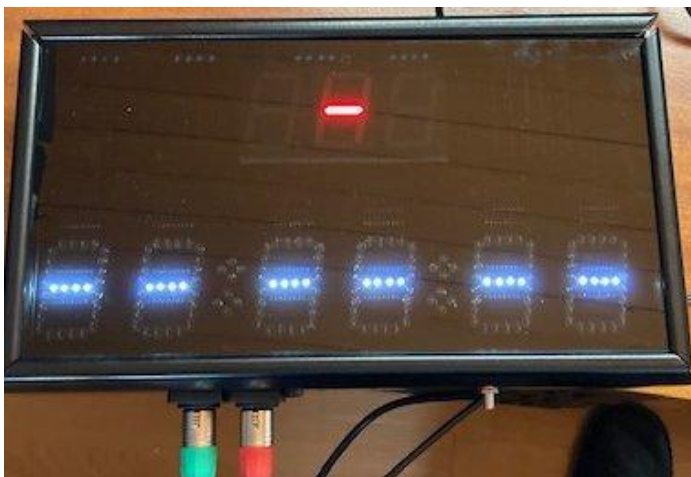
 This will blank to ---- until a car number is entered

The display will go back to showing real time after 90 seconds idle.

8. Circuit timer / Auto test, beam start

See below

9. Circuit timer / Auto test, manual start

Class F

Not normally for rally use. If fully automated rally timing is required use one of the two clock options.

This mode is used where the start and finish are located physically near each other and only one vehicle is running on the circuit at a time.
The start is done using the traffic lights and the finish using the beam input.

In mode 8 the clock starts on the first beam break and times are recorded for subsequent events.
In mode 9 the clock starts on the green light.

The clock can be configured for use in 1s, $1/10^{th}$ or $1/100^{th*}$ of a second timing (*subject to appropriate approvals).

In this mode the clock does not show real time. The light sequence starts on pressing enter and stops when the beam is broken. Select light sequence 7 or 9 for an immediate green light, or 1-6 for a countdown light sequence)

00:00:00
ENTER to start

Waiting for start request

00:00:00   03
Lights running

countdown sequence

Lights run to green, clock starts from 00:00:00 (on green light if mode 9, on beam break if mode 8)

00:04:24.22
CAR xxxx FINISHED (B)

After beam is broken

The STOP button can be used to abort the light sequence or instead of the beam input but cannot be regarded as an accurate measurement much less than 1 second.

Multiple breaks of the beam will be recorded to allow several vehicle times to be set off from the same green light. The clock should be configured as a FF for immediate display of time or SF for first time (see Mode 2)

The clock will continue running until ⬆ is pressed where the clock will freeze and be cleared to 00.

PC

Lights

01:23:45
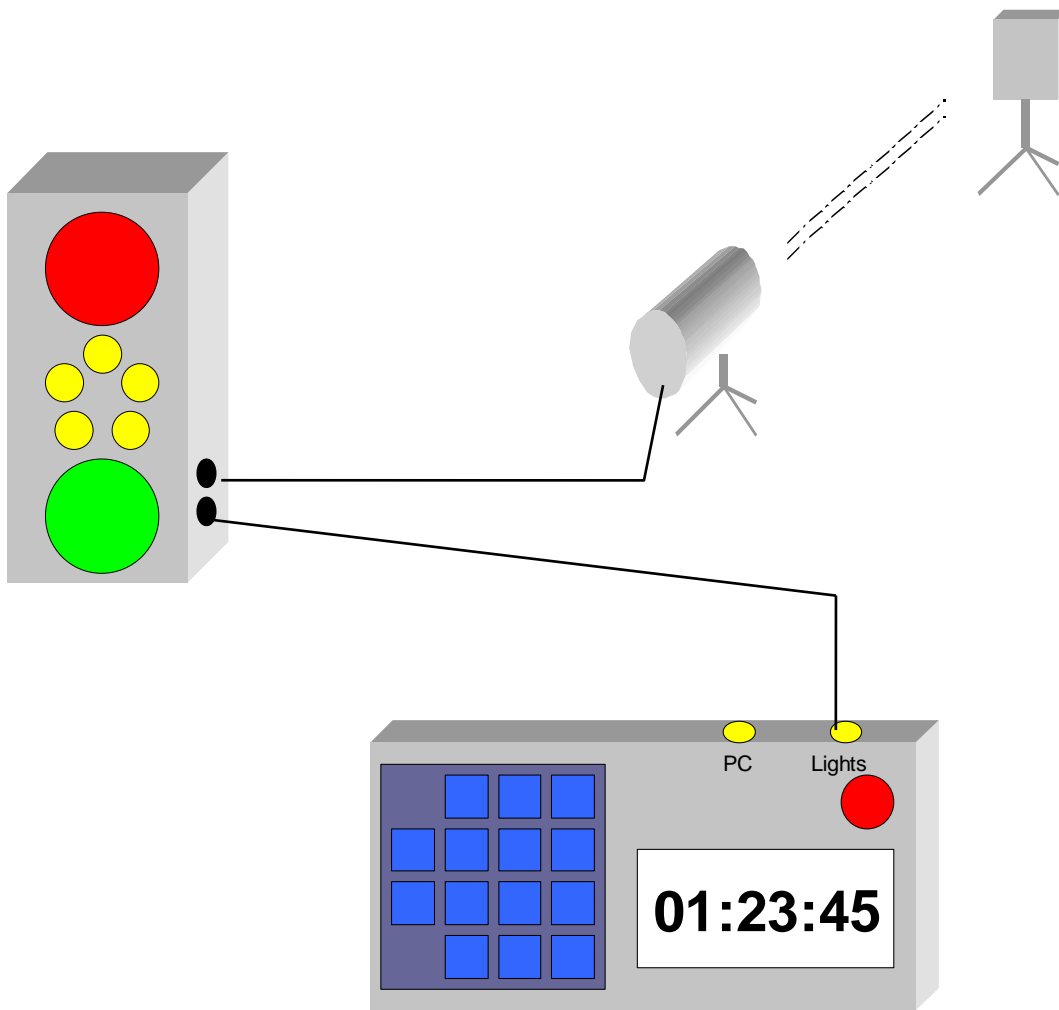
10. Single stage event timer / Comp Safari timer.

Requires two clocks linked via wired communications port.

This mode allows the clocks to calculate the run time for each vehicle and estimates the order of arrival. It is intended for stages where the start and finish are very close together, ideally either side of a timing unit.

When mode 10 is selected 2 new menu items will appear;

Max run time	HH:MM:SS	This should be set to the maximum time allowed for a vehicle to complete the stage/lap. Any vehicle taking longer than this time to complete the stage will automatically be given this maximum. If not required this should be set to 00:00:00
Bogie time	HH:MM:SS	This is the calculated minimum time for the stage. This time will be subtracted from all stage times when calculating the totals. Any vehicle completing the stage faster than this time will be given a time of 00:00. If the bogie is set to 00:00:00 the lap times shown will be the actual time taken.

The start operates in the normal way (using mode 3), with the timekeeper entering the vehicle number and the start being operated by the traffic lights. Beam jump start detection may be used.

The start information is automatically passed to the stop clock so that the possible car numbers, and the order they were set off are known.

Most likely next vehicle

Number of cars on course

09:20:32
Next Car 12   OUT 2

Safari timer stop display
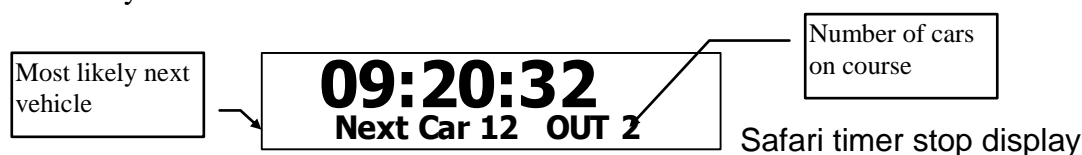
When a car crosses the stop line the display will change to:

09:20:56 **HELD**
ENTER CAR No.   12

Waiting for car confirmation
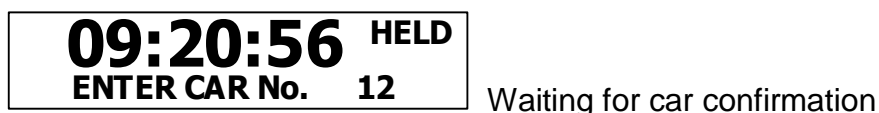
If the car number is incorrect, because it has been passed at some point on the stage, the real number can be typed in on the number keys. If a number is entered for a vehicle that the clock does not know about it will emit a low tone and the display will not change.

Any number of vehicles may cross the line, each will be recorded and held in a list until matched up against a car number. If the beam is triggered accidentally a reserved number can be entered (i.e. 999 or 0)

Once the vehicle number has been confirmed the clock will calculate the run time and current total for that vehicle. The display will show the confirmed stop time and lap number.

09:20:56
Car 12   RUN 2   Stop time

Pressing ⬆ will display the calculated lap time:

00:16:26
Car 12   Run 2 Time

The lap time is calculated as the time when stop was pressed – start time (received from other clock) – bogie time.
If a repeater clock is configured as ST (Stage time), this calculated lap time will be displayed immediately on entering the vehicle number.

Pressing ↑ again will display the total for this vehicle:

00:31:46
Car 12   Run 2 Total

The clock will record all lap times, stop times and keep 1 total for each vehicle entered.

Pressing ↑ again will either show the stop time of the next vehicle that finished, the start time of the last vehicle that was set off or revert to the clock display showing the number of cars on stage.
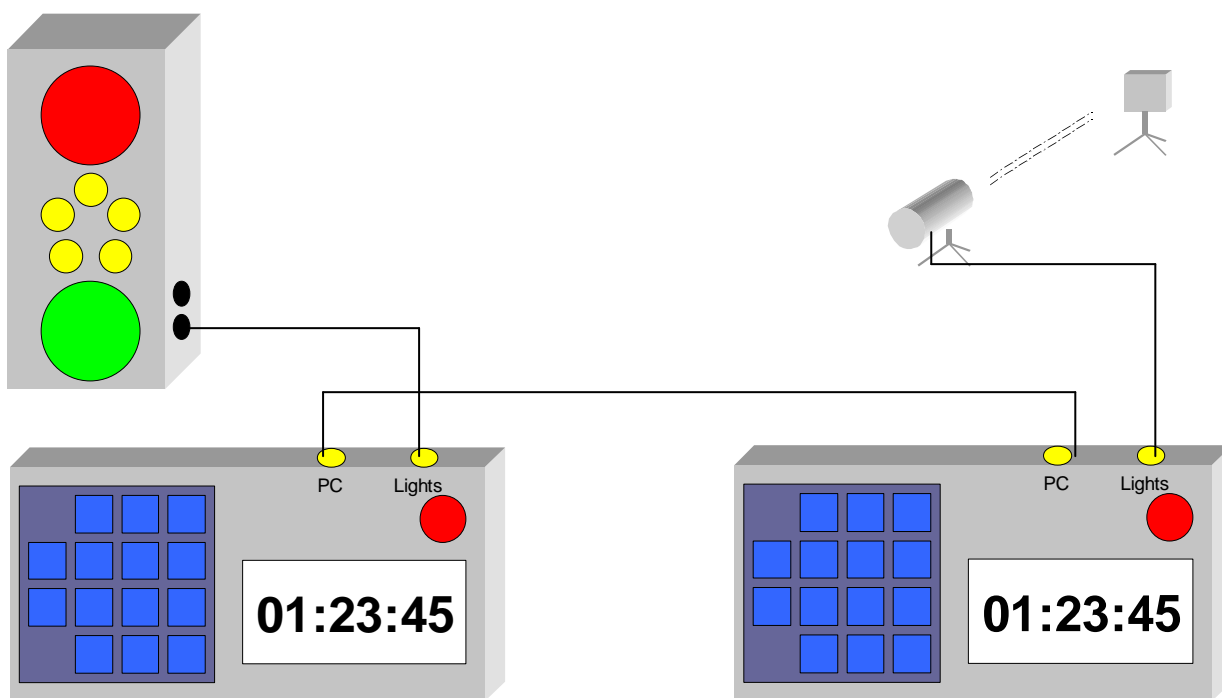
All the lap times stored in the clock can be transmitted together as a sorted list by pressing menu-5. This is always in CSV format and can be directly read into Excel or similar spreadsheet as a results matrix.

The LED repeater clock can be used with the finish clock to display the time of each finisher, the calculated lap time, or alternate the lap time and the total. The display can be configured in one of two modes:
ET   The display will count up from 00:00:00 when a car starts until confirmed at the finish. The display will revert to the running time of the next most likely car to finish when UP is pressed.
ST   The display will show --:--:-- until the first car arrives at the finish and then show his time until the next car arrives (i.e. a static display)

Correcting mistakes.

Incorrect starting number entered: Before the green light, simply re-enter the number on the start clock.
After the green light, use ↓ to locate the start time on the finish clock and re-enter the vehicle number.

Confirmed the wrong vehicle number on the finish:

Entered vehicle not currently running. Simply re-enter the correct number against the stop time and press enter.
If vehicle is still running, re-enter correct number against the appropriate stop time. This will give correct lap time and total for this car, but the incorrectly entered car needs re-entering into the clock. Use ↓ to locate the start time for this lap, which will now be shown as 8000+vehicle. Re-enter the number without the 8000. This will allow the original car to be clocked in normally, however the total may be wrong.

Editing totals / penalties

If the vehicle incurs a penalty, the total for that vehicle can be adjusted so that it is included in the results.

1. Select the appropriate vehicle total record using the arrow keys.
2. Press MENU, which will put the clock into edit mode
3. Press ↑ to add 10s
4. Press ↓ to remove 10s
5. Or enter a new total and press ENTER
6. Once done press MENU or STOP to leave edit mode

Simplified operation for single lap events.

If the calculation of a running total is not required, select USE: RG for the clock on the finish, rather than FF. This will inhibit the totals and remove then necessity to use the ↑ key several times for each event.

Automatic confirm

If the event is such the there is no chance of two vehicles passing and therefore the expected vehicle will ALWAYS be the one displayed and finish clock can be set to ATC mode.
This will then take each beam break and assign the next expected vehicle, confirm it and display the elapsed time without any user intervention.
This is particularly useful for auto test and autosolo events where the course would be closed if a vehicle stops.
The main danger to this operation is false beam triggers from spectators, marshals and loose stage furniture. If this occurs find the original start time on the start clock, press ENTER to re-confirm it and then scroll back up for the next car to be entered.

11. Speed trap

This mode can be used to give a spot reading of a vehicle speed on a stage.
It requires two beam or similar detection devices to be used and a dual beam input cable.

65.2 **mph**
Car 12

The distance between the two beams must be greater than 1m and less than 1Km and should be measured accurately and entered into the clock. Values can only be entered to 0.1m so the beams should be set up to accommodate this. At 60 mph a 10cm increase on a 1m gate will give a false speed of 66 mph! Over 4m the error would be reduced to 1.5 mph.

When the first beam is broken the display will change to show "counting", when the second is activated the speed will be displayed in miles per hour to a $1/10^{th}$ accuracy.

If the first beam is broken a second time before the second beam is activated the clock will not be able to calculate a speed for the second vehicle.

A vehicle number can be entered against each recorded speed for later retrieval.

Speed timing uses the clocks internal high accuracy timer in a high-speed mode. This means that it cannot maintain date and time information.

Dual Beam
input cable

PC   Lights

01:23:45
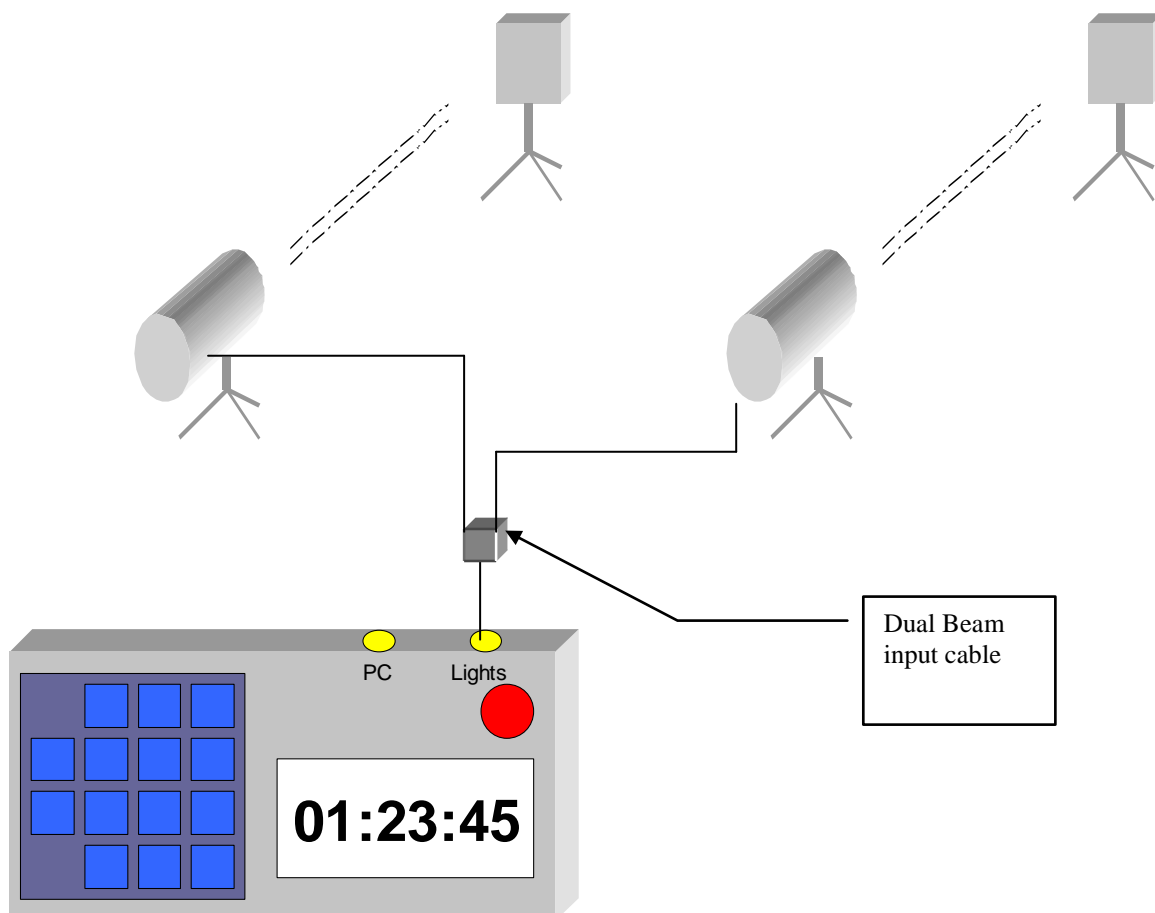
12. Traffic flow control

Two sets of traffic lights can be chained together and a single clock used to control them for traffic flow control. The lights operate the normal RED - RED+AMBER - GREEN - AMBER - RED sequence used worldwide.

The time between changes can be set in second on MENU 3 once the mode is entered.

Pressing the STOP button will place both sets of lights on RED until pressed again.

The time both lights are on RED is ½ the time set for the change time or 4 seconds minimum.
To control a junction 4 sets of lights can be chained together, every other one will operate the same.

Note the lights are not approved by the DOT and therefore are not legally binding. Permission must be gained from the police before they are used on a public highway.

Sequence running
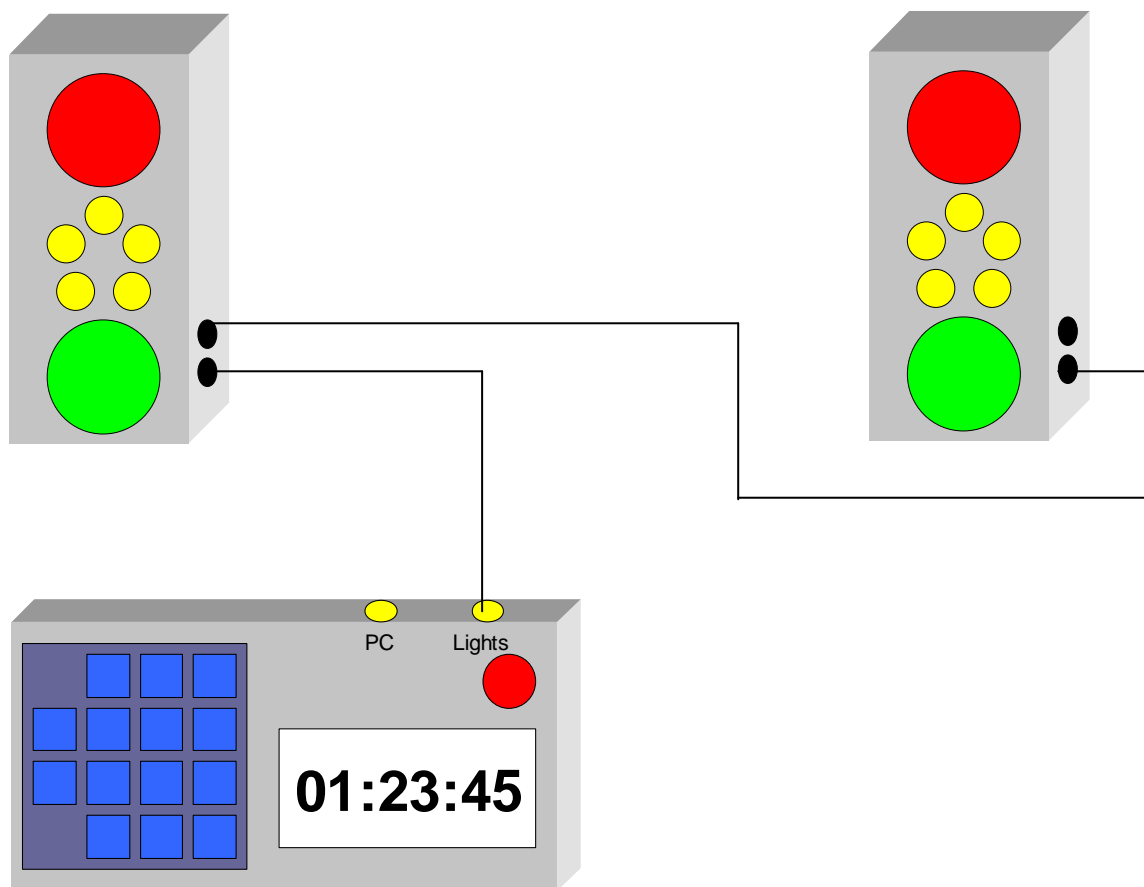
13. Stopwatch modes

These provide general purpose timing functions where the complexity of split timing is not required.

Three modes are available, selectable using the mode selector menu:

FF - Multiple stop timer. Records every button press as a new time. Could be used to time all runners in a 100m race.

SF - Stop / start. The timing is suspended on each alternate press of the button or beam. Can be used to time the total time an intermittent event occurs.

RG - Lap timer. A lap time is recorded on each press of STOP and the counter is reset to 00:00.

In all modes the time is reset to 00:00 by pressing ⬆ and the clock is started by pressing the STOP button or on receiving a pulse from the beam input. Display can be down to 1/100ths of a second.

If traffic lights are attached they will show RED until the clock is started and then immediately turn to GREEN. If a countdown is required use the sprint modes.

Note. The internal real time clock will be stopped when using this mode.

14. MSA Test mode

This mode is included to make to testing and calibration of the clock easier.

Pressing the STOP button will reset the clock to 00:00:00.00 and the time will be held until a beam input occurs.

At this point the display will start counting from 00:00:00 until a second beam break occurs.
The time displayed on the clock will be the exact time between the first and second inputs.

The test can be reset at any time by pressing the STOP button.

15. Service / pit stop timer

The timer has an operation mode designed specifically to assist in scheduling service stops for competitors. It can be used to give a countdown of time remaining from a specified limit.

The LED repeater display can be used to show either the countdown timer (HH:MM:SS) or an alternating display of the real time and minutes remaining.

Automatic mode

If the exact arrival time of the vehicle is known (to the nearest minute), the timer can be pre-programmed with this time so that the display will automatically start to count down when the vehicle arrives.

Use the MENU key to access menu 4 and enter the required start time as HHMMSS and press ENTER. Press MENU again to access the service length setting. Enter this value as HHMMSS and press ENTER.
Press ENTER again to exit from the menu

The display on the clock will show:

```
13:06:42
EXPECTED 13:20:00
```

The LED display will simply show the time of day.

The top line shows the current time, the bottom line shows the time you have just entered.
If the time of day is incorrect follow the procedure in the user manual for setting the clock.
If the expected time in incorrect, repeat the above procedure.

Once the expected time is reached the display will change to:

```
13:20:12
SERVICING 00:19:48
```

and the clock will make play a tune.
The LED display will start to alternate the time of day and the minutes remaining for the service.

During the service time, pressing the STOP button or number keys will have no effect on the timer.
If MENU is pressed, simply press ENTER to exit.

The servicing time will count down from the entered time until it reaches 00:00:00.
The clock will then play a different tune and the display will change to:

```
13:42:10
SERVICE OVER
```

To get the clock ready for the next service, press MENU until menu 4 is reached and enter the new time.

To abort the service stop or start the timer early follow the procedures for manual operation.

Manual operation

If the exact time of arrival is not known it may be simpler to use the two buttons on the bottom of the display to operate the clock.
Use of the manual system will override any automatic timer settings.

1. Enter the desired service time into the clock at menu 5
2. Press ENTER to exit the menu
3. When the vehicle arrives, press the RED button once.
4. The timer will play a tune and display the "servicing" message
5. The LED display will start to alternate real time to time remaining
6. The countdown will only start on the next whole minute after the button is pressed.
7. The countdown will continue until it reaches 00:00:00, where the clock will play a tune and display – on the led display.
8. Pressing the GREEN button at any time during a service will abort the countdown.
9. Pressing the RED button during a service stop will have no effect.

16. Addressable display mode

This operation allows a network of displays to be created, each showing a programmable time from a central clock or PC.
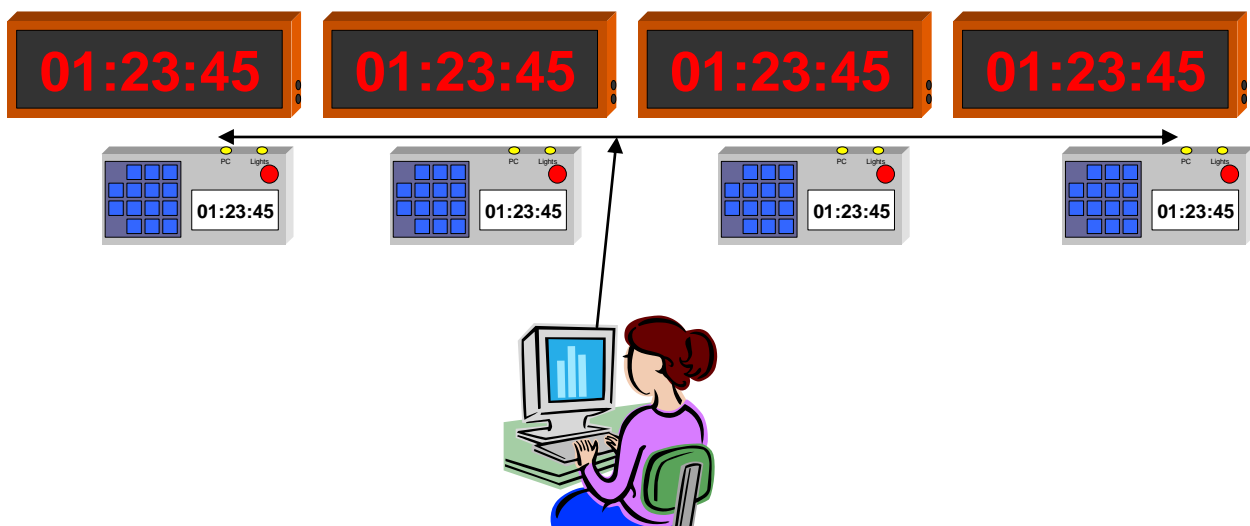
The serial transmit line from the PC is connected I parallel to the data input on all the ECM timers.
Each timer is configured in mode 16, display 1 is set to Stage 1, display 2 set to stage 2 etc.
Display commands can then be sent from the PC to any individual display
More than one display can be set to the same stage number, all displays with the same number will show the same information.
ECM can supply a program which will allow times to be entered and sent to individual displays. It is also possible to broadcast information to all displays by using stage 0.

17. Countdown stopwatch

These provide general purpose countdown timing functions similar to the standard stopwatch functions. This can only be used for timing to whole seconds.

The starting time is set in menu 3, for example 10:00 (10 minutes)
On pressing the STOP button, the clock will start counting down in seconds from the specified time.
Pressing the STOP button again has the following effects:

Three modes are available, selectable using the mode selector menu:

FF - Multiple stop timer. Records every button press as a new time. Could be used to time slowest competitors in a walking race.

SF - Stop / start. The timing is suspended on each alternate press of the button or beam. Can be used to time the total time an intermittent event occurs.

RG - Lap timer. A lap time is recorded on each press of STOP and the counter is reset to its initial value.

In all modes the time is reset to the entered value by pressing ⬆ and the clock is started by pressing the STOP button or on receiving a pulse from the beam input.

Note. The internal real time clock will be stopped when using this mode.

A LED repeater display can be connected to show the countdown time.

If traffic lights are connected, they will show the following:

Green light shown whilst the clock is counting down.
Amber lights show last 5 minutes (not seconds as usual)
Red light comes on when time reaches zero

18. Intermediate time display

This would normally be used to provide a display for a spectator area, showing the relative speed of vehicles in an event.

The clock will time the difference between two consecutive cars and subtract the current start interval, giving a ± difference value to the current system resolution (1s 1/10 or 1/100)

For the first vehicle in the procession, the time difference is meaningless, because any reference time will be caused by marshals or during setup. The timer will record the time each vehicle is seen, and calculate the difference between this and the previous entry, and subtract the current start interval (15s, 30s, 1m or 2m, Im=0)

If the display is -ve, the second vehicle is this amount of time faster than the previous driver, if +ve, he is slower by xx.xxs at reaching this point in the stage.

An LED display should be connected to show the public the time, configured as ST.
The stage use should be set to FF.
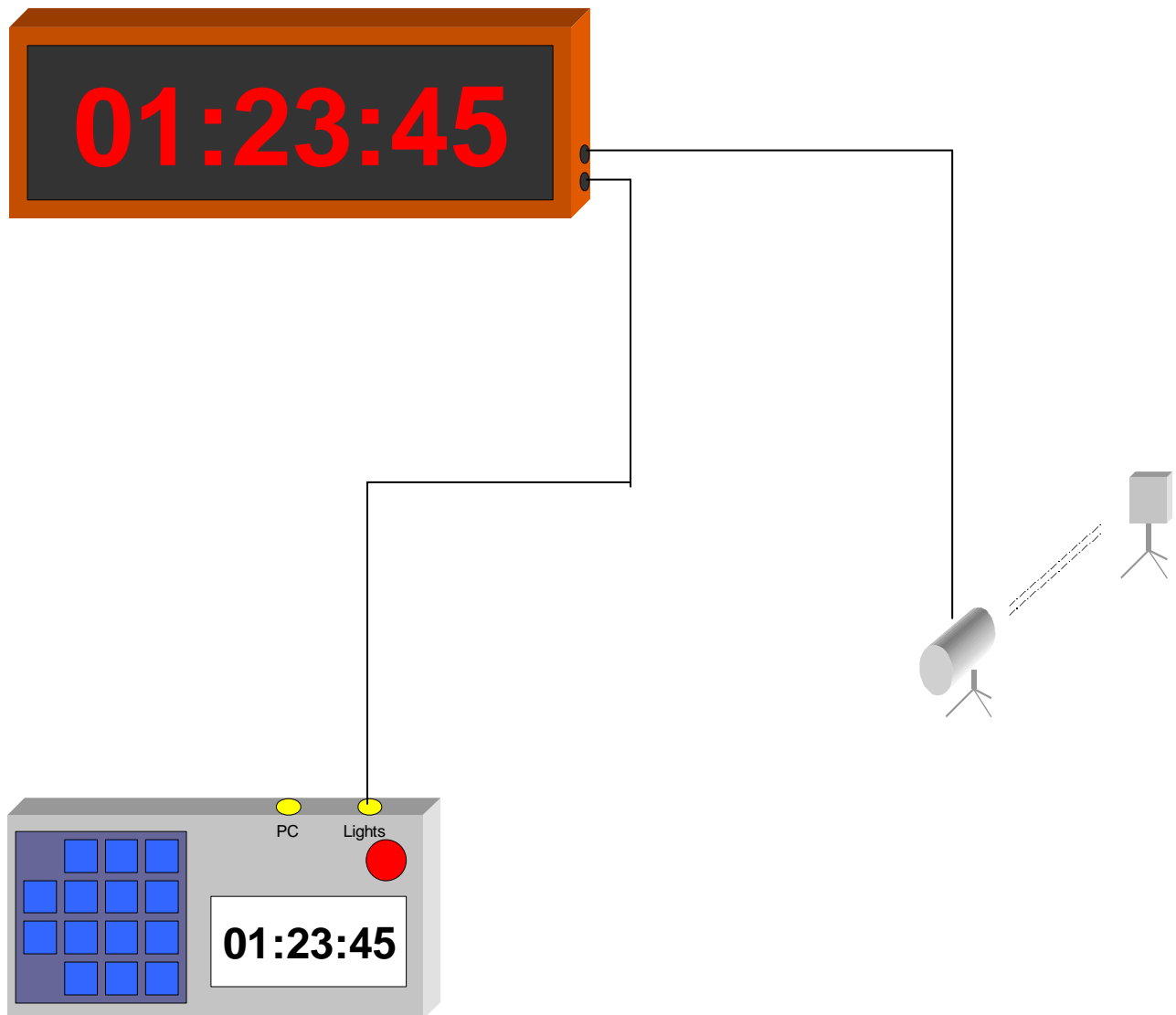
19. Manually settable up/down timer

This mode provides a running time display but allows the time to be easily adjusted to allow synchronisation with an external event.

A typical example would be displays used for a running marathon. Each display needs to show time counting up from the point where the start signal was given, but it is likely that ones on the route may not actually be in position at the start of the event, thus the time on a reference display can be used for synchronisation.

This operation mode can also be used to count down from a specified time, and then start counting up again.

Count down mode
Set stage use to SS

The display will initially show:

```
00:00:00
ENTER to start
```

The required starting time HH:MM:SS can be entered on the keyboard. The time will start at this time and start counting down as soon as enter is pressed or a beam break is detected.

Pressing STOP whilst the clock is counting down will re-display the time entry screen but not affect the running time display unless ENTER is also pressed.

As soon as the time reaches 00:00:00 it will change its internal mode and start counting UP.
This means that it is necessary to go into the menu and change the use setting back to SS if the timer is to be re-used as a down counter.

Count UP mode
Set stage use to SF

The display will initially show:

```
00:00:00
ENTER to start
```

Pressing ENTER will start the timer from 00:00:00 or alternatively a different time can be entered on the keyboard.

Pressing STOP whilst the clock is counting save a time and re-display the time entry screen but not affect the running time display unless ENTER is also pressed.

20. Alternate display timer

This mode is almost identical to mode 2, Enhanced timer, except the display is formatted into two lines of medium sized text, rather than 1 large line and one tiny line, and competitor numbers can be entered in advance of the beam break, rather than just afterwards.

Each press of the button or beam break will record a time.
This is to allow the clock to record several vehicles passing in a short period of time.
The clock can be set to run in seconds, $1/10^{th}$ second, $1/100^{th}$ or minutes.
This mode also allows entry of vehicle numbers against each time.

This mode of operation is very dependent on the "stage use" setting

20.1 ATC or FF

Each time the button is pressed or the beam input is used a new time will be displayed. The stop number will be increased for each one recorded. Vehicle numbers can be input as they happen, or after the event by using the arrow keys to access old data.
Vehicle numbers can also be entered in ADVANCE of the beam break and will then be immediately assigned as the car passes.

> **03:06:42.1**
> **STOP #15 M. V. xxxx**

Frozen time, waiting for car no

The ↑ and ↓ keys can be used to access all previous times. Vehicle number can be changed is incorrect.

Data will normally only be printed / transmitted if a vehicle number is entered. If a duplicate number is entered it will be assumed to stage 2, 3 etc. A number can be corrected if an error is made by using the cursor keys and re-entering the data. It will be retransmitted and flagged as a correction.

20.2 Stage Stop (SF)

In this mode only the time of the first vehicle is shown on the display, any further vehicles will be recorded and held internally until accessed by pressing the arrow keys. This allows the correct vehicle number to be entered when the car arrives at the stop line, the clock can then be shown to the driver if required, and the next time called up when the next car arrives. If a false beam trigger occurs it can be left unassigned or a specified error code entered.
Once a time has been dealt with, press ↑ to access the next recorded time. This will be the time for the next vehicle to reach the stop line. If no further times are available the clock will revert to displaying the real time.
This mode takes any pressure off the stop crew to record times as they happen but requires some practice to make sure the correct time is allocated to each driver.

If more than one vehicle time is available a ↑ will be displayed in the bottom right hand corner of the display. This will clear when all times have been viewed.

Pressing STOP, or a beam break will always generate a new time.
Pressing ↑ on the most recent time in the list will revert the display to the real time.

The clock will also drive a large LED clock display showing the same time as on the display.

20.3 Stage Start (SS)

The traffic lights will free run at whatever interval is set in the configuration menu.
The display can show 0.1 or 0.01 seconds but this is unnecessary for clocks at the start.
A vehicle number can be entered up to the point at which they leave the line. All times will be recorded in memory even if no number is entered. The ⬇ key can be used to access and enter numbers against any times missed.
Start times will be printed or transmitted only when a vehicle number has been entered.
If the same number is entered more than once it will be assumed to be for stage 2, 3 unless the stage number is changed in the menu.

```
03:06:42
NEXT VEHICLE XXXX
```
Free running clock waiting for car number.

If the display is configured for whole seconds only a countdown of the time to go will be displayed for the last 10s.

```
03:06:52      08
NEXT VEHICLE  21
```
Vehicle confirmed, countdown showing.

Pressing STOP will display

```
03:06:58
START HELD
```

The lights will show RED and the clock will remain frozen until ⬆ is pressed

An LED repeater clock can be configured to show the start time or countdown the seconds until the start.

Menus

Pressing the MENU key will display the following status screen:

Temperature in degrees Celsius.	
Beam input status.	
Clock status display	
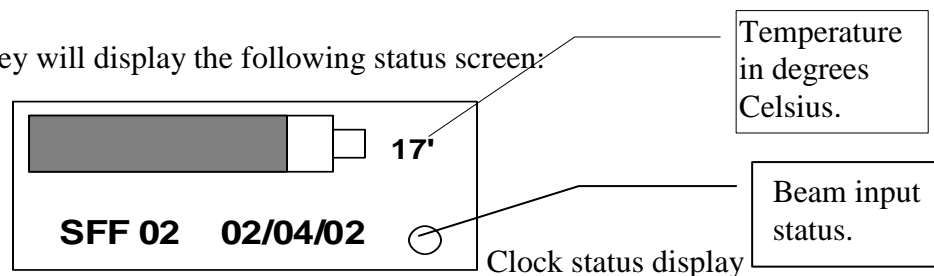
Pressing ENTER or the STOP button will exit any menu. If a beam break occurs while in menu it will be recorded but not displayed until the menu is exit.

The clock serial comms port is fully enabled while displaying the system status. This allows a remote PC to talk to the clock, ask for data and set operating parameters.
Note the clock uses a lot more power while displaying status so it should not be used unnecessarily.

Special menu hot keys

With the status screen displayed the number keys have special functions attached to them:

9	Download all stored times. This will send all events from the clocks memory out of the comms port to a PC or printer using the current format.
8	Download single stage times. This will send all entries from memory with the current stage number. Set the stage number in menu 1
7	Comms test mode. This puts the clock into a self test mode and counts the number of data packets sent and received. It can be used to check cable runs and communications between two clocks.
6	Synchronise time from GPS time
5	Mode 10 only, results download. Sends all the recorded lap times in CSV format.
4	Send all valid times (not tags or tag definitions)
3	Print date and stage settings on printer or PC
2	Synchronise clock. Sends a time signature to another clock. See section about setting the time.
1	Not used
0	Not used

The menu structure is password protected, using two passwords. This allows some field operators to change the operation of the clock but not change the time or password settings. The units will be supplied with no password set (000000) so that all menus are accessible. This should be changed as soon as the unit is commissioned.

Each menu is selected by repeatedly pressing the menu key; the arrow keys and number keys are used to change items.

The following menus are available however some will only appear if required:

1. Stage Number
   Enter password.
   On entering the user (or timekeeper) code the following menus are available:
2. Stage use
3. Clock MODE
4. Next start time / Lights change time / Speed trap length / Service out time / Max run time
5. Bogie time / Service min.
6. Power down
7. Clear memory
8. Lights sequence
9. Start interval
10. Comms port
11. Comms mode
12. Comms delay
13. Print blank lines
14. Clock repeat
15. Display type
16. Alternate display
17. Beam gate width
18. Beam input level
19. Backlight time
20. Extra Memory
    Enter password
    On entering the timekeeper code the following are available
21. Clock units
22. Set DATE
23. Set TIME
24. Speed adjust
25. Hardware Type
26. Set User password
27. Set System password
28. GPS Time zone
29. Tag holdoff
30. Tag valid
31. Tag Auto

On leaving the menu (pressing STOP) any passwords entered will be forgotten.

Menu details

1. Set stage/ lap number.

Number 01-99.
If automated data collection is being used the clock will need to identify itself to the computer. It is also sometimes handy for the marshals to be able to see the stage number.
The clock attempts to calculate the stage number allocated to each record stored. Initially it used the number entered in menu 1. If the same vehicle number is entered against a second time, the stage stored number will be increased by 1. This will allow the same clock to be used for start or stop for any number of consecutive stages without the clock details being changed.

If the stages are not consecutive, i.e. on a multi-venue stage rally (e.g. Stage 1,2 & 6,7) the stage number will need re-entering before the start of the later stage.

The clock will use the greater of the entered stage number or the calculated stage number from the number of times the vehicle has passed the control.

When connecting the flying finish to the stop line using RF comms or cable, it is essential that the two clocks have the same stage number assigned. The stop clock will filter out any times that do not have the same upper digits. i.e. set to 10 and 10 will work for 10 stages as the FF clock will increase from 10,11,12 etc. To run more than 10 stages reset both clocks to a higher stage number. See linking clocks.

2. Set stage use.

Values: ATC, SS, FF, SF, RG
See section about specific operating modes.
This setting can alter the way the clock operates but is primarily used when data is stored so that when a PC recovers the data it can determine which clock it is talking to.
See specific mode examples.

The traffic lights will only operate if the unit is configured as a Stage Start.

3. Set clock mode

Mode   1 - 20
Set the operation mode of the clock as described in the previous section.
Setting an invalid mode will display "mode not implemented".

4. Menu 4 - variable

This menu will vary depending on how the clock is configured

4.1 **Set regroup service time.**
　　　Time MM
　　　This is used to calculate the correct regroup out/ service out time.

4.2 **Traffic lights change time.**
　　　If the clock is used in mode 12 to operate two sets of lights, this item is used to set the time the lights stay on green in each direction. Values can be 0-99s

4.3 Speed trap gate width.

If the clock is used in mode 11, speed trap, this menu will allow then entry of the distance between the two beam or similar detection points. The value must be measured very accurately and entered in xxx.x meters. See section 11

4.4 ATC & service nominated start/exit time

HH:MM:SS

This specifies the next start time to be allocated when in ATC mode 6. The value will automatically increase by 30s or 1m as times are used.

4.5 Comp safari max run time.

HH:MM:SS

This specifies the maximum time permitted to complete a stage and is used to automatically remove vehicles from the system when they become overdue. If not required set to 00:00:00

5. Menu 5 – variable

5.1 Comp Bogie time

HH:MM:SS

This is only used in mode 10 and defines the stage bogie time (minimum). It is used to calculate the normalised lap times for vehicles when they finish.

5.2 Min start/service time

When configured in modes 6 or 7, menu 5 allows the minimum time between arriving at an ATC before a start time can be issued (default, 3 mins) or the minimum service time (Max 99 mins)
If set to zero, issued times will simply be sequential from the time entered in menu 4.

6. Power Down

ON, OFF or SLEEP.
The clock should be switched off (or sleep) whenever it is not being used for timing to save battery life. There are two power levels, OFF where all internal data including the date and time are lost, and SLEEP where the time and date will be maintained. The clock accuracy is not affected when it is asleep so it can be left several weeks in this mode and will give the correct time when woken up. Off mode should be used if the clocks are going into store for more than a week to preserve battery life.

A warning is given when switching the clock off since the time and all data will be lost.

The batteries may be changed while in sleep mode without loosing the time.

To wake up the clock the following key sequence must be made within 5 seconds

STOP   MENU   ENTER

If any other keys are pressed or more than 5 seconds elapses between key presses the clock will remain asleep, this is to stop the unit breaking into life during transit and wasting battery life.

7. Clear memory

ALL   TIMES   NO

This should be used before each event to clear down the clocks memory for storage of event data. Any menu setting, the date and time are unaffected.
Select ALL to clear all information,
Use TIMES if tag data has been loaded into the clock to maintain this information.

8. Start lights sequence

Sequence 0-9
The traffic lights can operate a number of fixed sequences depending on their application.
If a repeater clock is used with no traffic lights this value should be set to 0
See the section on traffic lights for details.

9. Start run interval.

Run: 15s   30s   1m   m3   2m   Imm
The traffic lights can be set to run at one of the above intervals, either free running or on entering a vehicle number.
15s will operate the lights every 15s.
30s will operate the lights every 30s or the next available 30s (>10s from current time)
1m will operate the lights on the minute.
m3 will operate the lights every minute on the ½ minute
2m will operate on every EVEN minute.
Imm will operate the last 6 5-6 seconds of the selected sequence immediately on pressing enter. This means that the start time will not be aligned with real time, although will be an exact second. This is useful for mode F timing, and "go when ready" indication

10. Comms port enable

Use: OFF   USED ON

This gives overall control of the communications port.
If set to OFF, no data will be sent out of the port or received during any operation. This can help to save battery life if communications / printing is not required.
If set to USED the port will only be enabled when required to transmit data as a result of an event. The clock will not receive any data unless it is showing the status menu.
If set to ON the comms port will be permanently enabled, allowing data to be sent and received from the clock at any time. This will reduce the battery life a little.

11. Comms port usage.

Use: PRN CSV Omg Link, RF
Not displayed if comms is switched off.

All serial communications is done at 9600 baud, 8 data bits, no parity, 1 stop bit.

The device incorporates a device that generates RS232 levels only when required, when not used the line will idle at 0v. Some systems may regard this as a line break condition.

See later section on the comms port protocols.

Link mode allows two clocks to be connected together or data to be requested as a single block rather than as it happens.

RF is specifically designed to allow an external high power radio modem to be used and will retry any message until it is received.

12.Comms delay

Use: 0 50 250 500 1K
This sets the maximum speed that events can be sent out of the communications port, and is required for some printers, RF repeaters and results systems. The time indicated is in ms (1/1000s).
To determine if a delay is required, press STOP 10 times to record dummy data and then press MENU-9 to download all items. If the data is printed / received correctly no further delay is required. If parts of lines are missing keep increasing the delay and re-trying the test.
The delay does not affect the clocks ability to record events, even if within 1/1000s.

13.Print blank lines?

Use: YES NO
The clock normally only send data to the port if a vehicle number has been entered. This saves paper and avoids hundreds of spurious events from beams. However if you do want an external record of these beam breaks select YES to output data even if a vehicle number is not given.

14. Clock repeater

Defines what the repeater clock will display
Shows:OFF   RT   DT   ST   ET

OFF   Disabled clock repeater
RT   Real time HH:MM:SS. Continues irrespective of clock operation
DT   Time shown on Display - stops when clock stopped
ST   Finish/start time/LAP HH:MM:SS.xx or special function
ET   Elapsed time   HH:MM:SS.xx

15. Display type

Shows HMS MSTH VMS MST
This defines what type of repeater clock is plugged into the timer
Note: The traffic light sequence may need setting to 0 if the repeater clock is used without traffic lights.

HMS   6 digit display showing HH:MM:SS
MSTH 6 digit display showing MM:SS.TH
VMS   7 digit display showing Vehicle number VVV MM:SS
RLD   Combined traffic light and HH:MM:SS display (WRLD) (not RTCS)

16. Alternate display

Use: OFF   TT   TL
Any LED display can be made to display the temperature every 4 seconds by setting this to TT.
Mode TL can only be used in comp safari mode to display alternating lap time and total.

17. Set beam input gate time.

Time TT in 50ms
Range 0 to 5s (00 to 99)
When using a beam or similar vehicle detection system it is often desirable to ignore false triggering of the unit after first detecting a vehicle. The false trigger can be caused by odd body shape, multiple axles, dust, mud or exhaust following the vehicle.

If set, any beam events will not be recorded after the first within the specified time period. A typical value is 10, giving a 0.5s holdoff period. If all events need to be recorded set the time to 00.

This value is ignored when using the clock as a speed trap.
The same value is used for both beam inputs on a version 3 clock.

18. Beam input mode.

The external beam inputs can be triggered either by a contact being broken or one being closed. This is to allow many different manufacturers units to be used.

    MAKE   The time is taken when the beam input is connected to ground.
    BREAK   The time is taken when the input is disconnected.
    DUAL   Time is taken when both beam inputs are made together.

To ensure that you have the correct setting for your unit, set up the beam and connect it to the clock. Place an object in the path of the beam, the clock should beep and record a time. Remove the object, the clock should not beep or change. If it does, the setting is incorrect.

The dual input mode is to give some level of dust and spectator immunity. Set up two beams ½ -1m apart, ensuring that they do not interfere with each other.

19. Backlight timer.

Time SS
If the clock is to be used in very low lighting conditions the backlight can be enabled to come on after every key press and on a beam break detection. The backlight should only be used is absolutely necessary because it will seriously drain the internal batteries. A typical value of 5s should enable the user to read the time.

20. Extended Memory

Use: OFF ALL USED SPL
The clock basic memory can store 450 times. If more memory is required for download to a PC the extended memory can be enabled using this function.
OFF disables any use of extended operation.

ALL will save everything recorded by the clock
USED will only save information where a vehicle number has been entered against a time.
SPL can be used in comp safari mode to only store the run times in extra memory.
It is not possible to use the arrow keys to look into extended memory. It can only be printed or downloaded.

21. Set display units.

Units: 0.01   0.1   1s   1m
The clock display in all modes* can be altered to give only the accuracy required for the application. This also affects printouts and times downloaded. The internal timer still operates to 0.01s irrespective of the value set here to ensure accuracy.
*Mode 1 does not display settings below 1s

22. Set date.

Date DD/MM/YY
The date is used for internal housekeeping within the clocks memory. This is important if an event crosses midnight or over several days.
Simply enter the date as a 6 digit number and press ENTER.

23. Set time.

Time HH:MM:SS
See Setting the clock later

24 Clock speed adjustment

Value 0-99 +,= or –

If the clock is found to run slightly fast or slow it can be corrected using this setting. This should only be used if a very accurate timing reference is available, or if an accuracy test has been carried out over several days.
Software correction should <u>not be enabled</u> if the timer is being used for 1/100ths timing over short time periods.

The setting consists of a value in the range 0-99 which indicates the level of correction and a character indicating if the correction should be positive, to increase the speed of the clock, or negative, to slow it down.
Setting the value to 0, or the adjustment type to =, will disable any software correction.
If the clock is running slow, press ↑ until the display shows +
If the clock is running fast, press ↓ until the display shows -.

The following table shows what level of correction will be applied for various settings.

Value	In 10 hours	In 24 hours	Per week	1s in
0	No correction	No correction	No correction	No correction
1	0.03s	0.1s	0.728s	9.6 days
10	0.047s	0.113	0.794s	8.8 days
20	0.052s	0.126s	0.88s	8 days
50*	0.08s	0.189s	1.32s	5.3 days
63	0.10s	0.24s	1.69s	4 days
86	0.20s	0.47s	3.31s	2.1 days
94	0.30s	0.71s	5s	1.5 days
99	0.43s	1s	7.2s	24 hours

The maximum correction is 1s in 24 hours, if the clock is running outside this accuracy it must be returned for repair.

If a clock has been certified to R(0.1) the calibration value used for the test will be written on the back of the unit. Only this value can be used if the certification is to be maintained.

25 Hardware type

This menu is no longer used, it will show TYPE 5 hardware

26 / 27. Set passwords.

USER: xxxxxx
System: xxxxxx

The user and System passwords can be entered as any six-digit number. The current values will be displayed.

A value of 000000 will disable the password and give immediate access to all menus.
If only a system password is set the user will have access to all menus except the ability to change the time. Both passwords may be set to the same value.

If a password is forgotten it can only be removed by plugging it into a PC and sending the password clear command. A utility program is available from ECM to facilitate this. Passwords are also cleared whenever the clocks software is changed.

The Stage number and clock use fields are not password protected. This is to allow a stage to be swapped round without timekeeper intervention.

28. GPS time Zone

HH:MM:SS + or –
Allows a correction from UDT to be entered when the GPS module is used to set the clock, see setting the time.

For GMT use a value of   00:00:03-
For BST use a value of   01:59:57 +

29. Tag Holdoff

MM:SS
This setting is only used if RFID transponder tags are being used.
It defines the period of time before the same tag can be seen again to filter out spurious triggering
This is important if a car breaks down somewhere in range of the receiver unit.
A value of 5:00 is typical for a multi-venue stage.

30. Tag Valid

MM:SS
This setting is only used if RFID transponder tags are being used.
It defines how long between seeing the vehicle tag and a beam break it will assign the tag to the beam.
This will depend on where the reader unit is positioned and is typically 10s

31. Tag auto

YES NO
This setting is only used if RFID transponder tags are being used.
If enabled, the beam will be automatically assigned to the last seen vehicle and transmitted without any user intervention.
For manual operation, set to no.

Setting the time

The clock should keep accurate time for many months but when it does need setting one of the following can be used:

From menu: Enter the time as a 6 digit number e.g. 180200 for 18:02:00
press ENTER or STOP as the second clocks over.
The beam input can also be used to confirm a time entered on the keyboard.

Pressing ENTER from this menu will enter JOG mode which displays the real time and allows it to be modified as follows:

Pressing ⬆ adds 1s to the time and clears any part seconds.
Pressing ⬇ clears any part seconds and deducts 1s from the clock.
Pressing **0** clears all seconds and part seconds
Pressing **4** adds 1 hour without affecting seconds or part thereof
Pressing **1** removes 1 hour.

Via comms: When setting a number of clocks a serial comms lead can be used to quickly configure each unit once one has been set accurately.

This requires the master clock to be on the MENU STATUS screen.

The second, slave clock must also be showing the status screen (first menu) and have comms enabled or set to "when used"

With the clock synchronization cable plugged in press the '2' button on the master clock. The slave unit will beep and display the new time. It may then be unplugged and another unit set by simply pressing '2' again.

The protocol used to set the time is encrypted to avoid any spurious signal or hackers adjusting the clock unnecessarily.

To exit clock set mode press the STOP button.

Time zone correction

The clock may be quickly adjusted for time zones, daylight saving or BST by entering the set time menu, pressing ENTER to invoke jog mode and using

Pressing **4** adds 1 hour without affecting seconds or part thereof
Pressing **1** removes 1 hour without affecting seconds or part thereof.

Press STOP to return to normal operation.

Clock synchronisation.

When preparing a batch of clocks for an event, the date and time can be quickly sent from one clock to another. Follow the following procedure:

1) Decide on a master clock and set its date and time using the process described in the user manual.
2) This master clock should be kept by the chief timekeeper for the event as a time reference.
3) Plug the clock synchronisation cable into the port marked "Printer/PC"
4) This cable is normally 0.5m long and has two identical 4way connectors on each end. It does not matter which end is plugged into the master clock.
5) The master clock can be configured in any mode of operation; however USE FF, mode 1, is usually the most convenient.
6) Press STOP on this clock, followed by MENU.
7) This will then show the battery status and date
8) Press '2' on the keyboard
9) The display will show the time and a message "Press 2 to Sync"

10) Power on one of the clocks to be set.
11) Plug the other end of the sync cable into this clock. It is not necessary to fully screw the connector into this clock, which will make things a bit quicker.
12) On this clock, press the red STOP button, and then MENU
13) Press '2' on the Master clock
14) The second clock should then play a small tune and show the correct time.
15) Unplug the cable from the clock you have just set.

16) You can now repeat steps 10-15 for as many clocks as required.
17) To exit sync mode on the master clock, simply press STOP.

If it does not play a tune, or the second clock makes a low boop noise, press '2' again on the master clock. If this still does not work, check that the comms port is set to ON or USED in menu 10 on both clocks.

GPS Synchronisation

If the clock is fitted with a GPS receiver module it is possible to set the time very accurately to GPS time.

Power up the clock normally and press MENU to display the battery level screen.

Press '6' which will display the message:

```
GPS Working

Connecting
```

Which indicates that the system is attempting to talk to the GPS module

It will quickly change to:

```
GPS Working

Seeking
```

Whilst it looks for satellites. As with any GPS receiver the unit must have a clear view of the sky, it will not be able to connect in a building and may have difficulty in highly built up areas.

Once one satellite is detected it will change to

```
GPS Working

Getting time
```

3 satellites are required to get an accurate time signal.

You may see the message:

```
GPS Working

Checking time
```

Appear briefly before the clock plays a short tune and returns to the running clock display.

GPS Time correction.

Satellites give out universal time, which is roughly equivalent to GMT but can vary. During BST or in countries other than the UK a correction value can be entered in menu 28 as HH:MM:SS +-

The default during GMT in the UK is 00:00:03- which should match the speaking clock and Radio 4 pips exactly (not on digital radio!)

It is necessary to change this to 01:59:57+ during BST since the clock may be used at the point the time changes.

Any value can be entered into this correction field so that any time zone, even 15 minute time zones can be accommodated. Use the arrow keys to change from a positive correction to a –ve correction as required.

Traffic Lights
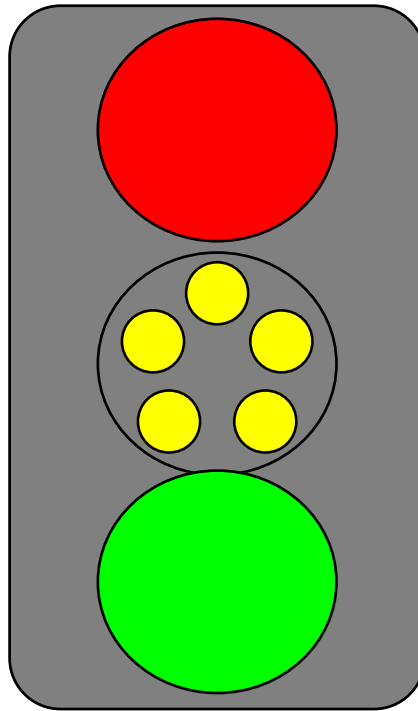
Specification

Overall size   110*220*60mm fitted with standard tripod mount.
Lights of a larger size are available by special order.

The lights consist of a 65mm cluster of red LEDs, five smaller clusters of amber LEDs and a 65mm green cluster.
The amber lights are used to count down the last 5 seconds before the GO signal.

The clusters are constructed using DOT approved signalling LEDs, intended to be sunlight viewable from over a 10m. Each cluster is made of several chains of devices so that in the unlikely event of a device failing the lights will still continue to operate.

To allow additional timing equipment to be triggered or a warning siren, a pair of relay contacts are available activated at the same time as the green light.

A user adjustable control has been provided on the back of the lights to allow them to be dimmed in low lighting conditions or at night.

Power supply

12v DC via a 2 way Bulgin connector (4mm banana plugs on early units) from a car battery, cig lighter socket or ECM battery pack.

Typical current consumption (max power)   100 mA
Maximum power consumption (5 Amber+Red)   220 mA.

Light Sequences

The green light will remain on for 6s. (except sequence 8)
A number of pre-programmed sequences are available to allow the lights to be used in different ways on differing events.

Sequence	Red	Red+Amber	Amber	Green
1	15s	10s	5-4-3-2-1	0
2	10s	not used	5-4-3-2-1	0
3	10s	5-4-3-2-1	5-4-3-2-1	0
4	On unless green or amber	10s	5-4-3-2-1	0
5	On unless green	5s	no countdown	0
6	30s-10s	15s	10s –5-4-3-2-1	0
7	On until green	not used	not used	0
8	30s-10s	15s	10s –5-4-3-2-1	20s
9	On until green	Last second only	Last second only	0

Additional light sequences can be added on request.

If the light sequence is set to 0 no data for the traffic lights will be sent out of the port, this is important if a clock repeater is used on its own, without lights.

Sequence 6 matches the FIA World Championship prescriptions for start operation, The red light illuminates at 30s before the start, the amber & red come on to indicate 15s, the red goes out to indicate 10s, the amber counts down from 5s.

Sequence 7 removes any element of prediction from the lights and gives an immediate red-green change at the specified start time. This is particularly useful for mode F, sprint timers.

Sequence 9 is a very fast sequence with no countdown, just an amber followed by green; useful for sprint or where immediate sequencing is used.

Repeater Clocks

A large, daylight viewable, LED clock display can be attached to a clock running in any mode. The display can be configured to show:

RT	Real time	This display keeps counting even if the clock is stopped.
DT	Display time .	The display shows exactly the same as the clock. It freezes if the clock is stopped.
ST	Start time	Counts down seconds to a green light
ET	Elapsed time	Gives the lap time if clocks are connected.

Displays are housed in a weather proof aluminium case with a contrast enhancing anti-reflective perspex screen.

12v DC (11 - 14.2v) supplied via a two way Bulgin connector. The current required will vary depending on the display configuration (0.5A for 4.5", 2A for 7") and the time displayed (11:11:11 uses a lot less power than 00:00:00). For the 7" displays a reasonable power car battery should be used rather than an alarm battery.

Standard configurations.

1) HH:MM:SS 6 digit 7" display, RED or AMBER
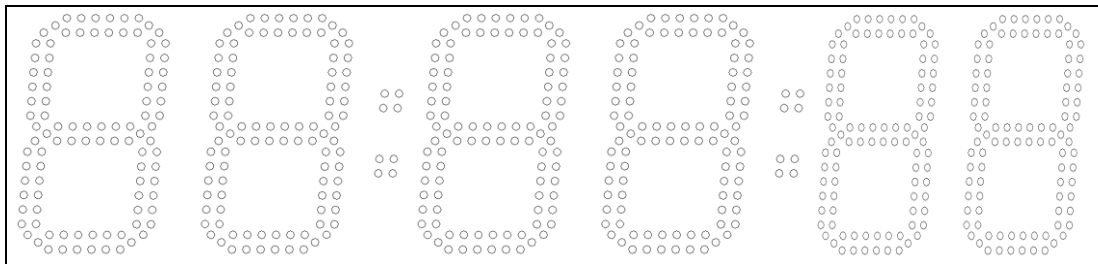
Also compact display with vehicle number

2) MSH   MM:SS.th   6 digit 4.5" dispay, RED or AMBER
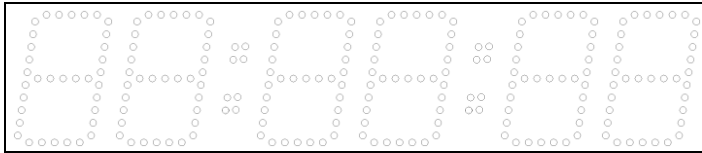
Or compact display

3) VMS   Display with vehicle number. VVV MM:SS or VVV SS.th Mixed colours.
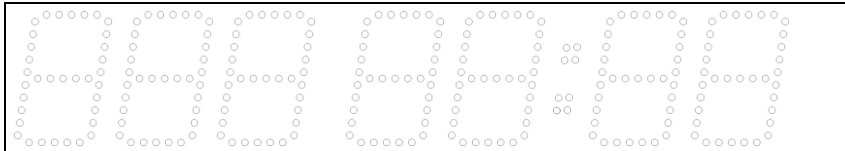
5) RLD
This setting is used for the combined start lights WRLD only and will ensure the display shows
HH:MM:SS
Use of this mode with any other display will give reversed digits
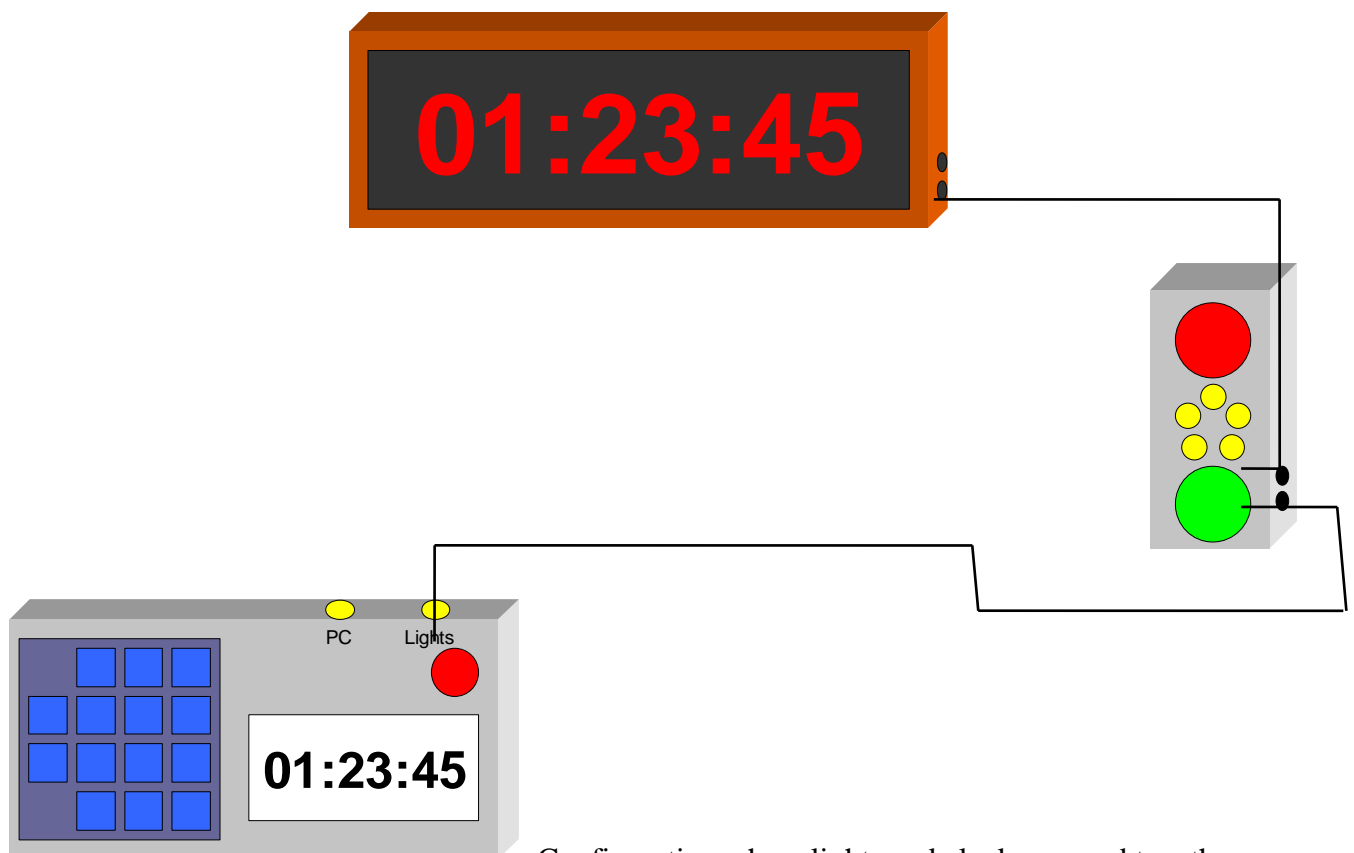
Configuration where lights and clock are used together.

Communication protocols

The RS232 port on the clock can be configured to operate in 4 different modes using the menu
It is always configured for 9600 baud, 8 bits, no parity, and is only enabled when required, or if the
clock is showing the system status screen, or if one of the linked clock modes are selected.
Pressing the '9' button when in the system status menu will force the clock to transmit its entire
memory in the current format. Note the clock will freeze while this download takes place.

Serial printer mode - PRN

Selecting this mode will cause the clock to output ASCII data on each event (STOP, beam, lights…)
suitable for a ticket printer.

Example:
```
STOP  0001 STG 01 13:31:09.2
BEAM  0004 STG 01 13:31:22.3
BEAM  0005 STG 01 13:31:22.5
STOP  0006 STG 02 13:31:26.8
START 0010 STG 02 15:02:00
```

In clock mode 1 the data is sent immediately when the stop event occurs, in mode 2 the data is only
sent when a vehicle number is entered.
If a vehicle number is altered the new information will be printed and a '*' will appear next to the
vehicle number.
The text is only printed to the timing resolution set for the clock.
The serial printer should be configured for 9600 baud, no parity, 8 bits data, Xon/Xoff handshake.

PC compatible mode - CSV

In this mode data is output in ASCII CSV format which is ideally suited for reading into a spreadsheet
or database application

```
Function,stage,vehicle,hh:mm:ss,th    sample header details


SS,14,0012,09:22:11.00 <CR><LF>
FF,05,0123,10:11:22.30 <CR><LF>
```

Omega compatibility mode - Omg

This mode should be used with PC software designed for use with the Omega power timer
It outputs data on each event to the exact specification of the omega clock. Some enhancements have
been made to allow for corrections and multiple laps.

The format is <0x7f> <STX> "F" VVV HHMMSSth "0" <ST> <FNC> <LAP> <CR> <LF>

where ST is   '0' for a normal record
              '1' for a correction
      FNC is   '1' for a stage start
              '2' for an ATC
              '3' for a flying finish or stop time
              '4' for regroup in

'5' for regroup out
'6' for an allocated start time
'7' for jump start details

LAP is   the number of times this vehicle has been seen or the stage number, whichever is the greater.

Packet comms mode - Lnk

This is the internal communications mode used by the timer which has advantages over the simpler ASCII formats since it is more compact and less likely to contain errors.

When transmitting any number of spurious 0xFF bytes may be sent while the comms chip / RF link is powering up.

All data packets start with the Hex code 0xAA (170 decimal) and are terminated by 0xBB (187 decimal)

If more than 32 characters are received, or any bad character the packet will be thrown away. The packet will only be processed on receipt of a BB byte.

RF mode – RF

This uses the same data format as LNK mode, but retransmits each event for up to 1 minute or until another event occurs. This is important on radio based systems where there is a good chance of a data error. The receiving clock will simply ignore duplicate events being received.

RF mode should only be used if the radio modem does not have it's own retry mechanism.

Received data

The clock will accept data packets while displaying the status menu or if configured for permanent comms.
Data must be prefixed with <0xAA> and terminated with <0xBB>

Each command consists of a pair of bytes followed by some data as necessary:

PC	Password Clear	Clears any passwords set in the clock, no data required
DL	Download Request	Forces all clock data to be sent as a block
SS	Set Stage number	2 bytes, giving stage number and function 0-4
CL	Clear all	Wipes all data from memory
CF	Config pkt	16 bytes giving entire clock setup information.
SP	Set passwords	6 bytes giving user and system passwords
PT	Play tune	1 byte tune number 1-18
DM	Display message	displays a 2 line*15 character message on the display

Set date and time
Time values are sent in binary and will be written to the clock on receipt of the terminator.
      <0x55> <0x42> <YY> <MM> <DD> <HH> <MM> <SS>
sending this packet will force any part seconds to be cleared and the clock will emit a beep.

Transmit data

Fixed length binary data packets designed for interface to other clocks or proprietary software. This format includes a checksum and a running packet count so that data corruption and missing packets can be detected by the receiving unit.

Packet format
> <0x00> <0xFF> <0xFF> <0xAA>
> <FUNC> <STAGEN> <VL> <VH> <H><M><S><T>
> <count> <CSM>
> <0xBB> <0xFF>

The 00,ff,ff pre-amble bytes should be ignored. They are included to enable any hardware repeater units or carrier on RF units. The terminating FF should also be ignored.

<FUNC> is	0	ATC	Time control
	1	SS	Stage start
	2	FF	Flying finish
	3	SF	Stage finish
	4	RGI	Regroup in control
	5	RGI	Regroup out
	7	JP	Jump start details

<STAGEN> is the stage number or lap number as a single byte BCD
<VL><VH> is the entered vehicle number in BCD
<H><M><S> is the time as single byte BINARY
<T> is the number of tenths of seconds. Note this will always be sent even is set to 1s resolution
<count> is the packet count in BCD (to avoid AA or BB)
<CSM> is the arithmetic sum of all values between the AA and BB bytes. If the sum becomes AA or BB, 1 will be added.

Software revision file

1v0 20 May 2000
Released to MSA for testing and TWE London-Sydney

1v1 1 June 2000
1) Added time zone correction
2) Added ASCII and Omega comms
3) Clock now enters jog mode on ENTER

1v2
1) Changed operation of mode 2 - stop button now not a toggle
2) Changed LCD update default to 128ms
3) Fix for passwords - flag not set on ENTER from menu

1v3 11 June 2000
1) Serial comms settime
2) Added comms commands
3) Added key from status screen '9' to send all comms out serial port
4) Lap counter and query to mode 2 vehicle entry
5) Unwritten modes report "not implemented" message
6) Mode 3, start timer

1v4 05 July 2000
1) Swapped Clk and Lat on traffic lights for new lights pcb
2) Sstart modes 1,2 now record times and not stop times & allow vin to be entered after.
3) Display update timer now 250ms or 100ms locked to 1s count
4) mode 3 improved.
5) Mode 4 implemented

1v5 23 July 2000
1) Clock now bound checks and clears invalid times.
2) Mode 4 car display sorted

1v6 July 2000
1) Additional handlers for clock repeater

1v7 1 November 2000
1) Beam gate time added to menu - replaced slippage time
2) Clock repeater moved to item 11
3) New item 12 clock repeater config HH:MM:SS MM:SS:T VVV:MM:SS
4) Increased history to 256 items
5) Bug found with password entry and powering down fixed.

1v8 10 January 2001
1) Reduced power consumption during active mode (1/2 speed) and sleep mode.
2) Fixed month and year rollover bug
3) Omega comms mode, send only requested clock resolution
4) MSA Test mode (14) for R(0.1) testing
5) Additional comms receive commands.
6) Block download (menu-9 or via comms) now sends ALL records

1v9 27 January 2001

1) PCI and LNK mode comms added
2) Software timing calibration added
3) FIA and immediate light sequences added.
4) Mode 12, 2 way lights added.
5) Bug in day of week rollover fixed.
6) Power OFF modified and SLEEP mode added

2v0 8 Feb 2001
1) release version of above, no other changes.

2v1 9 April 2001
1) Bug with setting the time via comms fixed.
2) Green light only stays on for 6s rather than 10s
3) Comms test now correctly starts in any mode
4) Clear memory now works again.
5) 1m lights sequence bug fixed

2v2 15 June 2001
1) Fixed problem with clocks crashing when in OFF mode & button held down for 15s
2) Added warning on selecting OFF mode
3) Made memory fully cyclic after 256 entries- count 1-999
4) Download all now sends the correct lap number
5) Default time correction made -55
6) Viewing, printing or sending history uses stored function type
7) In mode2, stage start, times will be sent out comms if a vehicle no is entered
8) Lap number/comms after a jump start is now correct
9) Password protection is enabled after clearing memory

2v3 August 2001
1) New menu for comms overall control (OFF USED ON)
2) New mode for stage stop / clock mimic
3) Block download now sends 1 block every 50ms
4) New mode (6) for ATC control issuing start times
5) New mode (7) for PC regroup timer
6) New mode for timing from beam to beam with lights
7) Red light now stays ON when aborting a start
8) Repeater display modes changed to allow tenths and hundredths.

2v4 15 September 2001
1) STOP key debounced changed to stop it missing key presses after a bad bounce.
2) Entered vehicle numbers are now zero blanking removed on number entry
3) Mode 6 (ATC) & 7 (RG), min times can now be entered & used.
4) Mode 7 RG now finished.
5) In mode 6, ATC nominated start times are sent as type 6 not type 1.
6) Mode 8, beam start mode F timer fully working
7) Some comms text & mode flags corrected, jump start Omega now #7

2v5 1 December 2001
1) Memory depth increased to 450 entries
2) Tidy up of modes and functions (internal)
3) Lap now uses largest of stage no or calculated laps
4) csv format stage/lap no is now correct.
5) Jump start detect on mode 4, sprint timer.
6) Printer strings now all 5 chars to keep printout tidy.
7) ATC/RG modes 6,7 ignore seconds on calculations.
8) Jump start on all modes except free running lights.
9) Speed trap mode, calcs, comms and display finished.
10) New comms command "RC" to request current settings (16 bytes, binary)
11) "DL" comms request for data can now include optional 0-3 for format "DL2"
12) mode 5, mimic timer. Now stacks up times if in stage stop mode.
13) If in stage stop mode, a beam break does not now clear the edit field unless current vehicle.
14) 14 Comp safari mode added.

2v6 1 January 2002
1) Fixed bug introduced in 2v5 in mode3 on jump start detect.
2) Battery level now has splits to show charge.
3) Start countdown and start time now available on repeater display.
4) LCD is now always updated at 100ms to stop apparent drift
5) All packets received in mode 5 and 10 are now re-transmitted
6) Pressing the STOP button in stage finish mode does not set the clear edit field flag
7) Holding STOP button pressed while asleep no longer causes time to be lost.
8) In free running start, lap numbers are now set to the default stage number.

2v7 1 January 2003
New features added:
1) Various stopwatch modes.
2) 15s start available for traffic lights.
3) LED display can now alternate display – Time/temp, time/total
4) Comp safari, special results download mode.
5) Programmable printer / comms transmit delay.
6) Indication of beam input on status screen.
7) New function to download only 1 lap of data.
8) Version number sent from comms on power up.
Enhanced features:
1) Clock synchronisation can now be done from status menu.
2) Menus Re-arranged to put clear memory earlier.
3) Password security moved to top level - only set stage number available to user.
4) Several new menus added, others moved or skipped.
5) Modes 5 and 10 now accept settime and commands and will always receive Lnk mode and re-transmit data in any format.
6) Option to transmit any event even if no vehicle number entered.
7) Jump starts are always displayed or transmitted as 0.1s or better

8) Stage numbers added to CSV and ASCII mode formats.
9) Memory is now fully cleared if the clock is switched off.
10) Speed trap beam width now upto 1000m
Bugs fixed:
1) Problem with duplicate passwords being used fixed.
2) Repeated pressing of STOP while OFF no longer crashes unit.
3) Default adjust scalar fixed to -55
4) Setclock on exact minute bug fixed. Checksum added for security.
5) Unfreeze clock in jog mode
6) Backlight is switched off immediately if timer set to zero
7) Problem with lap no of first entry in memory fixed.
8) Vehicle number on comp safari repeater display is now correct.
9) Vehicle no is cleared on esc from menu or clear memory.
10) Comp safari memory full problem fixed.
11) Comp safari totals if timing to 0.1s corrected.

2v8 May 2003
1) Ability to edit totals in comp safari mode.
2) Simplified comp mode (RG)

3v00 August 2003
1) New hardware support:
    Second beam input
    Power supply control
2) ADC routines made re-entrant to stop pause at 1m

3v10 14 October 2003
1) Invert for backlight on new hardware
2) Fix for crash on multiple press of power button when OFF
3) check for comms disabled on send_string at power up.

3v2 26 October 2003
1) stop battery status flickering
2) New lights sequence to allow 20s green light
3) OFF mode crash recovery
4) Speed trap using both inputs
5) reduce power use on start from OFF
6) Enable comms tx in menu to stop break chars

3v3 4 November 2003
1) New menu for Memory settings,
2) Improved compatiability with SII units

3v4 12 December 2003
9) Menus re-numbered for extra item introduced in 3v3
10) Extra check at power on for SIII units

3v6 June 2004
1) All records received in comp mode are converted to START times
2) Sprint timer start times are sent out as SN (was NS) in CSV mode
3) 'SN' now decoded in receive routines.

3v7 1 July 2004

1) New Mode 16, display mode to allow addressable data download.

3v8 13 July 2004
1) Mode 17, countdown stopwatch
2) Mode 13, stopwatch, display now clears to 0 on restart

3v9 1 September 2004
1) clocks can now be Sync in mode 5 & 10 if in csv mode
2) Auto-max in comp mode if in csv comms now works

4v0 2 January 2005
1) New menu for clock type override, menus now use equates
2) power up double reset for display from sleep & off
3) seconds on countdown display (mode 15) for Prodrive
4) fixed problem with clock crashing in JOG mode or menu-2 if comms disabled.
5) mode 10 will now receive comp safari results in CSV mode
6) Crash when using external memory in mode 10, download 5 fixed.
7) Bug in mode 6, ATC, when issuing times on minutes fixed
8) print titles in PRN and CSV mode and from MENU-3

4v1 18 Feb 2006
1) Comp safari mode: Pressing UP when looking through history records now skips start times
2) Comp safari mode: Pressing UP onto a blank stop time now prompts for vehicle
3) Comp safari mode: Major bug in comms between start clock and finish clock fixed 10 in (10am) if lnk->CSV
4) Start time display now displays "----" until a vin is entered and clears on green light off.
5) Start timer correctly cleared down on power up.
6) Edit flag reset after failing password or clear memory to allow a card number top be entered correctly

4v2 12 August 2006
1) On power up, check hardware type again after reading EEPROM & switch off backlight
2) Unknown hardware type now defaults to 3v0 (latest h/w)
3) Beep on power up if in sleep (stop pressed)
4) Comp safari mode; does not now process max if in sleep mode
5) When using mode 5, stop line, the display will now update with vehicle if time if already on display

4v3 December 2006
 AVR 128 version ONLY

4v4 2 January 2007
1) Comp safari mode; Fixed bug in where clock crashed after 450 motors!
2) New hardware type for MEGA128 - type 4
3) Fix bug with 1 minute starts to hold back at 6s (& 2m & 1M30)
4) Clears led display countdown or time to go on STOP in start mode
5) Clear vehicle number to blank on led display if clock running
6) Display now correctly shows if time to start > 1 minute.

4v5 4 March 2007
1) Fixed backlight inversion from 4v4 with type 3 clocks

4v6 23 September 2007
1) Corrected bug in comp mode when running to 1/10 or 1/100 in subtraction.
2) mode 5, stop line repeater, now shows ------ on display if running (no data received)
3) mode 5, stop line repeater, in RG mode, ignores all data except comp safari totals to act as a multiple repeater

4v7 November 2007
1) Start timers modes 3& 4 now allow Immediate light countdown.
2) New lights sequence with a 1s all amber, for quick starts
3) Passwords entry now hidden on entry
4) Dual beam input, both needed for break to record
) New mode, 18 to calculate an intermediate time from the previous vehicle.
7) hardware build version introduced (-1, -2, -3 -4)

4v8 22 April 2008
1) New RF comms mode to resend each packet every 0.5s up to 100 times for RF modem use.
2) comms receive, now ignores duplicate information
3) Stop repeater clock (mode 5) in RG mode ignores all packet types (not just CSV) for all but comp safari times.

4v9 22 April 2008
1) release version of 4v8 including lots of work for comp safari mode over RF

4vA 1 June 2008
1) Bug fix - when receiving times to 0.1s in CSV mode check for terminator & ignore. Previously added 130ms to all the times!
2) CSV output now has '.' separator on 1/10ths
3) Stop repeater mode (5), configure in ATC mode to just show stop times and ignore all others
4) Fix - in mode 10, stop time will be queued to send if tx is busy (RF mode issue)
5) First time defaults changed to mode 2 SF on loading new code.
6) on manual STOP button, edit & clear flag maintained to stop xx42 problem on entry
7) On editing start times, don't blank or * the time (password bug)
8) Led repeater display VVV is now not sent if showing HH:MM:SS or MM:SS:TH

4vC 9 October 2008
1) Mode 13 Stopwatch, FF timer mode now can be made to ignore any further inputs on the first beam seen until the second beam is triggered. This is enabled by selecting DUAL beam mode (MAKE beams only)

4vD 16 April 2009
1) LCD init fix added for revised hardware displays (port inits)

4vE 12 May 2009
1) 2nd LCD init removed from wakeup code

2) countdown timer (mode 17) now plays a tune on final count and operates traffic lights.

5v0 2009
1) System adjusted for Mk5 hardware

5v1 April 2009
1) GPS decoder added

5v2   29 June 2009
1) WRLD (RLD) mode added for reversed digits on display layout

5v3   14 July 2009
1) removed clear menui from GPS powerup

5v4 22 Jan 2010
1) Added RF retry staggered holdoff including stage number offset.
2) Added RF comms repeater to mode 5 when SS selected.
3) resetable countdown to 0 and up mode 19 - Marathon timer
4) display update changed to 50ms from 100ms

5v5 30 March 2010
1) New display mode (ET) in comp safari mode that shows running time of likely competetor.

5v6 26 April 2010
1) Removal of duplicates on receive now goes back 32 entries (8 comp records) also wipes record
2) RF repeater mode - time lag reduced to 8s
3) Green light forced off if still on when new number entered.
4) Time scaler set to 127 if zero adjust or =
5) edit mode disabled on a jump start to force the marshal to press UP to get the next time.
6) In mode 4, select ATC to pre-enter vehicle numbers for open starts

5v7 July 2010
1) Added Class E test & beam events for 1/100 timing
2) Modified class E timer to count >24 hours (99)

5v8 1 October 2010
1) Brief code branch - CAR text changed to DOG for dog sled events
2) Added new alternate display type - shows run time for 10s then back to real time
3) Mode 10 - MENU-8 transmits just STOP times
4) GPS not enabled when asleep

5v90 1 DEC 2010
1) Back to "Car" in all menus
2) Fix to allow 000 to be received and not create a new entry if same time exists

5vA0 23 June 2011
1) Added VVV to MSH mode display for vvv MM:SS.TH displays

5vB 16 November 2011
1) Added filter for comms based on high digit of stage no.

stage 0x will receive anything, any other stage nos will only receive the same stage prefix.
2) 0.1s error on CSV - 0x13!!

5vC 19 January 2013
1) pre-entry of comp finisher
2) Auto confrim comp mode
3) blank WRLD on STOP
4) Speed trap   - clear display on waiting
                         - scroll back through times

5vD 24 March 2014
1) Special version for Ireland to show 1/1000s in mode 2

5vE 25 June 2014
1) 1/1000 mode removed
2) In mode 10, will retry time if in RF mode.
3) will only send actual time if in RG mode

5vF 6 Jan 2015
1) Added receive handler for T0/T1/T2/T3/T4 for data tag input

5vG Sept 2015
1) tag based comms. TT storage and transmit
2) de-dupe for 1 min tags
3) find TT for any tag and generate record.

5vH Nov 2015
1) Tag T0 messages increase stage number as per other modes

5vI Jan 2016
1) direct feed of start queue from T0 tags. i.e. clock only operation

5vJ Feb 2016
1) Added SL Start lights external command
2) Added AL Abort lights command
3) Compatibility with Version 4v4 clocks

5vK April 2016
1) introduced new flag for edit mode to stop beam breaks and tags messing up manual entries.
2) Retry system re-written to send immediatly and then queue up retries for 12s each
3) Tidyup of TAG system for rally use

5vL Sept 2016
1) Added 3 new menu items for TAG operation
2) Fixed Comp safari bug intro in 5vJ
3) Fiex bug in mode 2 with entering nos before beam break.

5vM Nov 2016
1) Ignore tags with 0 car assigned
2) Allow upload of tag data in RF and mode 2

5vN Feb 2017
1) Start on 1m entering next car if lights still green switches off light
2) Mode 3 start, ATC sub mode now send a 'SR' packet to results software to trigger start calc.

3) Comp mode - should update running value again!

5vP 5 Feb 2017
1) Bug in auto-start ATC mode corrected
2) allows tag life 00 to disable feature

5vQ 25 July 2017
1.Duplicate tag search wipes out unwanted data from memory
2.Comp safari mode - not accepts unchanged jump starts
3.Comp mode - confirm second vehicle bug fixed
4.Memory full bug if extended disabled in tag mode
6.auto start +1s bug fix
7.quick transmit in CSV MENU-4
8.clear memory but not tags fn
9.mode 9 start issue
9.Battery level recalibrated

5vR 3 Sept 2017
1. Recalib battery level to give FSD with new batteries.

5vS 12 Feb 2019
1.New remote command to remove start time from a comp clock - either maximum or rerun   AS nnnn
2.Pass 'AS' command through a start clock to fininsh clock

5vT 2 May 2019
1.In STOP mode, do not show tag data if received.

2.put backlight on when receiving remote comms

5vU 25 June 2020
Covid 19 release

1. ATC mode altered: a) Actual time button pressed sent out comms as a T1 time
b) arrow keys can be used to adjust the time (HH:MM) and confirm a revised time
2. Altered HH:MM:SS to always include VVV output for new display

5vV 28th Sept 2020
Further Covid changes

1. ATC mode, increase stage number as per other modes
2. In Start mode, when showing start time, revert to running display after 32 seconds idle
3. In mode 2, allow display to blank when in ET mode -i.e. only show frozen times
4. Service in / regroup
        Dont show running clock (90 second idle timer)
        don't show seconds (00) when running 30s starts
        stage number needs to increase

5. Tag download bug with vehicle number 9x

Ports

The only external connections are via two waterproof sockets on the top of the case.
These should be fitted with dust caps when not in use to prevent mud and grit accumulating on the pins.

Both connectors are TRIAD -01 series 12mm connectors available from RS, Farnell and ECM. No attempt should be made to connect directly to the internals of the clock.

Serial Communications Port

4 way triad connector

Appropriate mating connector	Farnell	130-734
	RS	259-1126
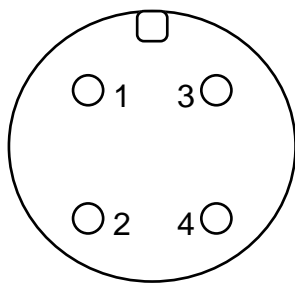
Pin	Use
1	Gnd.
2	Txd Serial Data output RS232
3	Rxd Serial Data input. RS232
4	+V battery charging input if rechargeable.

A ready made lead can be supplied to allow the clock to be plugged into a PC serial port.
Note, when coupling two clocks together a crossover lead must be used.

Note the idle state for the Txd output will not be the normal -10v. This is to save power. When a RS232 source is detected by the clock, and configured to send data it will switch on the output.

All serial comms is done at 9600 baud, 8 bits data, no parity, 1 stop bit.

See MENUS, serial protocols for data content.

Beam / Lights port

Appropriate mating connector	Farnell	130-746
	RS	259-1132
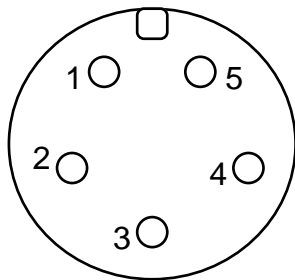
Pin	Use
1	Open collector latch to lights
2	Open collector data to lights
3	Second beam input (serial nos 030- only)
4	Open collector clock to lights
5	Beam break detect input
Case	Gnd

This port should only be used to connect to other ECM supplied peripherals.

All inputs and outputs are protected against short circuit and static discharge but can be permanently damaged if used incorrectly.

The beam input trigger is optically isolated and is biased high and coupled through a 470R resistor. To trigger the input this pin should be grounded for at least 10ms. The timing is taken from the point the pin is first grounded. The clock will not accept another input for 200ms after the line reverts to its high (floating) state.

The isolator requires 5-10mA to trigger so should not be left in its active state even when the clock is switched off.

The three open collector signalling pins can be coupled to a set of ECM traffic lights or / and a repeater clock using the cables provided with this apparatus.

If both a beam input and lights are required the beam input should be plugged into the side of the traffic lights into the connector marked OUT.

Specifications

Accuracy

The clock functions are controlled by high accuracy a temperature compensated crystal oscillator (TCXO).

	Stability	**accuracy**	**Temp range**
Basic accuracy	2 ppm	±1 minute per year	0ºC to 40ºC
Extended range	7.5 ppm	±4 minutes per year	-40ºC to 85ºC
Drift with age	1 ppm per year	±1 minute per year	
Drift with battery life	1 ppm from full to low	±1 minute per year	

(ppm = parts per million)

Under normal operating conditions (0-30ºC, 2 day event) the accuracy will be 2 parts per million (ppm). This means that for every 1,000,000 seconds (11.5 days) it can be a maximum of 2 seconds fast or slow, this works pro rata for $1/10^{th}$ or $1/100^{th}$ of a second:

Units	**Time until out by 1**	**Time until out by ½**	**MSA requirements**
0.01s	01:23:20	00:41:40	00:05:00
0.1s	13:53:20	06:56:40	00:09:00 (F) or 10:00:00 (R0.1)
1s	5¾ days	3 days	10 hours 0.5s (R)
10s	2 months	1 month	N. A.
1m	1 year	6 months	N. A.

The greatest accuracy is achieved with new batteries. This is particularly important when timing to R(0.1) over long periods of time.

This table gives the basic accuracy of the clock without any additional software correction. See page 22 for details of how to correct the clock for any known drift.

Physical

Size	170 * 88 * 40 mm.
Weight	335g.
Material	Flame retardant ABS case, Polyester membrane.
Environmental protection	IP67 (if case seal maintained, otherwise IP54)
Operating temperature	-20º C* to +40ºC
Conditions	The unit is intended for use in normal outdoor conditions. It is not designed to be immersed in water, or operated in hot, steamy environments. Do not leave in a vehicle in direct sunlight, this will cause the adhesive to fail and may cause damage to the batteries. The unit should not be operated if the keyboard membrane or window is punctured or if the LCD window becomes misted over.
Display	FSTN Liquid Crystal 122x32 graphic display, wide temp operation.

Processor

Speed	4 Mhz (risc)	
FLASH	128 K	
Ram	4 K	450 vehicle run details
EEPROM	4 K	500 vehicle runs

Batteries

3 * AA 1.5v high capacity cells 2500mAh recommended.

The current condition of the batteries can be found by pressing MENU on the keyboard. When the battery has 25% power remaining the backlight will be disabled to save power and the low power indicator will be displayed on the LCD. The unit will operate for 20 hours after Low is first displayed.

The unit operates from three alkaline AA type cells. E.g. Duracell or GP Alkaline.
Rechargeable batteries can be used but the operation life will be somewhat less than using alkaline batteries.
None alkaline batteries can be used but these will need replacing much more often.

The unit is protected against reverse voltage but fitting the batteries incorrectly may result in them rapidly discharging and overheating.

Note on operating in extreme conditions:
Many batteries are not designed to be used below -10ºC or above 40ºC. They will either stop producing power, have seriously reduce power available or in extreme conditions, explode. Special wide temperature range batteries are available from ECM if required.
The clock display will slow down as the temperature goes below -5ºC, at -20ºC the display takes 3 seconds to fully change. This means that it cannot be used as a live countdown display. The traffic lights and any frozen stop times will display correctly.

Provisional battery life details:

			Life
Nominal battery capacity	2500	mAh	(Duracell)
Operating current	14	mA	11 days continuous
Standby current (sleep)	0.4	mA	6 months minimum
Off current	0.01	mA	10 years
Backlight power	85	mA	1 day
Using rechargeable 600mAh	14	mA	2 days

Under normal use, with the lcd backlight disabled, 12 hours operating per event, assuming 4 days events per month, the batteries will last 6 months.
Use of the backlight will seriously reduce the life of the batteries. If you are holding an event where it is required fit new batteries and set the timer to the minimum useable time.

The batteries can be changed without losing the time or saved information if the clock is put into power down mode and the batteries are replaced within 15s. If the clock emits a single low tone on power up the time will need to be reset and any stored data will be lost.

Richard Blackshaw
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