



Lap Timer System RCA65



Instruction Manual

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Optical

Beacon Peak Infra Red wavelength	950 nm
Beacon Spectral half bandwidth	50 nm
IR Detector wavelength maximum sensitivity	950 nm
IR Carrier frequency	56 KHz
System Range	50 m min. 100 m typ.

Electrical

Battery Type for Beacon	PP3	8.4 or 9 volts
Car supply voltage	12 volts nominal	
Note: Supply can vary from 0 volts to +24 volts without damage to the system.		

Current drain

Lap Timer with Back Light On	90 mA
Beacon on Channels 1, 2, 3 or 4	15 mA

Environmental

Temperature	0 to 70° Celsius
Vibration (Lap Timer) operational	0.5 g
Shock (Lap Timer) operational	3 g

8. Troubleshooting

Use the following table to identify and fix any problems you find.

Symptom	Possible Cause	Try....
No Display	No Supply	Check wiring
Beacon not detected		First try at close range away from other beacons
	Beacon battery flat	Check battery voltage - see section 4.4
	Beacon or IR Detector not aligned	Check alignment - see section 4
	Beacon interference	Check for other interfering beacons - make sure your beacon is further than 5 metres away from others
	Beacon and Lap Timer set to different Main Channels	Use Set Up Mode to set channels - see section 3.2.1
IN Beacon not detected		First check at close range away from other beacons
	IN Beacon positioned incorrectly	Make sure IN beacon is not seen while Lap Timer is in Blank Time - see section 3.3.5
	In channel not set correctly	Make sure that the In channel is set correctly. See section 3.2.2

1. Introduction

Thank you for purchasing the Farringdon Instruments RCA60 Lap Timer System. It has been designed and developed by a group of keen club racers for cars, bikes and karts. We hope you will find the Lap Timer a helpful addition to your motor racing instrumentation. The latest version allows manual lap timing in addition to normal timing from a Farringdon or track beacon.

Please read these instructions carefully. The Quick Installation section will provide you with all the information you need to install the system and to use its basic facilities. However, we would recommend that you read section 5 before you try the system on the track. Section 3 provides you with the details that you will need to use all the facilities of the system.

These instructions have been written for systems installed in cars but Section 6 gives specific information for Karts and Bikes.

The RCA60 Lap Timer has been manufactured to the highest commercial quality standards but should be treated carefully. For example the liquid crystal display is rated at no more than 0.5g *vibration* and 3g shock in operation (2g vibration and 50g shock non operational) so please use the recommended mounting methods or better.

2. Quick Installation

This section explains how to mount the Lap Timer and the Beacon and to set up the system for the track.

2.1 Mounting the System Components

The Lap Timer consists of the following components:

- The Display Head
- The Infra Red Detector (IR Detector)
- Power cable
- Wheel Speed Sensor
- The Beacon (option)

The first two are mounted in the car by means of the supplied 3M Dual Lock tape. This tape is compliant and insulates the components from harsh vibration which may damage the system.

1. Fit the **Display Head** so that the driver will look at it square on, this will help minimise the reflections in the display window. For closed cars, position it so that it will be seen against the car's interior. Fitting it on top of the dash so that it is seen against a background of the windscreen and sky will make it more difficult to read. Use the Dual Lock tape making sure that the back of the display and the mounting surface to be used on the car are free from grease.

2. Now choose the position for the **IR Detector**. If possible try to find a position where the Detector can be changed round to face either side of the track (Left hand side at Donington, right hand side at Silverstone). The detector should be mounted at a similar height as the Beacon of the pit wall. The detector has an acceptance angle of only about plus and minus 7.5 degrees and should be mounted so that the Beacon will be "in view" when the car is on either side of the track. Make sure that the cable from the IR Detector and the cable from the Display Head will reach each other.
3. Plug the IR Detector cable into the 4 way Mini Sureseal connector on the Display Head lead and connect the Power Cable to the 2 Way Mini Sureseal plug. **The Mini sureseal connectors used are widely used in motorsport as they are waterproof (when mated) and relatively low cost, however they are easily misaligned—please be very careful when connecting these connectors.**
4. Now mount the wheel speed sensor. This is by far the most difficult item to mount and it is essential that it is mounted rigidly. The sensor should see one or more ferrous targets per wheel turn. To see the target it must pass within 3 mm of the black plastic end of the sensor. Make sure that the target has a flat surface—a cap head screw will not do! It may be possible to detect the heads of the bolts holding the disc to the hub or it may be necessary to make a separate target from sheet steel. Either way, this is the most critical part of the installation. Try and mount the sensor so that it does not overheat when the car is stationary after a race. Plug the wheel speed sensor lead into the 3 way Mini Sureseal socket. There is a small orange LED in the end of the sensor that will light when the target is seen, so apply power to the system and rotate the wheel and ensure that the LED lights when the target is under the sensor. Enter Set Up mode and move to the wheel speed sensor test. The display will show whether it is seeing a wheel speed target. Rotate the wheel and check that the display changes as the target moves under the sensor.
5. Connect the free ends of the Power cable to a suitable 12 volt supply. Try to avoid noisy supplies such as that supplying the ignition. Remember that you may wish to Recall lap times after a session and it will be convenient to be able to do this without the ignition switch on. So connect the system to a 12 volt point controlled by the master switch.

2.2 Aligning and Positioning The Farringdon Beacon

The Beacon beam diverges at about plus and minus 20 degrees (see section 5) although scattered infra red light from the front window will be sufficient to operate the system when the car is very close (less than a metre). **Make sure that you position your beacon at least 5 metres from any other, including the permanently installed PI beacon.**

WARNING The relatively small and light Beacon is easily moved or even knocked off the pit wall - secure it from accidental knocks - it is large enough to cause serious damage to the car and injury to the driver if it falls in the path of a car.

5. Changing the Battery in the Beacon

To change the battery in the beacon, remove the battery cover screw, remove the battery cover and disconnect the old battery. Connect the new battery and install it in the beacon. Make sure that the wires to the battery connector are neatly routed and re-fit the battery cover. Ensure that it is properly fitted at the edge secured with small plastic tongues. Any type of 8 to 9 volt battery can be fitted to the Beacon although Alkaline types are preferred.

6. Adjusting the LCD Contrast

The Liquid Crystal Display (LCD) contrast is adjustable through an access hole in the back of the display head. This has been provided for manufacturing purposes and it is unlikely that you will need to adjust the LCD contrast in normal use. The contrast is temperature dependent and if the display is left standing in the sun, it may become very dark. Before adjusting the contrast, cool the display down to normal running temperature to see if the contrast returns to an acceptable level.

However, you may find a clearer display is possible with fine tuning of the contrast control. If you are using the backlight, slightly more contrast may improve the display. To adjust the contrast, remove the sticker covering the access hole and use a 2 mm width screwdriver to very gently turn the adjusting potentiometer.

Be sure to re-seal the access hole after you have made the adjustment.

4.4 Beacon Battery Voltage and IN Channel Display

The visible red LED on the top of the beacon gives you information about itself as follows. When the beacon is first turned from OFF to Channel 1 three groups of LED flashes can be seen. The number of each group represents a digit of the IN Channel coded into the beacon during manufacture. As any of these digits could be zero, the number of flashes is the digit plus one. So for example, if the LED flashed twice, then after a short pause another three and finally after a further pause a single flash, the IN Channel code would be 120. (2-1=1, 3-1=2 and 1-1=0)

After the IN code has been indicated, the beacon continually flashes the LED in bursts, where the number of flashes is the battery voltage - 7 flashes means 7 volts. The battery should be discarded or recharged once the voltage has fallen to 6 volts.

2.3 Setting Channel Numbers

The lap timer will respond to a PI System 2 Channel 0 beacon (the type installed at most UK tracks and the four normal and the IN channels of the Farringdon Beacon. The latest version can be set to respond to a button press where beacons are not available. For the Lap Timer to react to these codes, it must know the channels you are using. To set the channels:

- 1 Turn on the system
- 2 Press buttons 1 and 2 on the display head at the same time. Set Up mode is entered.
- 3 Use buttons 1 and 2 to move forwards or backwards through the various set up items. The first item is "Main Channel 001".
- 4 Use buttons 3 and 4 to adjust the value. To select the PI beacon, set the channel to 000. For button lap timing set the channel to 005.
- 5 If you have a Farringdon Beacon, use button 2 to advance to the "IN Channel. Set the beacon to IN and point the beacon at the IR Detector. The channel number will change to the IN channel number of the beacon. Now press button 2 to advance to the next item and switch off the beacon.

2.4 Setting Hold and Blank Times

The Hold Time is the time that the display remains static after passing the Beacon. This should be set so that the display is still static at a point on the track where the driver can safely look at it. After the hold time has expired, the display will show the time into the current lap or display the Delta (performance) screen. If the Hold Time is set to a time longer than the lap time, the display will show the last lap time until the beacon is seen again.

The Blank Time is the time that the IR Detector is effectively switched off after seeing the correct beacon. This should be set to a time that would cover the length of the pit wall so any other beacons set to the same channel will not be taken as the end of the lap.

Now press buttons 1 and 2 to exit Set Up Mode and save the settings.

2.5 Clearing the Lap Count or Elapsed Time

There may be some time between switching on the system and the start of a timed session on the track. Pressing the buttons 2 and 3 on joining the track clears the elapsed time display so that it now shows the elapsed time of the track session. Similarly, pressing the buttons 1 and 4 after parade and green flag laps clears the lap count so that the count now shows race laps completed.

2.6 Best Lap Display

The Best lap display shows the lap number and lap time of the shortest lap time recorded in the run. The lap number is cleared on switch-on but the time is remembered and has to be deliberately cleared by pressing the any button when

3. Detailed Instructions

3.1 Modes of Operation

The RCA10 Lap Timer operates in one of the following modes:

Timing Mode
Set Up Mode
Recall Mode

Timing mode is the normal operating mode of the lap timer. Set Up mode allows you to change the IR detector channel numbers and the other stored settings.

Recall Mode allows you to look back through the laps recorded. The following sections describe each mode in detail.

3.2 Set Up Mode

Set Up Mode allows the various parameters of the lap timing system to set according to your needs. To enter Set Up Mode, press buttons 1 and 2 together.

In Set Up Mode, buttons 1 and 2 moves forwards or backwards through the set up items. Button 3 reduces the item and button 4 increases the item. Either button 3 or 4 will change items from Yes to No or No to Yes.

3.2.1 Main Channel

The Beacon transmits a beam of infra red light encoded with a channel number. This channel number depends on the Beacon Control Knob setting and can be from 1 to 4 inclusive. The Lap Timer will respond to the channel number set as its Main Channel Number.

Set the main Channel Number to the channel number that you are going to use on the Beacon.

The Lap Timer will set this channel automatically if you point the beacon (set to the channel you wish to use) at the IR Detector when the Main Channel is shown on the display in Set Up Mode. Once the channel number is displayed on the Lap Timer, press either button 1 or 2 to move on to a new item.

NOTE Setting the Main Channel number to 0 will cause the system to respond to PI System 1 beacons. These are installed at many Kart tracks and the PI System2 Channel 0 beacons installed at most UK car tracks.

For manual timing set the Main Channel number to 005. This will make the system respond to **either** a channel 0 beacon **or** a manual push on button 1.

4. Beacon Setting and Siting

4.1 Understanding Infra Red Communications

Infra red light (IR) from light emitting diodes (LEDs) can be turned on and off very quickly and it is this property that makes infra red ideal for short range communications. To increase the sensitivity of the receivers, a "carrier" frequency is used to turn on and off the LED. The receiver can then look for light that is being modulated at this frequency amongst other background light. To impose information on the infra red beam, this carrier frequency is itself turned on and off.

There are two ways in which this form of communication can be interrupted, first, by any light source strong enough to saturate the receiver - for example - the sun or another more powerful IR source - and second, other transmissions using the same carrier frequency.

The reason for the recessed lens and photodiode in the IR detector is to shield it from direct sunlight so providing the IR detector will not "see" the setting sun behind the beacon, it will not be saturated by the sun.

However, some other lap timers and data logging systems do use the same carrier frequency and others use much more powerful IR beams and it is for this reason that you must take care where the beacon is positioned.

4.2 Beacon Conflicts

From the explanation given in the previous section it is clear that reliable operation can only be guaranteed when the beacon is sited away from all others. A distance of 5 metres along the pit wall is probably safe. The Lap Timer will ignore all infra red signals on the same carrier frequency that do not contain the Main Channel or IN codes saved in its memory but if you find that lap times are obviously incorrect, look for another Beacon using your channel on the pit wall. With only four channels to choose from, it may be that more than four teams are using Beacons at the same track. In this case agree to use a single beacon and set all the Lap Timers to respond to this channel.

It is especially important to site the Beacon away from other beacons using large external batteries and having a large array of LEDs pointing over the track. These probably emit very strong IR signals which will saturate your Lap Timer.

4.3 Aligning The Beacon and IR Detector

The Beacon Beam diverges at 40 degrees and the IR Detector acceptance cone angle is about 15 degrees. Ensure that the IR Detector will fall within the Beacon's beam and, just as important, be sure that the acceptance cone of the IR Detector includes the Beacon when the car passes it.

3.4.2 Memory Wrap

The memory in the Lap Timer has the capacity to store more than 7000 laps so it is unlikely to be filled very often. If the memory is filled, the start of the memory will be overwritten and the Recall function will be able to access only those laps from the start of memory up to the last saved lap. To avoid this happening, use the clear memory function at the start of a test or race day so that the memory will then contain just that days lap times.

3.5 Performance Mode—The Delta Function

3.5.1 What Is It

The RCA65 Lap Timer has a facility to operate in Performance or Delta mode. This mode can be set by switching Performance to Yes in Set UP Mode.

In this mode, the lap time display changes to show the difference (Delta) between the current lap and the best. This difference is recalculated several times a second as the car laps the circuit.

This continuous monitoring of the driver's (and car's) performance can lead to massive improvements in lap times. It is also very useful during qualifying when a bad lap can be predicted and that lap aborted, saving tyres and allowing the driver to optimise his position on the track.

3.5.2 How Does Work

It helps to understand the way the Performance Function works so that the limits of the system can be appreciated. The system is fitted with a wheel sensor which provides a measure of the distance the car has travelled along the circuit. Every so many metres, the time from the beacon to this point is compared with that from the best lap and the difference (Delta) displayed. However, this only works when the length of the circuit is known and the frequency of the signal from the wheel speed sensor is known—this will vary with the number of targets and the diameter of the wheel. The RCA65 calculates both these factors during the first two calibration laps.

Of course, when the car is taken to a new track, the previous information is no longer valid and the system must be told to re-calibrate before attempting to display the Delta time. **Resetting the best lap time tells the system that it is at a new track and recalibration is needed.**

3.5.3 Common Problems

The Delta time display will be disrupted if an artificially fast time is recorded. This can occur if another beacon is placed on the pit wall by another team ahead of the beacon being used by the system. Also the system relies on the wheel speed sensor so that any problems with this—an insecure mounting or excessive temperature will cause invalid Delta times. Once an incorrect Best Lap either in time or distance, has been recorded, the display is invalid and only a real faster lap or resetting the best lap time can recover a sensible Delta time. If the beacon is obscured by another car and a "double" lap is recorded, the system spots this and returns to normal after seeing the beacon again.

3.2.2 IN Channel

When the IN Channel position on the Beacon is selected, a special code is transmitted which causes the IN display to be triggered in the car. This special code is assigned to the Beacon during manufacture and is one of a set of 200. Although not impossible, it is very unlikely that your Beacon IN channel is the same as another Beacon being used at the same time.

For the Lap Timer to respond to the IN code it must be set in its memory. The Lap Timer will set this code automatically if you point the Beacon, set to the IN channel, at the IR Detector when the IN Channel is shown on the display in Set Up Mode. Once the IN code is displayed, press button 2 to move on to the next item.

3.2.3 Hold Time

The lap time is frozen on the display as soon as the Beacon is seen by the IR Detector and remains there for the Hold Time. If the Hold Time is set to longer than the lap time, the display will show the last lap time all the time, but if it is adjusted to hold the lap time until a convenient point on the circuit, the display will revert to the running time of the current lap so that the driver can see his time at other points on the circuit.

3.2.4 Blank Time

The blank time is the time that the IR Detector is turned off after seeing a beacon set to the Lap Timer Main Channel setting. This prevents other beacons set to the same channel from "ending" the lap just started. If interfering beacons are set around the circuit, this may have to be set to a time that will allow the car to pass all the beacons. More usually, 20 seconds will be adequate.

3.2.5 Performance

Select Yes if the Performance or Delta Time function is going to be used.

3.2.6 Hours Mins

Selecting Yes for this option changes the elapsed time display from minutes and seconds to hours and minutes which is more helpful for endurance races.

3.2.7 Set Defaults

Selecting Yes to this option sets the lap timer parameter to the default settings as shown below:

Main Channel	001
IN Channel	002
Hold Time	030
Blank Time	020
Hours Mins	No
Set Defaults	No
Clear Memory	No

3.2.8 Clear Memory

The Lap Timer will hold over 1,500 lap times but when this is exceeded, the first laps are overwritten and only those laps from the start of memory can be *Recalled*. It is sensible to clear the memory once the data stored in the lap timer is no longer useful.

3.2.9 Wheel Speed Sensor Test

The display shows whether the wheel speed sensor is seeing a target.

3.3 Timing Mode

In Timing Mode the display shows:

3.3.1 Lap Time

The large characters show the lap time. This time starts at zero and increments until the Lap Timer receives an infra red signal from a beacon set to the Main Channel number. The time is then frozen on the display for the Hold Time. The resolution of the display is to 1/100 second but the last digit may be on the point of changing, so the time should be taken as having a tolerance of plus or minus 1/100 seconds. Slight variations in lap times will occur because of the spreading of the infra red beam so that a quicker time may be recorded if the beam is crossed close to the beacon first and then on the far side of the track for the second time. The lap time rolls over from 9 minutes, 59.99 seconds back to zero.

3.3.2 Lap Count

This display increments every time the correct code from a beacon is received. The number can be cleared by pressing buttons 1 and 4 together. If the beacon has been crossed before the start of a race on the parade lap and again on the warm-up lap, this allows the lap count to be cleared in preparation for the start. The Laps count rolls over from 99 to 00.

3.3.3 Elapsed Time

This display simply shows the driver the time that has passed since the system was switched on or since the buttons 2 and 3 were pressed together. Pressing these buttons on joining the track for qualification or practice makes this display the elapsed time of the session. This time changes from its maximum of 59.99 back to 00.00. Depending on the set up option, the time is displayed in minutes and seconds or hours and minutes.

3.3.4 Best lap

The area on the display for the best lap time starts by showing the text "Best"

followed by the remembered best lap time. The first or "out lap" is ignored (as this is determined by the time between resetting the lap count or elapsed time and seeing the beacon for the first time) but subsequent lap times are compared and the fastest displayed in the area. The best lap display is relatively small and may be difficult to read while driving, so the display reverses to become white characters on a black background every time a new best lap is achieved. This change is easy to see and indicates that the current lap time shown on the lap time display in large numbers, is the new best time.

The best lap time can be reset by switching the system OFF and then ON and pressing the any button when prompted. The best lap time will be reset to 9 minutes, 59.99 seconds. If an unrealistic best lap has been set by testing the system (in the pits for example) remember to reset it afterwards.

If you are using Main Channel 5, Button 4 will clear the best lap immediately.

3.3.5 The IN Display

The lap time area of the display changes to * IN * when the lap timer receives a signal from the beacon switched to its IN position. (See Section 3.2.2 for details on setting the IN channel in the lap timer.) The IN display alternates with the lap time to give a flashing display to attract the driver's attention.

WARNING Before using the IN function during competition, make sure that the regulations allow you to do so. You may have to use a Pit Board after all!

3.4 Recall Mode

Recall mode provides a means of looking back over the lap times saved in the Lap Timer memory. NOTE that the Lap Timer memory is non-volatile and will keep parameters set in Set Up Mode and all lap times when the power is switched off.

3.4.1 Moving Through Stored Laps

Enter Recall Mode by pressing buttons 3 and 4 together. The display shows the last lap recorded. The button 1 will select the previous lap and the button 2 will retrieve the next lap. The display will not change if you try to display a lap after the last or one before the first. Note that the session number is displayed as well. To make the Recall mode more useful, the session number increments every time the system sees the beacon after switched on.

To exit Recall Mode, press buttons 3 and 4 again.