

# DENFORD®

## User Guide

# Denford F1 Race System



**CE**  
APPROVED

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INNOVATIVE EDUCATIONAL PROJECTS

Denford Limited Registered in England No. 386161 - VAT Reg No. 183438350 - EDIRI No. GB 183 4383 50 000



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## 3: Warning Notices

### Warranty Disclaimer.

The Warranty on your Denford Race Track & Race System will be invalidated if any modifications are undertaken that are not authorised by Denford Ltd.

### Maintenance Disclaimer.

Always obtain permission from the person responsible for electrical equipment in your establishment before accessing the electrical control panels housed in the Start and Stop Gates if supplied. All work must be carried out by personnel suitably qualified to remove the access covers to the electrical systems. Denford Limited cannot accept responsibility for any damage, injury and/or loss that may occur through incorrect electrical practices.

Safe operation of the Denford F1 Race Track & Race System is outlined on page 24 of this booklet.

***Use of the Denford Race Track & Race System for any purpose other than those for which it is designed may result in injury, and may also invalidate the warranty.***

## 4: Unpacking the Denford F1 Race

Both the standard Denford F1 Race System and the Denford F1 Race System with a Sector Timing Gate are supplied packed in either a cardboard box as standard or a flight case which can be ordered as an option.

The race system components are protected by bespoke foam packing inside both the box and the flight case. The foam packing is re-usable and should be retained to re-pack the Race System after use.



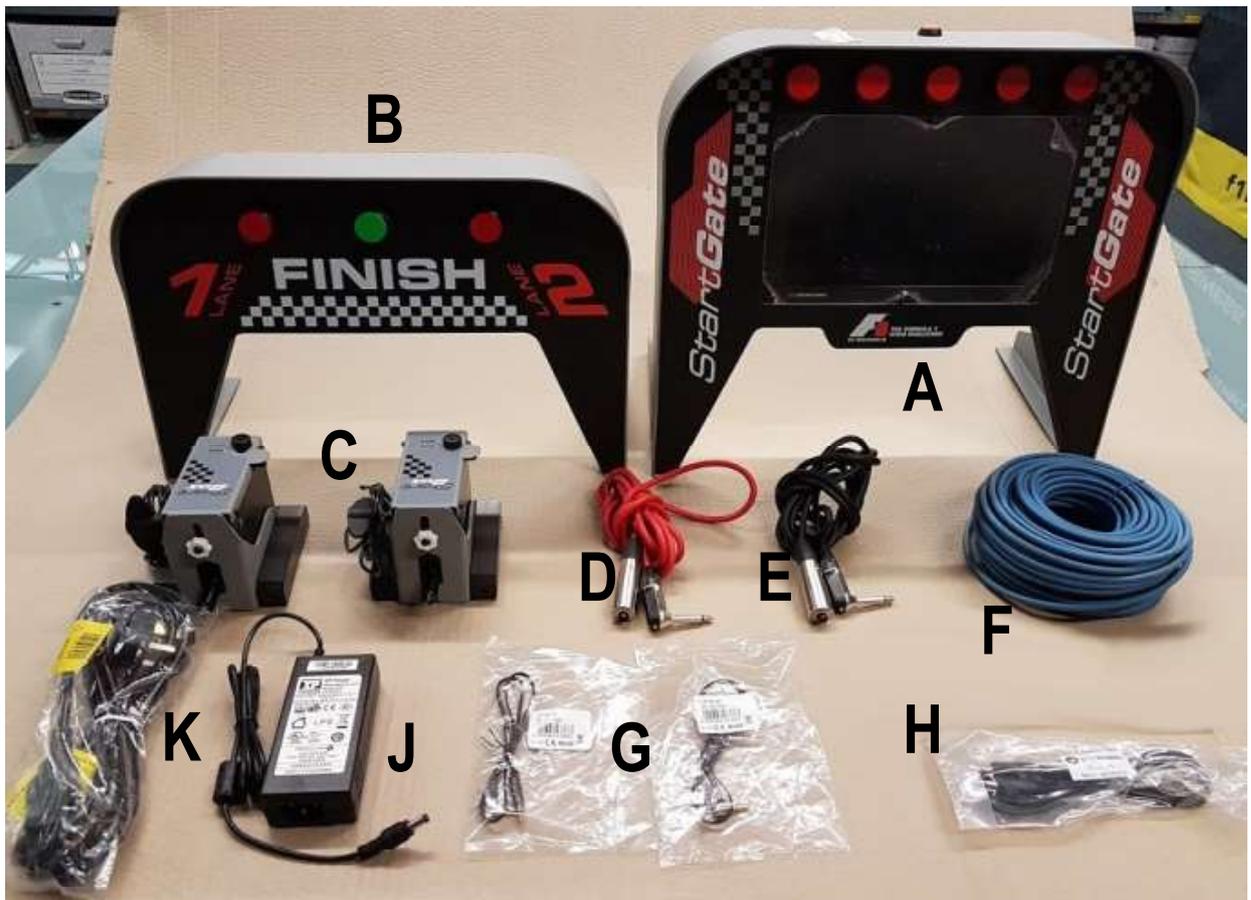
Standard Denford  
F1 Race System

Denford F1 Race System  
with Sector Timing Gate



## 5: Identifying the Denford F1 Race System equipment.

The standard Denford F1 Race System consists of the following equipment:



- |                                  |                                            |
|----------------------------------|--------------------------------------------|
| A.....Start Gate (1-Off)         | F.....Ethernet Cable 25M (1-Off)           |
| B.....Finish Gate (1-Off)        | G.....90 Deg Jack Plug Cable-Short (2-Off) |
| C.....Start Box (2-Off)          | H.....Jack Plug Cable-Long (1-Off)         |
| D.....Race Trigger (1-Off Red)   | J.....Power Pack (1-Off)                   |
| E.....Race Trigger (1-Off Black) | K.....Power Lead (1-Off)                   |

## 5: Identifying the optional Sector Timing Gate equipment

When the Denford F1 Race Track and Race System are ordered together from the factory with the optional Sector Timing Gate the following loose additional equipment will be supplied.



- W.....Sector Timing Gate (1-Off)
- X.....Ethernet Cable 25M (1-Off)
- Y.....90 Deg Jack Plug Cable-Short (2-Off)
- Z.....Jack Plug Cable-Long (1-Off)

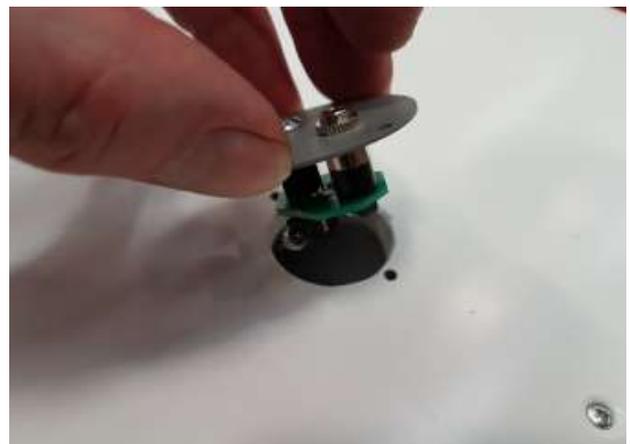
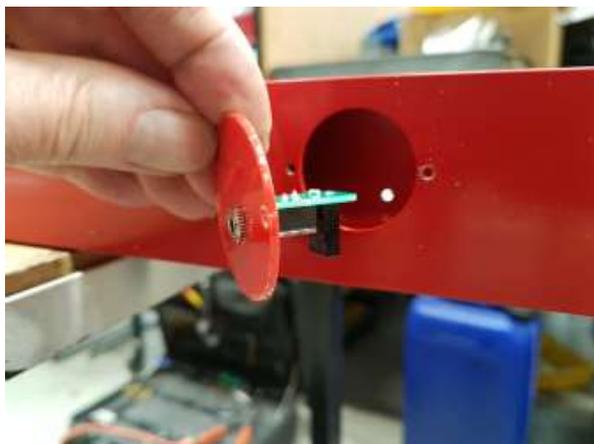
## 5: Identifying the optional Sector Timing Gate equipment.

When the Denford F1 Sector Timing Gate System is purchased separately the equipment identified on page 7 will be supplied along with these additional items shown below. These are the track sensors and must be fitted to the special Sector Timing Track Section.



The receiver sensors on the red mounting discs are fitted to the two outer (red) aluminium sections and the emitter sensor is mounted from underneath the track through the white track board into the centre (silver) aluminium section.

The receiver sensors are fitted and secured into the red aluminium sections as shown with the green circuit board facing upwards. The emitter sensor can be fitted either way around as long as the fixing holes align.



## 6: Positioning the Race System equipment

### **The Start Gate:**

This should be placed onto the track close to the end of the start section track but beyond the start line.



### **The Finish Gate:**

This should be placed at the beginning of the finish section over the finish line.



## 6: Positioning the Race System equipment.

### **Sector Gate (optional Fitment):**

Locate the mid section of track that houses the sector timing sensors, this section of track could be positioned anywhere between the Start and Finish Gates.

To identify the correct section look for the small round disks on the outside of the red outer aluminium sections and the corresponding holes through the inner aluminium section.



Position the Sector Timing Gate over the sensor positions (see below).

If the Denford F1 Race Track and Race System were purchased with the optional Sector Timing System, the sensors are already built into the track. If the Sector Timing System has been purchased separately the blank disks will have to be replaced with the supplied sensors as outlined on page 8.



## 7: Connecting up the Race System System

### Start Gate:

#### **WARNING:**

***DO NOT power up the Race System until all the cable connections have been made. When the Race System is powered up DO NOT make any additional connections or disconnections without first powering down the Race System.***

The cables to the start gate all pass through the cable management slots in the sides of the start gate.

- Connect the Triggers first (as these may be difficult to pass through once the other cables are in place). The Black button is connected to Lane 1 the Red button to Lane 2.
- Connect the Start Boxes.
- Connect the 25M Ethernet cable to the Finish gate connection. This cable should then be hung on the cable management slots in the track legs and run to the Finish Gate.
- If there is a Split Gate timer this connects by another Ethernet cable to the other side of the start gate.
- Finally Fit the power connector to the unit. (The power supply is 15V DC and requires 100-240VAC at 50 /60Hz).



## 7: Connecting up the Race System cont:

### Finish Gate:

**WARNING:**

*DO NOT power up the Race System until all the cable connections have been made. When the Race System is powered up DO NOT make any additional connections or disconnections without first powering down the Race System.*

The cables to the finish gate pass through the cable management slots in the side of the finish gate.

- Fit the Ethernet cable in the socket marked Start Gate.
- Fit the Receiver cable for Lane 1 and then plug the other end into the socket on the side of the track in Lane 1.
- Fit the Receiver cable for Lane 2 into the lower connector and then plug the other end into the socket on the side of the track in Lane 2
- Fit the Emitter cable into the upper connector and then plug the other end into the socket in the centre on the underside of the track.



## 7: Connecting up the Race System cont:

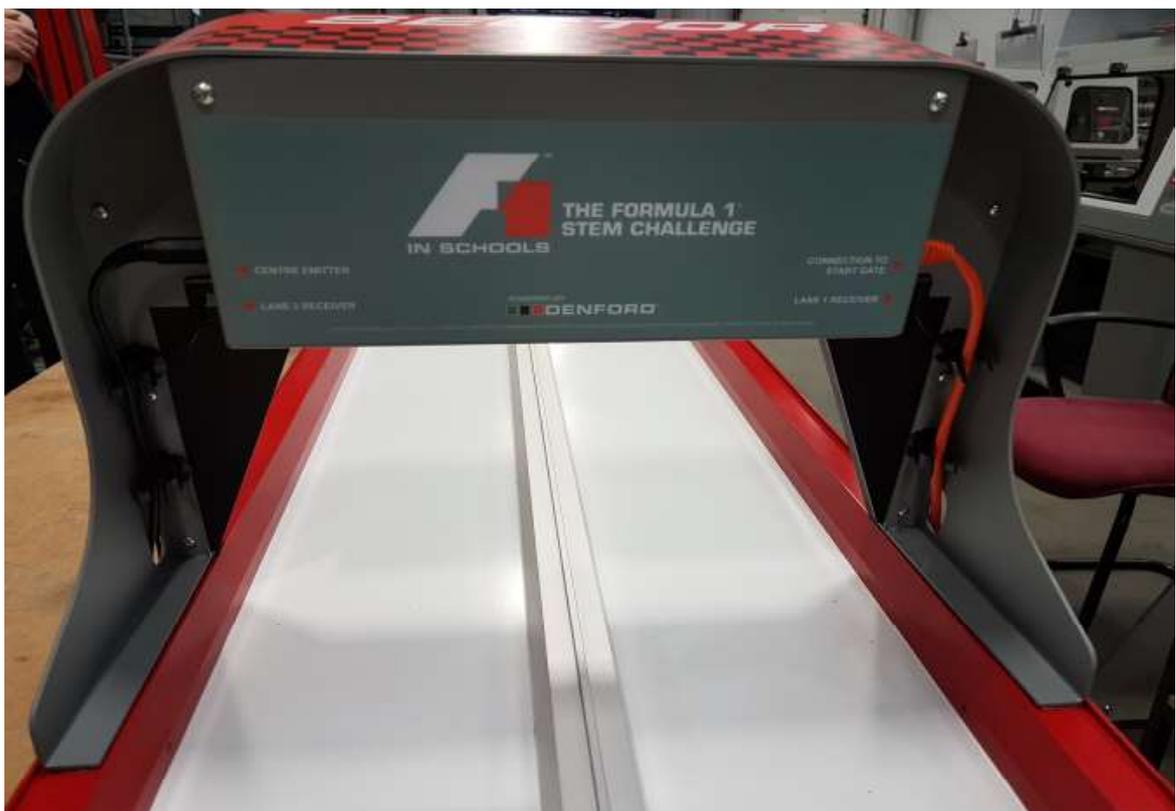
### Sector Gate (optional fitment):

**WARNING:**

***DO NOT power up the Race System until all the cable connections have been made. When the Race System is powered up DO NOT make any additional connections or disconnections without first powering down the Race System.***

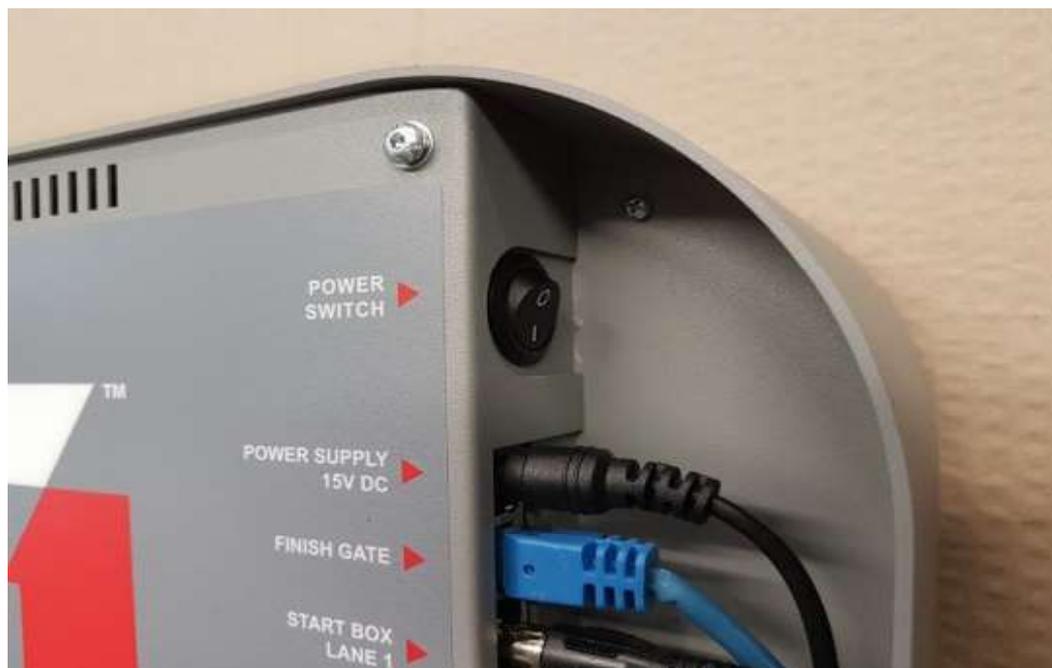
The cables to the Sector gate pass through the cable management slots in the side of the finish gate.

- Fit the Ethernet cable in the socket marked Start Gate.
- Fit the Receiver cable for Lane 1 and then plug the other end into the socket on the side of the track in Lane 1.
- Fit the Receiver cable for Lane 2 into the lower connector and then plug the other end into the socket on the side of the track in Lane 2
- Fit the Emitter cable into the upper connector and then plug the other end into the socket in the centre on the underside of the track.



## 8: Powering up and testing the Race System

Turn on the power using the Power Switch located at the rear of the Start Gate.



The Screen will initialise and will then display a timing screen either Manual or Auto Mode depending on the state of the switch.

The Finish gate and the Sector Gate (if fitted) should have the centre green light illuminated. This shows that the gate has power and that the two timing circuits are working correctly.

If you block the timing beam in either lane under the Finish or Sector Gates the green light will go out and a blue light will illuminate the track under the gate to highlight the lane being blocked. The blockage will also be indicated on the Start Gate screen.

## 9: Race System Operation

### Automatic mode:

Select the Auto mode with the AUTO / MANUAL switch on the rear of the Start Gate. Depress the switch upwards for Auto mode.



The Display will only show and record the CAR RACE TIME.

The trigger buttons are disabled in this mode.

- The race sequence is initialised by pressing the Reset Button, the timing sequence starts and each of the 5 start lights illuminate in turn at 1 second intervals.
- Once all 5 lights are illuminated there is a 1 second Delay and then the firing pods are activated and the timing starts.
- When the beam is broken at the finish gate the time is recorded.
- When both cars have finished the winner will be displayed by flashing the winning time and the Red light on the finish gate winning lane will flash.
- If for any reason one car does not finish, 10 seconds after the starts of the race the car that finished will be shown as the winner and the other car will record a DNF.
- Once a race has been completed the display of the times remains on screen for 30 seconds and then the screen returns to the ready mode.
- The start sequence can be aborted by pressing the reset button at any time during the race sequence.
- Pressing Reset again will initialise a new race sequence.

To exit Auto Mode select manual Mode from the AUTO / MANUAL switch.

## 9: Race System Operation cont:

### **Manual Mode:**

Select the Manual mode with the AUTO / MANUAL switch on the rear of the Start Gate. Depress the switch downwards for Manual mode.

In Manual Mode the screen will display the REACTION TIME, CAR RACE TIME and TOTAL RACE TIME.

- The race sequence is initialised by pressing the Reset Button, the timing sequence starts and each of the 5 start lights illuminate in turn at 1 second intervals.
- Once all 5 timing lights are lit, after a variable delay from 1 to 8 seconds and then the lights will go out and the firing pods are enabled and the timing sequence starts.
- The trigger buttons are monitored and when activated these trigger the firing pods.
- When the beam is broken at the finish gate the time is recorded.
- When both cars have finished the Race winner will be displayed by flashing the Red light on the finish gate.
- On Screen the best Reaction Time, Car Race Time and Total Race time will flash.
- If for any reason one car does not finish, 10 seconds after the starts of the race, the car that finished will be shown as the winner and the other car will record a DNF.
- Once a race has been completed the display of the times remains on screen for 30 seconds.
- If a trigger is pressed prematurely then the firing pod on that lane is disabled and the car will not race. The screen will display a false start but the other car will race normally.
- If both triggers are pressed prematurely then the race is aborted.
- The start sequence can be aborted by pressing the reset button at any time during the race sequence.
- Pressing Reset again will initialise a new race sequence.

To exit Manual Mode select Auto Mode from the AUTO / MANUAL switch.

## 9: Race System Operation cont:

### Reaction Time Mode:

This mode is purely for testing the reaction time using the Trigger buttons.

- To select Reaction Time put the Race system into Manual Mode.
- Press and hold the Reset Button down for 6 seconds then release the Button.
- The display screen will now show Reaction at the top of the screen and a timing window for reaction time.
- The race sequence is initialised by pressing the Reset Button, the timing sequence starts and each of the 5 start lights illuminate in turn at 1 second intervals.
- Once all 5 timing lights are lit, after a variable delay from 1 to 8 seconds and then the lights will go out and the firing pods are enabled and the timing sequence starts.
- The trigger buttons are monitored and when activated the reaction time is stored.
- When both reaction times are logged the winner is displayed on screen and the winning reaction time flashes.
- If for any reason one trigger is not activated within 10 seconds of the start lights going out, the winner will be displayed.
- Once a race has been completed the display of the Reaction times remains on screen for 30 seconds.
- If a trigger is pressed prematurely then the screen will display a false start but the other trigger continues to function normally.
- If both triggers are pressed prematurely then the race is aborted.
- The start sequence can be aborted by pressing the reset button at any time during the race sequence.
- It is possible to set the Reaction Time mode so that races can be restricted to be run twice between any two names, or an indefinite number of times. The option to change this is at the bottom of the admin screen (See page 22).

**Reaction time races are set to unlimited races**

LimitedReactionTimes

UnlimitedReactionTimes

When reaction races are limited, they can only be run twice before a new team name is entered. When it is in unlimited mode, a new team name is never required.

To exit Reaction Time Mode, select Auto Mode from the AUTO / MANUAL switch.

## 9: Race System Operation cont:

### Connecting the Start Gate over a network:

The Start Gate can display the race results as a live feed to a web page. In order to do this, a connection must be made between the Start Gate and wherever the web page is displayed. This can either be on a monitor connected to a PC, or on a phone or tablet device. The Start Gate can be connected to the gates Wifi hotspot or if there is an ethernet port available by connecting an Ethernet cable. The team names displayed can also be edited, and the previous race results downloaded as a spreadsheet compatible file (CSV).

To connect to the built-in Wifi signal, connect to the wireless ID of 'f1inschools'.

To connect using an ethernet cable, plug the cable directly into the ethernet socket on the Raspberry Pi. On some models of Raspberry Pi there is no Ethernet Port, if this is the case then a USB to Ethernet adaptor can be used.

Make sure that the Start Gate is switched off when making connections.



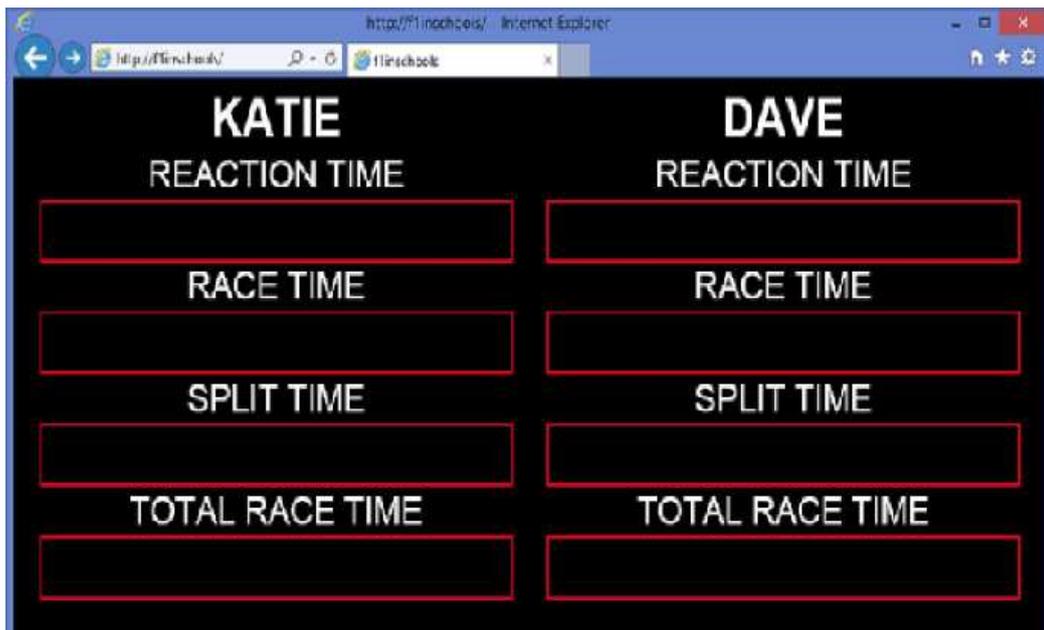
The other end of the ethernet cable can be plugged into a standard network, or directly into the Ethernet port on another computer.

Once the cable is plugged in, switch on the Start Gate.

To test that the connection is active once booted, open a browser and enter the address of:

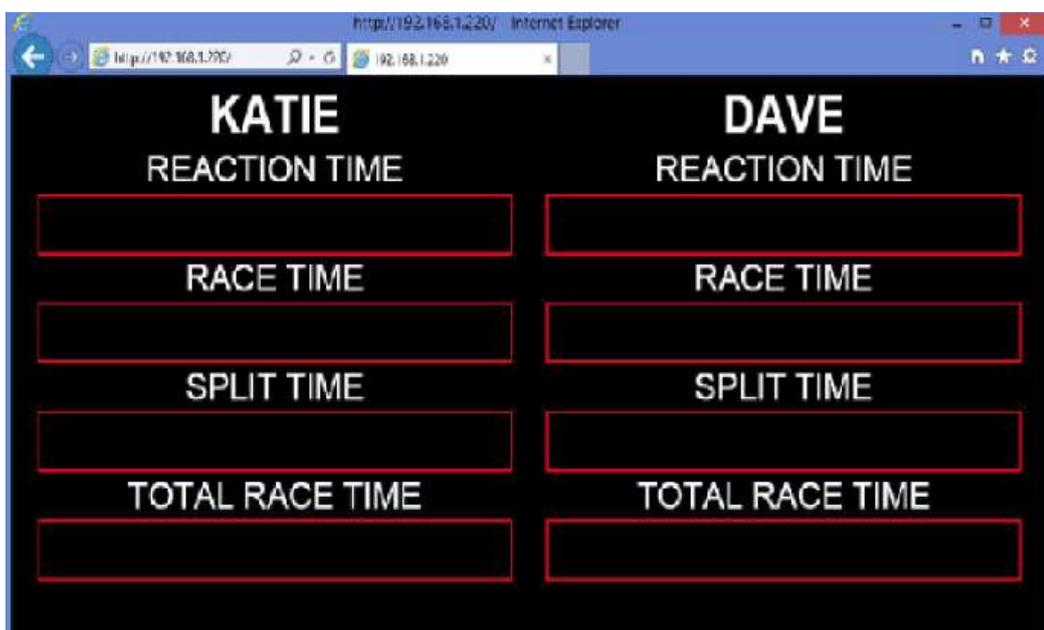
<http://f1inschools/>

## 9: Race System Operation cont:



KATIE	DAVE
REACTION TIME	REACTION TIME
RACE TIME	RACE TIME
SPLIT TIME	SPLIT TIME
TOTAL RACE TIME	TOTAL RACE TIME

If this fails then the IP address of the Start Gate is displayed in the top left of the main race screen. The IP address is automatically assigned either by the server on the network, or by negotiation between the two computers. It will be made of four numbers, either 10.0.0.1, or else probably beginning 192.168.1... Enter this number directly into the browser.

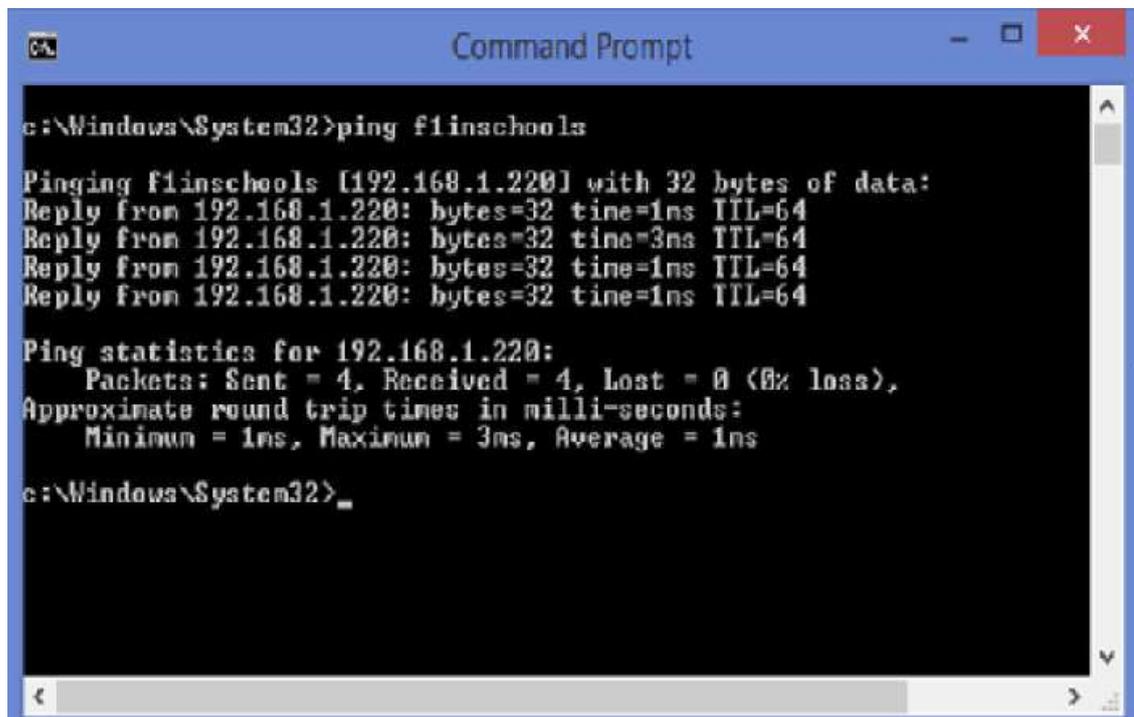


KATIE	DAVE
REACTION TIME	REACTION TIME
RACE TIME	RACE TIME
SPLIT TIME	SPLIT TIME
TOTAL RACE TIME	TOTAL RACE TIME

## 9: Race System Operation cont:

Alternatively open a command prompt in Windows, and enter the command of :

Ping f1inschools



```
c:\Windows\System32>ping f1inschools

Pinging f1inschools [192.168.1.220] with 32 bytes of data:
Reply from 192.168.1.220: bytes=32 time=1ms TTL=64
Reply from 192.168.1.220: bytes=32 time=3ms TTL=64
Reply from 192.168.1.220: bytes=32 time=1ms TTL=64
Reply from 192.168.1.220: bytes=32 time=1ms TTL=64

Ping statistics for 192.168.1.220:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 3ms, Average = 1ms

c:\Windows\System32>
```

Once the IP address is found, it will rarely change whenever the Start Gate is switched on again. The frequency of its changing is due to settings on the network. The simpler URL address of <http://f1inschools/> will never change.



## 9: Race System Operation cont:

### The Race Screen:

The Race Screen gives a live update of current race. Any number of clients can show the results at the same time. The Race Screen is just a web page, and can be viewed by a web browser on a device on the same network as the Start Gate. The URL to view the web page is :

<http://f1inschools/>

Or alternatively the address can be entered as the IP number that is shown at the top left of the Start Gate screen. In the example above it would be :

<http://10.0.0.1>

The Race Screen updates itself after a race, and will clear itself automatically at the start of a new race. The team names can be set using the Administration Screen , described in the next section.

After each race completes, only those boxes with a result are displayed. So in automatic mode, only the race time box will be shown. Reaction time will only show the reaction time box. Manual mode will show both reaction time and race time. The split time will appear in manual and automatic mode if there is a split time returned from a split gate.

## 9: Race System Operation cont:

### The Administration Screens:

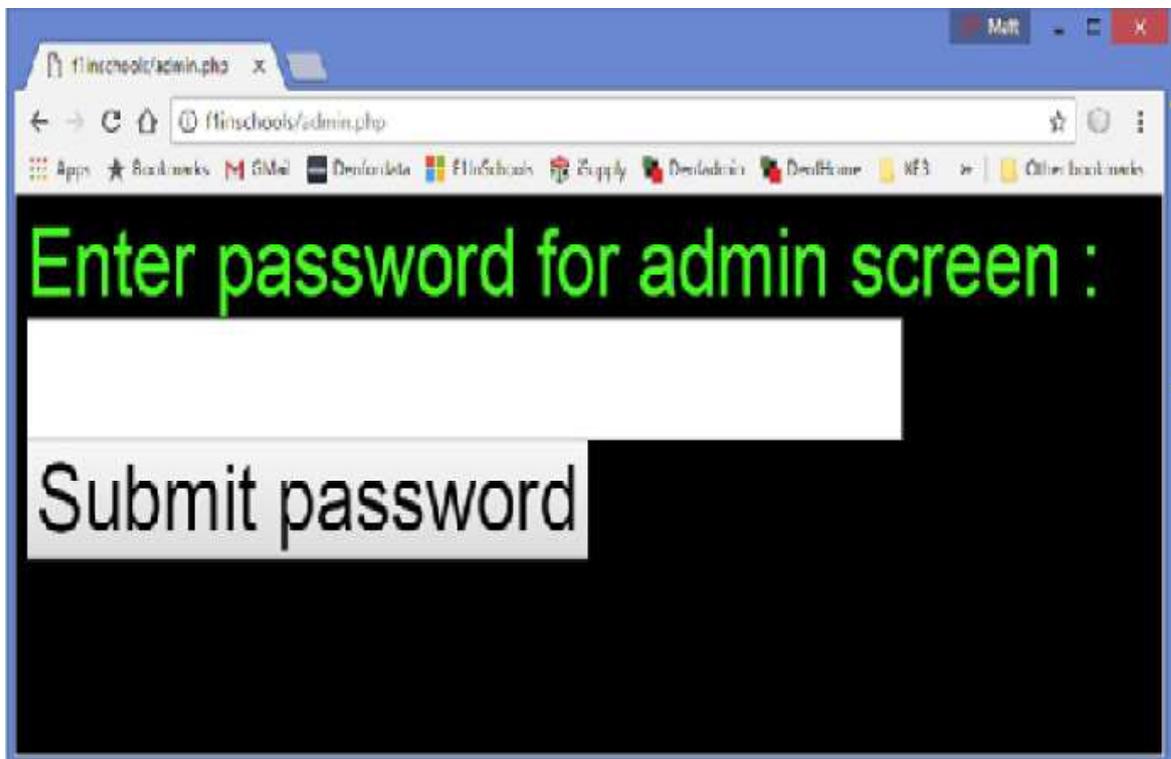
The team names can be set using the administration screen. This is available by appending /admin onto the URL. For example :

<http://f1inschools/admin.php>

or

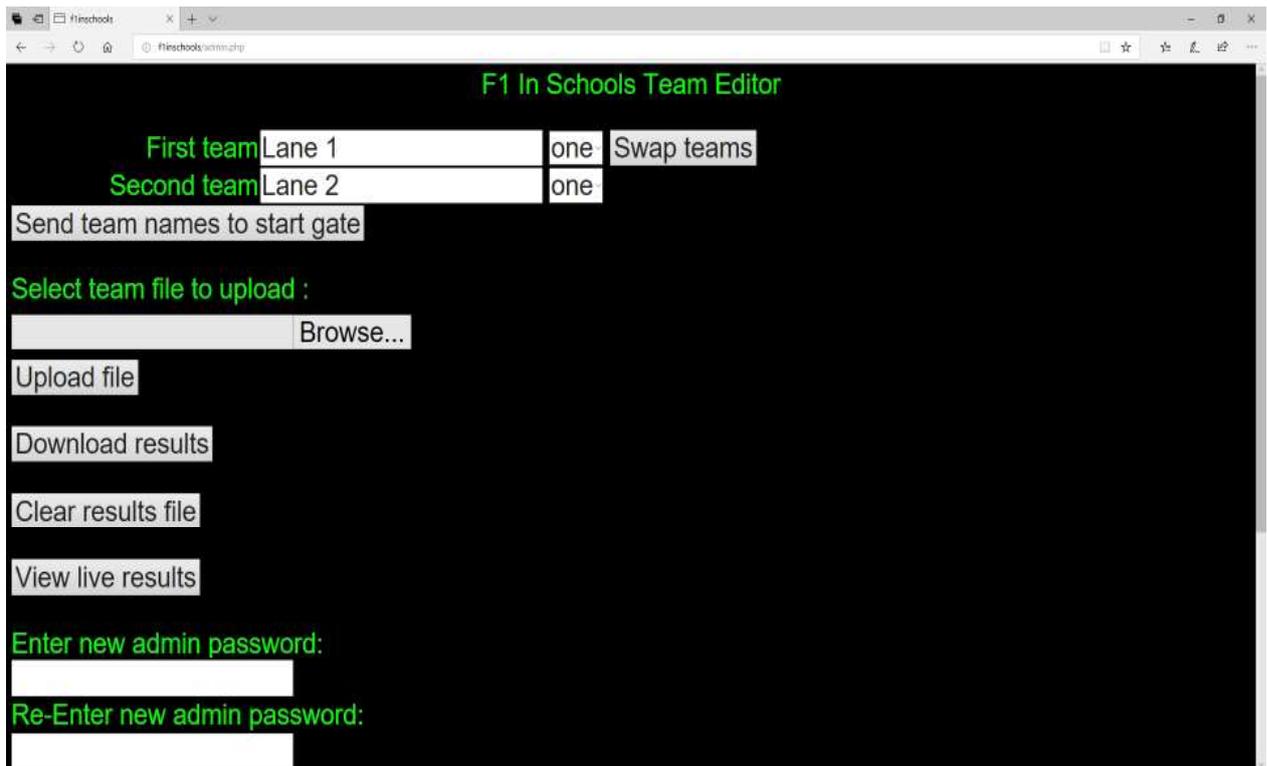
<http://10.0.0.1/admin.php>

This will present the admin password screen.



The default password is 'admin', all in lower case. It is advised that the admin password is changed on the next screen. Once the password is accepted, the main admin screen is shown (see following image). Please note that cookies must be accepted by your browser. If the option is switched off then it will not be possible to log on as administrator.

## 9: Race System Operation cont:



The team names can be entered into the first two boxes. Pressing the 'Send team names to start gate' button will update the team names on the Race Screen. Pressing the 'Swap teams' button will change the team names between the different lanes without them having to be edited. The team names are displayed automatically capitalised. The maximum length of the team name is 20 characters long. Only letters, numbers and spaces are allowed in the team names. All other characters are removed.

The 'Choose file' can be used to select a file of team names. The file must be a text file with one team name on each line. For example :

Red racing  
Blue burners  
Green dream  
Etc;



## 9: Race System Operation cont:

Pressing the 'Upload File' button will load the team names into the drop down boxes at the end of the team names, where they can be selected and the team name boxes will automatically be filled in.

The 'Download results' button will download the results of the previous races in a comma separated variable file (CSV). This file format is understood and opened automatically by all spreadsheet applications. See the section below about the Results file.

The 'Clear results file' button will empty the existing results file. A warning will be given first.

The 'View live results' will send the browser page back to the live results.

The two password boxes are used to create a new admin password. The default password is 'admin'. The entered password in the two boxes must match to be accepted.

The two Wifi buttons will activate the Wifi hotspot. It is on by default. When it is switched on, it will remain on and be available every time that the Start Gate is powered up. See the section below about the Wifi connection.

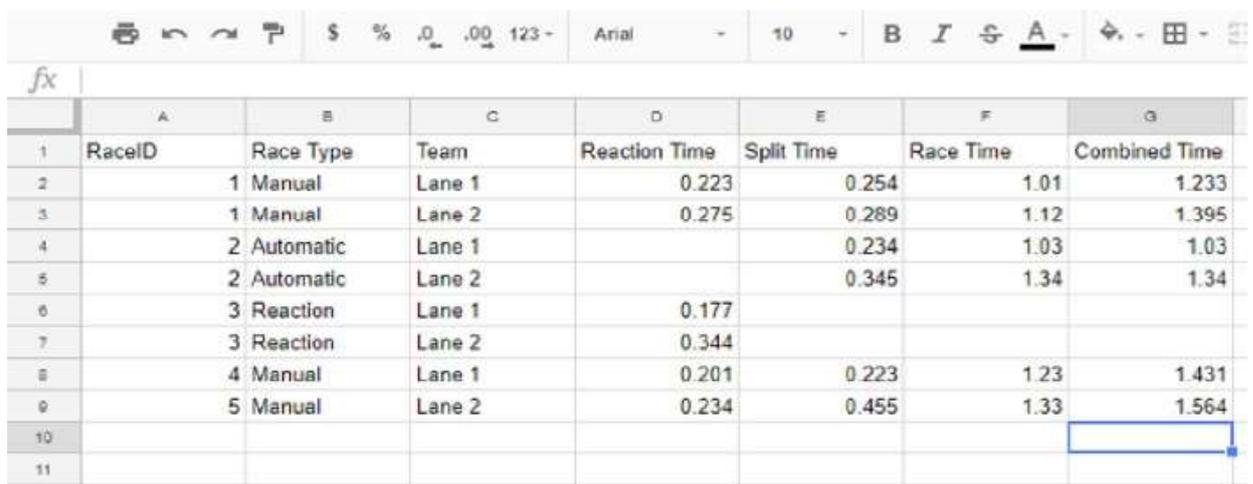
Finally, the Limited Reaction Times and Unlimited Reaction times buttons will change the operation of the Reaction Time screen. If Limited Reactions is chosen then only two races may be run on the Reaction Time screen until some new names are entered. If Unlimited Reactions is chosen then the names do not need to be changed.



## 9: Race System Operation cont:

### The Results File:

The results file is a CSV file. All completed races are stored in this file. All spreadsheet applications will be able to understand the contents. The contents of the file stored on the Start Gate cannot be edited.



	A	B	C	D	E	F	G
1	RaceID	Race Type	Team	Reaction Time	Split Time	Race Time	Combined Time
2	1	Manual	Lane 1	0.223	0.254	1.01	1.233
3	1	Manual	Lane 2	0.275	0.289	1.12	1.395
4	2	Automatic	Lane 1		0.234	1.03	1.03
5	2	Automatic	Lane 2		0.345	1.34	1.34
6	3	Reaction	Lane 1	0.177			
7	3	Reaction	Lane 2	0.344			
8	4	Manual	Lane 1	0.201	0.223	1.23	1.431
9	5	Manual	Lane 2	0.234	0.455	1.33	1.564
10							
11							

The first column is the race number.

The second column is whether the race was Manual, Automatic or Reaction.

The third column is the team name. The first row is Lane 1 and the second row is lane 2.

The fourth column is the reaction time. Automatic races do not have reaction times so that cell is blank.

The fifth column is the split time, if there is a split gate fitted to return a time.

The sixth column is the race time.

The seventh column is the combined race and reaction time.

## 9: Race System Operation cont:

### Connecting using Wifi:

The Start Gate has its own Wifi hotspot and is the default method for connection to the gate. A connection can be made using an Ethernet cable plugged directly into the Raspberry Pi if it has an ethernet port fitted. If there is no ethernet port on the Raspberry pi then a USB to Ethernet adaptor can be used.

The Wifi connectiun is switched on by default and should only be turned off if an Ethernet connection is available to turn it back on.

Any number of users may be connected to the hotspot at the same time.



The hotspot is called 'f1nschools'. It can be renamed through the Admin screen.

It is not password protected, and does not provide an internet connection.

Some devices will therefore show the connection with an alert, and ask the user for confirmation before completing the connection.



## 9: Race System Operation cont:

Once connection is established, the Race Track screen can be reached from the slightly different address of :

<http://f1inschools.com/>

or by using the fixed IP address of :

<http://10.0.0.1>

The IP address of the Wifi connection will never change.

The admin screen is still available by appending /admin onto the URL. For example :

<http://f1inschools.com/admin.php>

or

<http://10.0.0.1/admin.php>



## 9: Race System Operation cont:

### Generic Results File:

The results from the last race are available as a computer generated file. These are in JSON format, a commonly understood file format. The file can be retrieved by appending / times.json onto the URL. For example,

<http://f1inschools/times.json>

or

<http://10.0.0.1/times.json>

The layout and sample contents of the file is :

```
{“raceresult”: “ KATIE WINS!”,  
  “team1name”: “KATIE”,  
  “team2name”: “DAVE”,  
  “player1TriggerTime”: “0”,  
  “player2TriggerTime”: “0”,  
  “player1RaceTime”: “0”,  
  “player2RaceTime”: “0”,  
  “player1SplitTime”: “0”,  
  “player2SplitTime”: “0”,  
  “player1CombinedTime”: “0”,  
  “player2CombinedTime”: “0”}
```

The race results file contains the details that are made available for the web based Results Screen. If there is a result for the field then a given field will have a number, otherwise it will be set to be 0. Although the values of the fields will vary, the format of the file and the available fields will never change.



## 10: Safe Operation of the Denford F1 Race Track & Race System

Teachers and/or responsible adults should observe and implement the following safety guidelines prior to and during operation of the Denford Race Track & Race System. Denford Ltd is not responsible for bodily injury or property damage resulting from misuse of its products or failure to observe or implement proper safety guidelines.

- a. The Denford Race Track & Race System should only be operated by adults or students under adult supervision.
- b. It is not recommended to fire the Start Box's without cars in place.
- c. The operator or other persons must not place their hands in front of the cars during launching.
- d. Do not launch anything other than the cars designed for Denford Race Track.
- f. Always ensure the car is attached to the tether line before launching.
- g. Do not tamper with the electronic components comprising the Denford Race System.
- h. Ensure that participants and spectators are positioned clear of the designated track area when racing commences.
- j. Ensure that either a Denford Deceleration system or towels are used to stop the cars at the end of the track.





# On-Line Technical Forum

TECHNICAL SUPPORT AVAILABLE 24 HOURS A DAY, 7 DAYS A WEEK

Denford's Technical Forum is a free of charge on-line technical support service that is available to Denford customers 24 hours a day, 7 days a week.

"The technical forum has provided a wealth of information and support for our 20-year-old Denford CNC machine, in fact just as good as the support we receive for our brand new CNC Router!"



As well as offering comprehensive technical support, Denford's On-Line Technical Forum enables customers to share ideas and projects with other users. Media such as teaching material, project work, PDFs, images, drawings and text documents are easily attached to messages for all users to view and comment on.

You can also read the latest Denford news before anyone else, and keep track of machine and software upgrades, some of which can be downloaded direct from the Technical Forum web site.

The On-Line Technical Forum has proved to be hugely popular with customers. One recent user posted a note to inform us that the Technical Forum has "provided a wealth of information and support for our 20-year-old Denford CNC machine, in fact just as good as the support we receive for our brand new CNC Router!"

Of course the traditional methods of phone and email are still available, but try out this new service by simply logging on to [www.denforddata.com/bb/](http://www.denforddata.com/bb/) and register.

Denford's On-Line Technical Forum is a free of charge service that can be accessed 24 hours a day, 7 days a week.

The On-Line Technical Forum is available to Denford customers, old and new, and it couldn't be easier to use. Just visit <http://www.denforddata.com/bb/> and register on line.....it's that simple.

Denford's On-Line Technical Forum opens up the traditional communication channels that can restrict customer and technical support, due to availability of staff, teaching commitments or different time zones.

A multitude of topics relating to Denford machines and software (both new and old) are covered within the forum, which is simple to search, and easy to use.

Denford's Technical Team and Denford customers from around the world regularly log on to the forum to offer support and advice and, most importantly, post a solution for all to see.



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