FORMULA 3 DRIVER'S HANDBOOK

FIREBIRD

FIREBIRD

REVS
For the Commodore 64/128

Programme by Geoffrey J. Crammond

Special thanks to David Hunt, Formula 3 racing driver, for technical consultancy.

Logo design and original cover illustration by Philip Castle, Artwork by Andy Farmer and Rob Shone

Photographs courtesy of the National Motor Museum, Aerofilms, Sporting Pictures, The Photo Source and David Wilkinson.

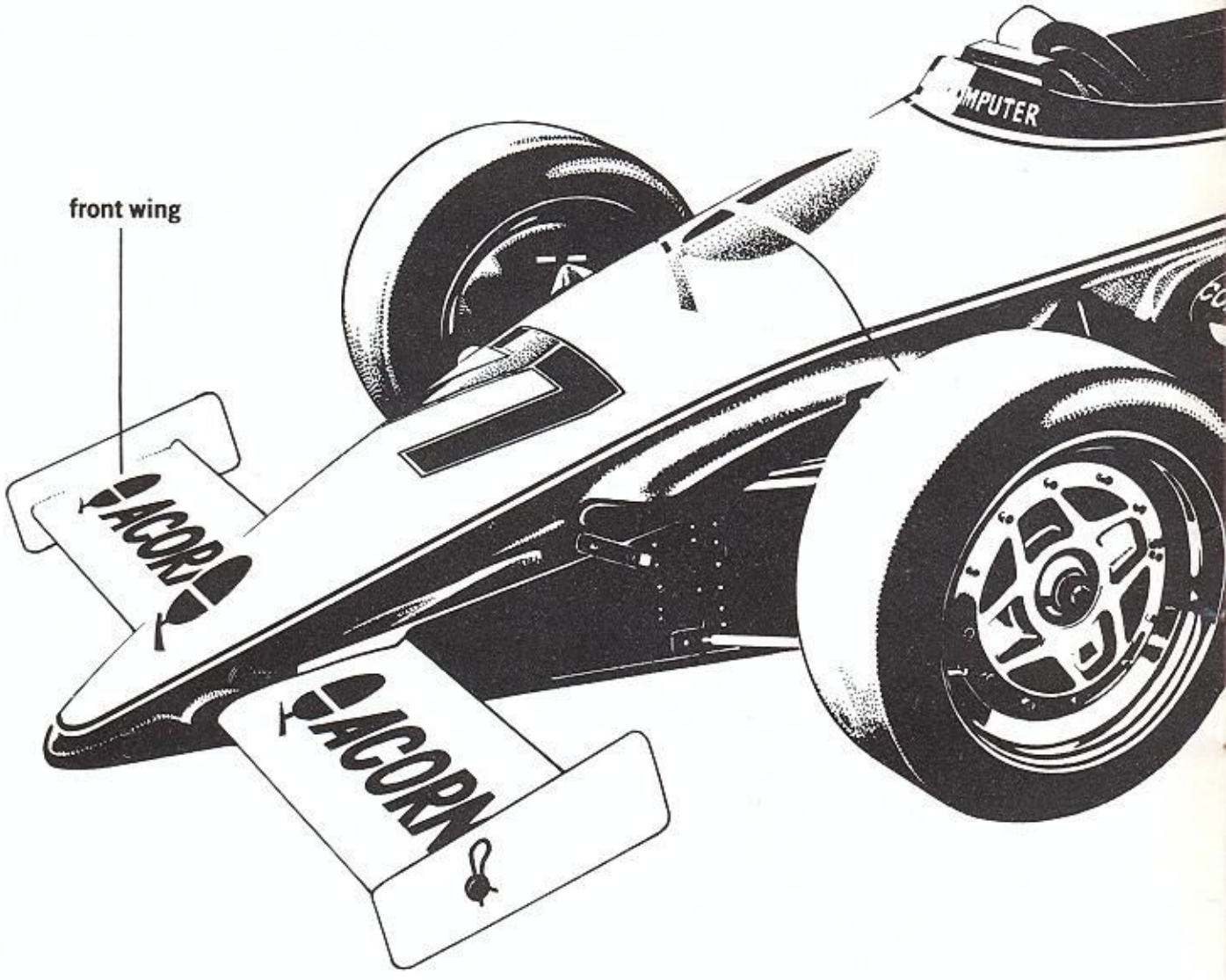
Manufactured by Cosprint Ltd

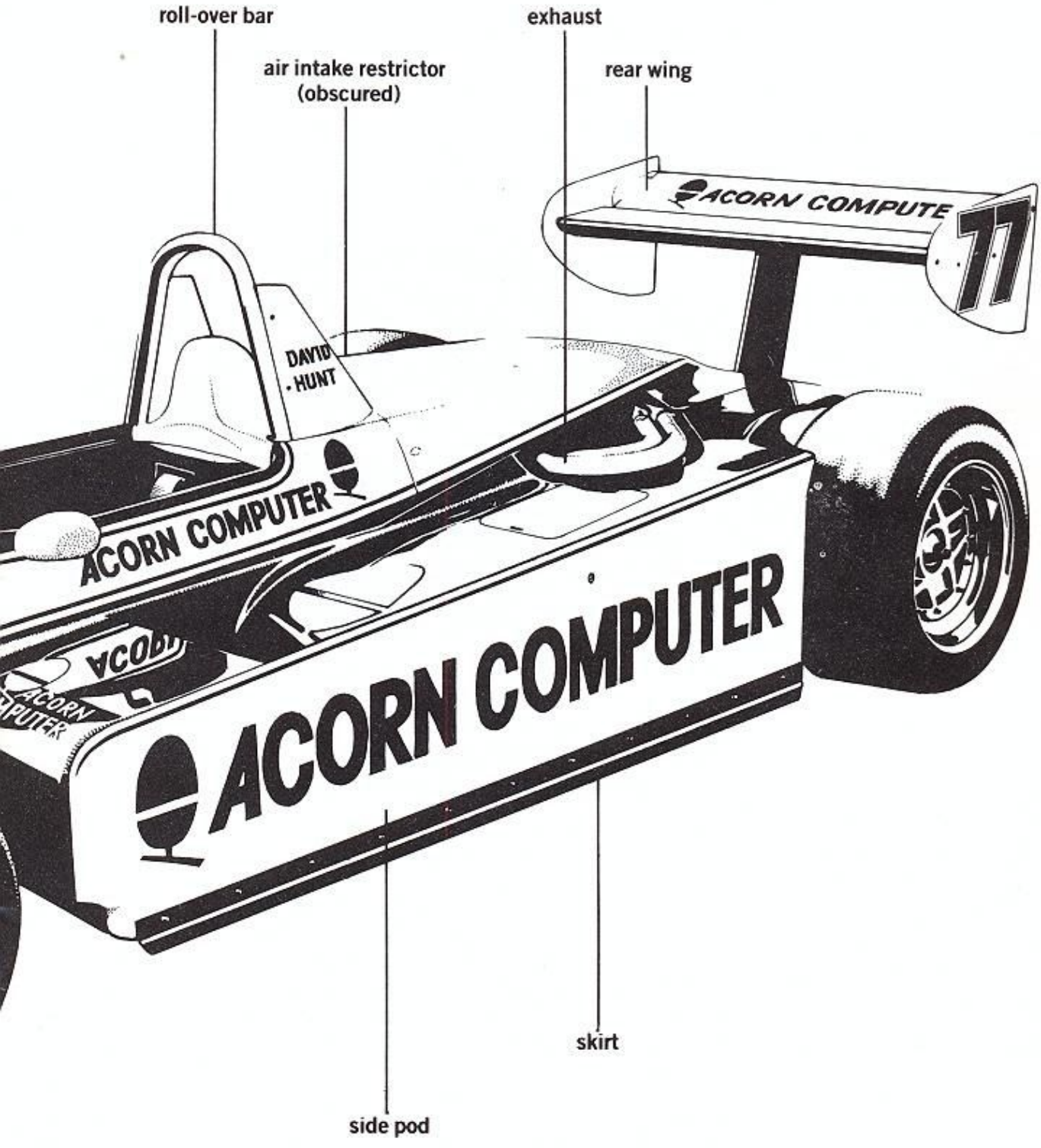
Published by FIREBIRD SOFTWARE, Wellington house, Upper St. Martins Lane, London WC2H 9DL

Contents

The Ralt RT3 Toyota Novamotor

A Formula 3 car is a single-seat racing car powered by a 2 litre, normally aspirated (ie no turbo-chargers) production-based engine, limited to producing only about 160 brake horse power via an inlet restrictor. The driver sits in front of the fuel tank and engine, from which the gearbox is hung at the back of the car. He uses slick (ie bald) tyres in dry weather, and rain (grooved as in a road car) tyres in the wet. At front and rear there are wings which help push the car onto the ground at high speeds (they are upside-down aeroplane wings) and on either side of the car a side pod, which is also shaped like a wing on its underside. It is this side pod which creates the 'ground effect' essential to cornering at high speed. Further information about wing settings is contained in the section about aerodynamics.

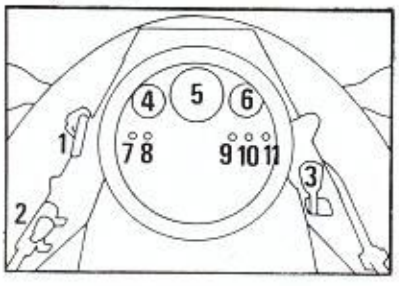


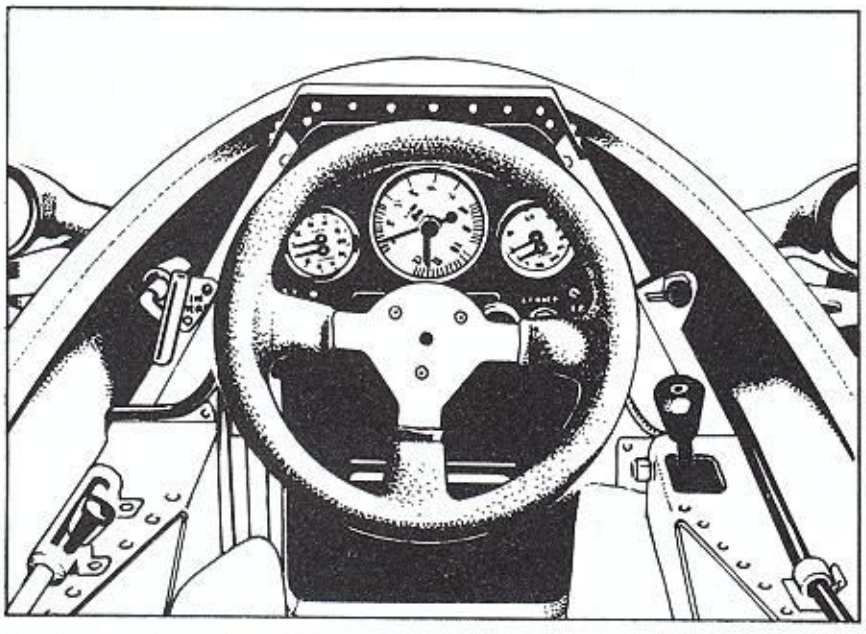

roll-over bar
air intake restrictor (obscured)
exhaust
rear wing
ACORN COMPUTE
77
DAVID HUNT
ACORN COMPUTER
ACORN COMPUTER
skirt
side pod

The Controls

'The pedals (as in a road car – clutch, brake and accelerator), steering wheel and gear lever (both shrunken versions of their road car relatives) are all in the ideal position for me,' says David Hunt. 'I have 5 forward gears and 1 reverse at my disposal.

1 cockpit adjustable anti-roll bar (front)
2 cockpit adjustable anti-roll bar (rear)
3 gear lever
4 fuel pressure/water temperature
5 rev counter
6 oil pressure/oil temperature
7 starter button
8 fuel pump
9 fire extinguisher
10 rear light
11 ignition





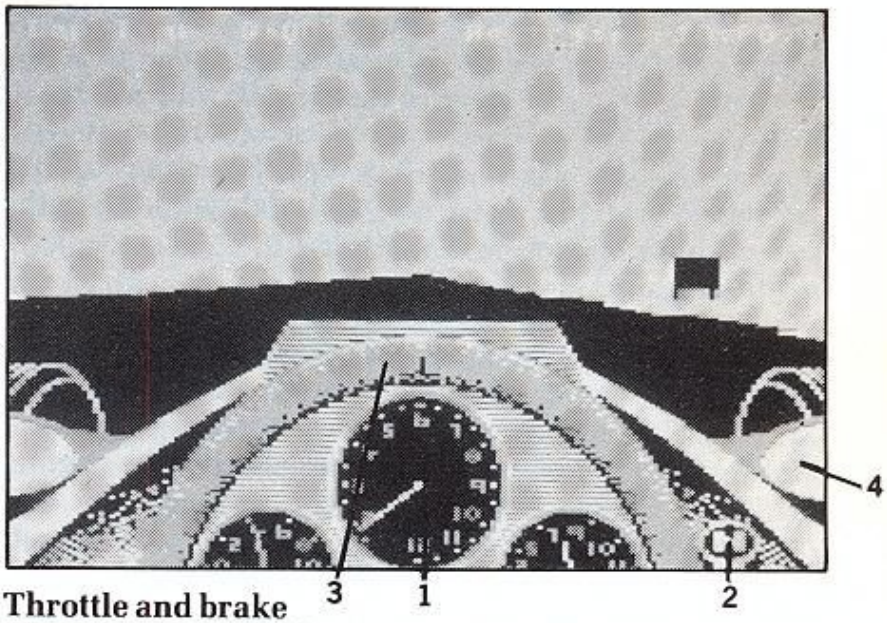
'Information about the real business going on behind me is relayed via 5 gauges, which are labelled in the illustration. But in a race most of my attention is focused on the rev counter and wing mirrors so these have been faithfully reproduced in the simulation.'

Note:
When using a paddle or analogue joystick for the steering you can select either:
A linear response (SHIFT LOCK DOWN) which responds most like a a real steering wheel.
Or a non linear response (SHIFT LOCK UP) which makes it less sensitive when driving straight.

Driving
You can drive your Ralt RT3 using either:
Computer keys ⇪/f1
Computer keys with steering paddle ⇪/f3
Switched joystick with steering paddle ⇪/f5
Use joystick up/down to Accelerate/Brake. Up and Fire to change gears up. Otherwise, Fire changes gears down.
Or if you have one, an analogue joystick ⇪/f7
Control using an analogue joystick is explained in the diagram

Steering
Steering using the joystick is outlined in the accompanying diagram. Key control is achieved by pressing ‹ or › which cause the steering wheel to rotate left or right respectively. Holding both the keys down at the same time stops the rotation, thus maintaining the current lock. Releasing both keys is like letting go of the steering

wheel, and the steering will self-centre according to the speed of the car. Use the Space Bar to amplify the effect of keys ❮/❯ or joystick left/right.

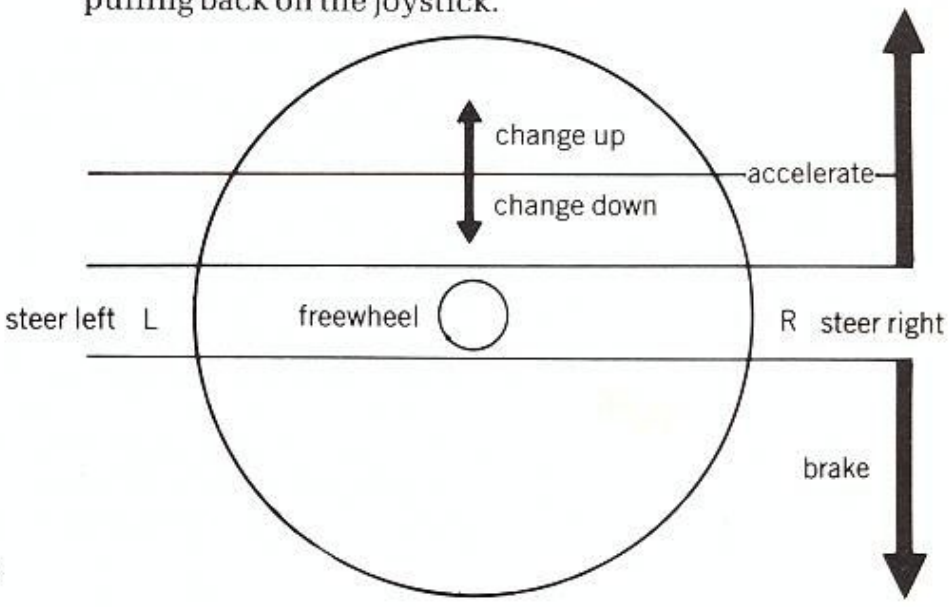


1. rev counter
2. gear indicator
3. steering position indicator
4. wing mirrors

Throttle and brake

Throttle is applied by depressing S on the keyboard or pushing forward on the joystick.

Brakes are applied by depressing A on the keyboard or pulling back on the joystick.



Analogue joystick controls

Gears and clutch

In your Ralt RT3, the Q key is used to change up a gear and the CTRL key to change down. Holding down Q/CTRL effectively draws in the clutch. If a gear is selected, then

releasing Q/CTRL will cause power to be transmitted to the drive wheels, provided of course that you have supplied some throttle. If the car is moving slowly or is stationary then the simulator will slip the clutch for you such that the revs are held constant until a certain speed has been achieved. It is therefore important when doing a racing start that you obtain optimum revs when Q/CTRL is released (see The Start). The fire button on the joystick has a similar effect to Q/CTRL and the position of the joystick determines whether a higher or a lower gear is selected.

Starting the engine
Before putting your drive skill to the test you must of course start the engine. Press T when the car is in neutral or the clutch is drawn in (Q/CTRL or fire button depressed) until the engine starts.

Wing settings
It is suggested that, to get going, you adopt wing settings of 40 rear and 32 front. To make full use of the wing settings to achieve the fastest lap times, read the chapter on The Aerodynamics of the Car.

Rev counter

How does a rev counter differ from a speedometer? Silly question, perhaps, but an important one if you are going to understand how to win races in your Ralt RT3. A speedometer will tell you how fast you're going across the ground. A rev counter tells you how many revolutions per minute the engine is turning, and the engine is most powerful when it is turning between 5000 and 5800 revolutions per minute. It follows that the gears should be changed so that the engine is constantly turning within this rev band. To avoid frustration the simulated engine has been made more tolerant of abuse than a real engine. It will run perfectly well at 2000, 3000, or 4000, or at 7000, but will not provide maximum power. So, change up at 5800 and expect the new gear to bite at around 5000.

Practice Laps and Qualifying Times

Loading the game presents you with the option to practise as many laps as you like or to go for a timed lap which will determine your position on the grid.

Practice
You will need to practise a great deal in order to master the skills of a Formula 3 driver.

Before you are allowed onto the track you will have to select the angle of wings on front and rear of the car. Novice drivers will require maximum control over their cars as they strive for a workable line at bends; for them, speed along the straights is a secondary consideration to staying on the track. (We all remember the feeling!) It is advised, therefore, that you look for a heavily weighted rear wing and slightly lighter front wing to begin with. Later, as your confidence builds, experiment and see how new settings affect your speed and control. You may return to the pits and readjust your wing settings at any time, provided the car is stationary, by pressing C= /←.

On commencing practice or qualifying laps, you are some way before the starting flag. Your time does not begin until you have made it past the starting flag, which can be seen on the left of the track.

The practice facility offered to new drivers is a one-driver facility. This is an extremely expensive operation as it limits the whole of a circuit to one car at a time. So, make full use of it.

Don't be too ambitious at first. Crawl around the track in low gear, searching for the ideal lines at corners, getting a feel of what the car is all about. The racing programme features a guided tour around the track, but do not expect to be able to follow it at the outset.

Coming off the track – how to handle it
See how revs are lost when you hang one wheel over the grass verge. Once completely onto the grass, it is like driving on ice. So, remain in high gear, reduce throttle but don't brake, and make only very slight manoeuvres.

If in a slide, try opposite lock, using the Space Bar to amplify its effect.

If in a spin, try using the brake.

Having stalled on the grass, get into 3rd or 4th gear and with the clutch drawn in start the engine. Pulling away in these gears will help to prevent a spin developing on the slippery surface.

When you are consistently within the 1.40 time, press ⏎/INST and opt for Competition.

Competition
Having elected to enter a competition, you will be offered a choice of three classes of race:

Novice
Amateur
Professional

There are graduation times for Amateur and Professional Classes. You will not be allowed to compete in a particular class unless you show yourself capable of the minimum qualifying time. If you fail to get a qualifying time, you will only be able to enter the Novice Class and you will be at the back of the grid.

Anyone is allowed into the Novice Class. The reason for this is that unlike Professional or Amateur Class races, Novice Class races cater for even the worst pile-ups. There are special emergency crews to take Novice Class cars, which have careered off the track following a mishap, and replace them in position. However, do not expect your car always to have escaped unscathed, and remember that you will never start your car while it's in gear.

You will be asked how long you wish the qualifying period to last. This allows you to ensure that there is sufficient time for you to attain a qualifying time before recall. You can emerge at any time from a qualifying period by pressing ⏎/7.

Having decided how long you wish the qualifying period to be, you will be asked to log the name of the driver – your name or any name you care to use (you may like to take on the persona of Jackie Stewart or some other hero from the hall of fame). Press RETURN and you will find

yourself back in the pits to set the car's wings for the qualifying lap(s).

Multi-player racing
Points system

Points	9	6	4	3	2	1
Position	1	2	3	4	5	6

1 point is awarded for the fastest lap time.

It is perfectly possible and the greatest fun to take turns with your friends to make qualifying times, and then all of you can enter a race. The way this works is for each driver to achieve a qualifying time and then one by one to drive in a race. The computer learns each player's skill from the qualifying round and simulates the other players' performance when each player races. The ingenious application of points ensures a fair result. The points system is modified so that a player's actual race accounts for half of the total points that the player can attain.

After a race, three score cards will show you the finishing positions and points, the best lap times and accumulated tournament points. You then have the option of pressing RETURN to see the score cards again or pressing the Space Bar to continue with the tournament.

The Start

Racing involves more consummate skills than qualifying.

Having opted to start a race, the standard or class of race will be confirmed and then you will move to a table of grid positions which has been determined by each driver's lap time.

You will then be left to choose the duration in laps (5, 10, 20) that you would like the race to be, and the name of the driver in the driving seat will be proclaimed.

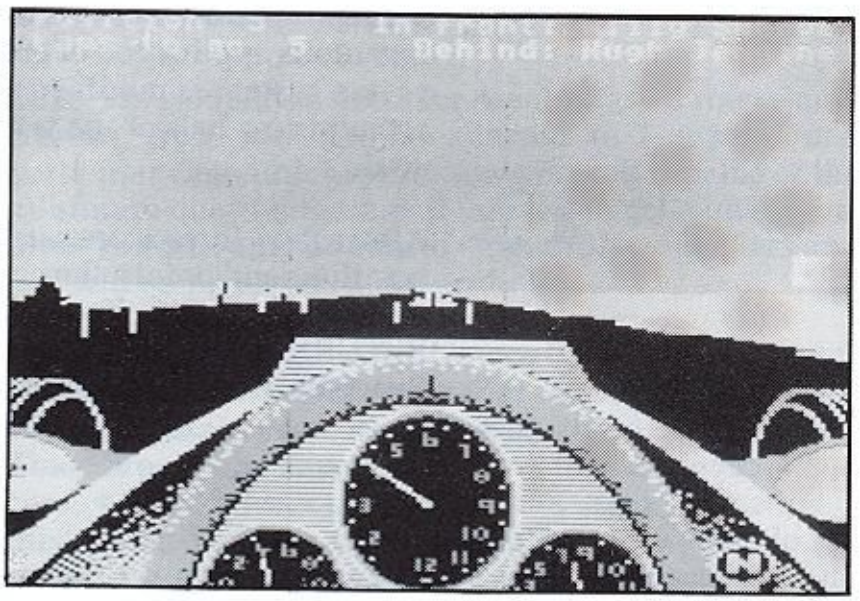
Next it is off to the pits for the wing settings, and thence to the starting grid.

On the grid you will be presented with:

1. your position in the field, which of course changes as you overtake cars or are yourself overtaken

2. the number of laps to go, which will be equal to the number of laps you have preselected

3. information as to which driver is behind you and which driver is in the position immediately in front of yours. If you are at the back of the field, the driver in pole position will be recorded as the driver behind you; if you are in pole position the driver in front of you will be recorded as the driver in 20th position.



Along the top of your screen you will be given important information, which will change as the race proceeds.

Turn your engine over. Do not attempt to move or your engine will stall. Look at the starting lights; as your engine turns over they'll light up blue. Rev the engine to required revs, move into first, holding down the clutch, anticipating that at any moment the indicator will display a green light confirming the start of the race. Let out the clutch (Q or firing button).

Wheel-spin start

In the section of this manual concerned with cornering,

we will discuss the importance of maintaining a balance between grip (tyres to road) and minimum resistance to your car's speed. As any racing driver knows, there is a point (near the 5000 revs mark) at which the tyres will spin momentarily to maximise forward momentum. Letting the clutch out in 1st with your revs at this exact point will get you away as fast as your car can manage. You'll know when you've found the balance by the sound of the tyres screaming across the tarmac.

Says David Hunt, 'I suppose the perfect start is a touch of wheel-spin. In a race I have two choices. Either I must spin the wheels or slip the clutch; it depends entirely on the conditions. (When it's wet you want to have a fair amount of revs on the engine and then let the clutch out slowly as you would in a road car to give the wheels all the help you can to get a grip.) Once or twice a season you get the perfect start, where you get everything right. I did it once last season: I was 12th on the grid and 5th on the first corner. Everything just clicked, and I went forward like a rocket.'

As you jostle for position, use your wing mirrors assiduously; otherwise a car, coming from behind and making for the same space as you, may knock you off the track.

'With the modern Formula 3 cars, most races are won or lost at the start because once you're behind another car it is difficult to run close, and very difficult to overtake.

'The start is also the most dangerous part in the real race. You certainly can't plan a start; you're driving on your instinct; it's back to the jungle. You've got to a. look for the gaps, and b. when you've found the gaps, make sure that no-one's going to fill them or you'll have an accident. You've got to have eyes in the back of your head because everyone behind you is trying to get in front of you. You've got to make sure that you're not leaving huge gaps for other people. Everything happens very quickly, and THEN, as you go round the first corner, there are 20 cars trying to fit onto a piece of tarmac that can hold only 3. You really do have to be sharp there; it's where most accidents happen – wheels touch or you run into someone . . .'

The Cockpit

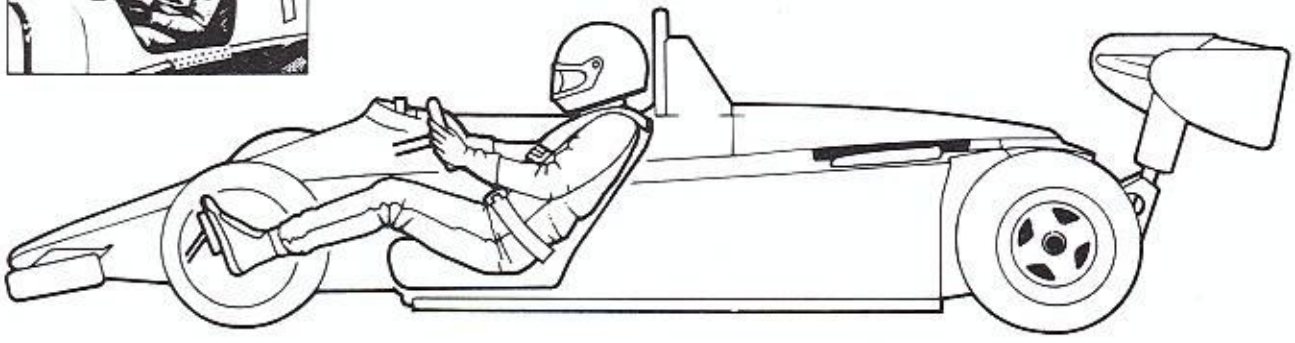
Driving position

As a racing driver you are either excess luggage or a snugly fitting constituent of the car itself; there is no in-between. If you are the former, it is of the utmost importance, both in real and simulated racing, that you convert yourself to the latter at the earliest possible moment.

While car-body unity is very much a mental state, it is facilitated by very basic, physical considerations. In the old days, drivers would be seated upright in their cars, elbows out over the bodywork as they struggled with the then heavy steering, but the cars developed.

They made the steering lighter, which permitted a smaller steering wheel and therefore a more compact cockpit design. Gradually it became possible to assume more of a deckchair position, axes of body and car coming ever into one; the driver turning with the car rather than turning the car.

'My office,' says David Hunt, 'is a very tight fit.' Today's seating position, more laid back than it used to be, demonstrates the designers' brief to make car and body as much a single entity as possible.



'People always say you're lying down in a racing car,' notes David Hunt. 'You're not actually lying down, you're simply more laid back than you are in a road car. You've got your arms nice and bent; you've got your legs bent. You're taken back for aerodynamic efficiency, but the ideal driving position is probably sitting more upright. I did some studies on it from a physical point of view, looking at the whole thing as a chiropractor would. We definitely do not sit in the perfect position, but as soon as you move into the perfect position, you destroy the aerodynamic properties of the car. The driver almost always comes second to the car.

The Aerodynamics of the Car

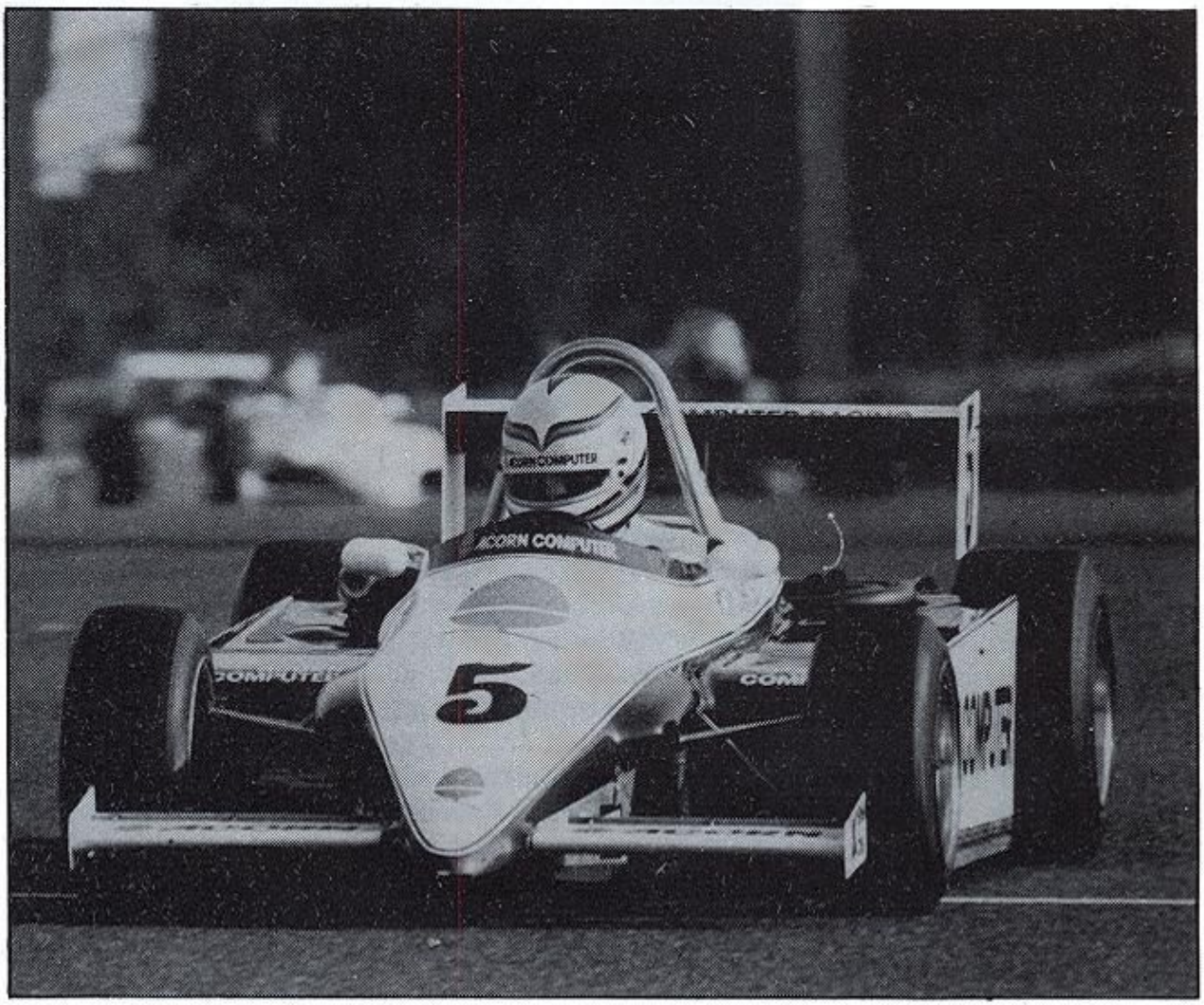
The chief purpose of the RT3's aerodynamic design is not simply to let the air slip by in as unimpeded a fashion as possible, but to increase dramatically the car's grip and road-holding capability.

Wing adjustment

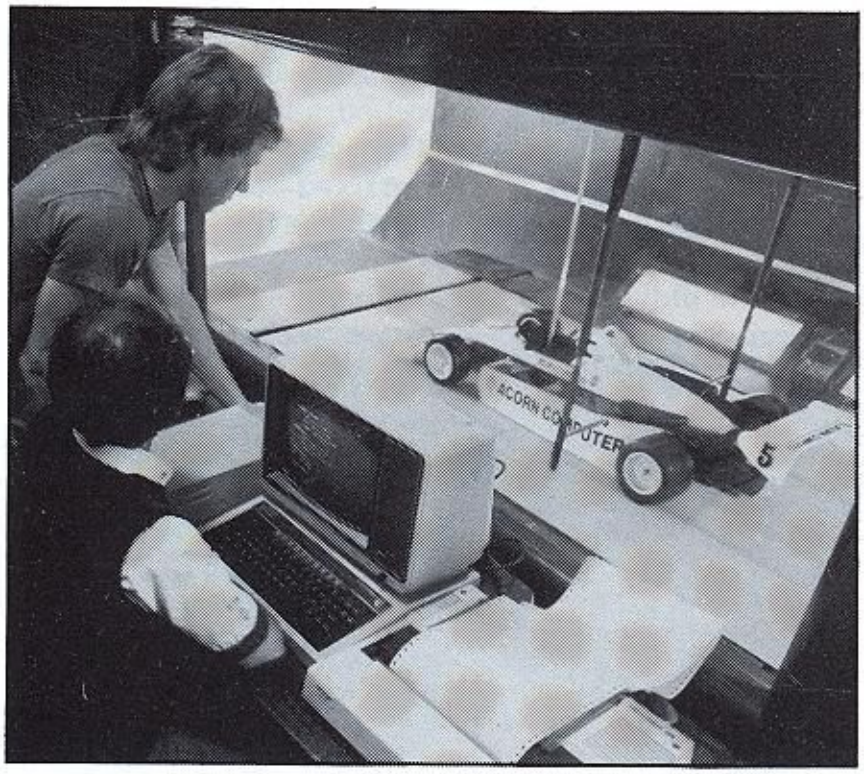
The wings, back and front, and the car's pods, which it carries on its sides, are the vital elements. All are illustrated here. You cannot adjust the side pods, but you can the wings; indeed the wing adjustments will prove critical to your performance on the track.

The more downforce required, the greater surface area of wing must be presented to the air; consequently the more speed resistance (or drag) is set up. In other words, the nearer 10° are your wing settings, the less speedy along the straights is your car.

The wings are similarly shaped to those on an aeroplane, but fixed – as it were – upside down, so as to push the car down on the road and increase grip at high cornering speeds.



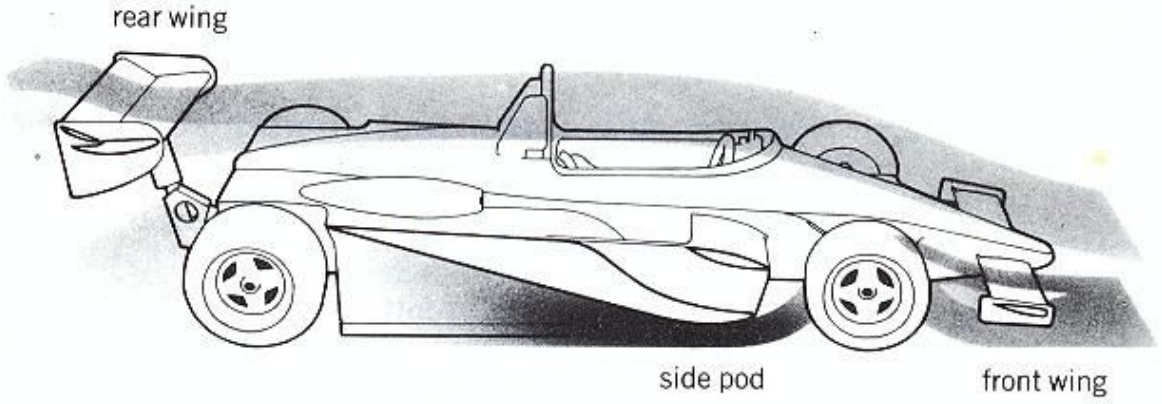
How much downforce, and where precisely it is directed onto your car is the substance of the fine aerodynamical balance which may win or lose you a race. In the simulation, each rear and front wing is adjustable on a scale of 0 to 40, corresponding to 10 degrees of wing movement; a setting of 40 gives you maximum downforce.



David Hunt wind-tunnel testing a third-size model with the help of a BBC Microcomputer.

David Hunt explains the practical importance of making these adjustments: 'A high wing setting will give you good cornering performance due to increased downforce, but bad straight line speed due to increased wind resistance; equally a low wing setting will give you good straight line speed (less wind resistance) but poorer cornering performance (less downforce). A lap of Silverstone is made up of a series of straights and bends and to obtain a fast lap time, the discerning driver must find a compromise between optimum straight line speed and optimum cornering performance when selecting wing settings.

'It is also very important to obtain a good balance between front and rear wing settings to make the car



As the diagrams show, both front and back wings redirect airflow above and below the wing surfaces. The air travelling below the wing has to travel farther, and therefore faster, than the air passing across the upper wing surfaces. This feature causes lower than atmospheric pressure on the lower surfaces because, clearly, there is a less dense concentration of air molecules on the lower surfaces at any one time. The effect creates downwards pressure on the car. This 'downforce', as it is known, is essential for cornering fast; it helps keep your car on the track.

handle correctly. The nature of the modern racing car design dictates that one should run less front wing in relation to the rear wing to achieve this balance. If you run too much front wing in relation to the rear, you will find that the car has a tendency to spin on the corners. If you run too little front wing in relation to the rear you will find that the front of the car will slide away at the corners.

'Different driving styles require slightly different wing settings. As your driving skills improve, you might well find that you require a change in your wing settings to reduce your lap times further.'

Increased downforce aids tyre grip but also increases drag. Experiment with different settings – C/← returns you to the pits at any time so long as your car is stationary.

The aerodynamics of the side pods

The side pods of the RT3 are permanently fixed and not adjustable in the way that wings are.

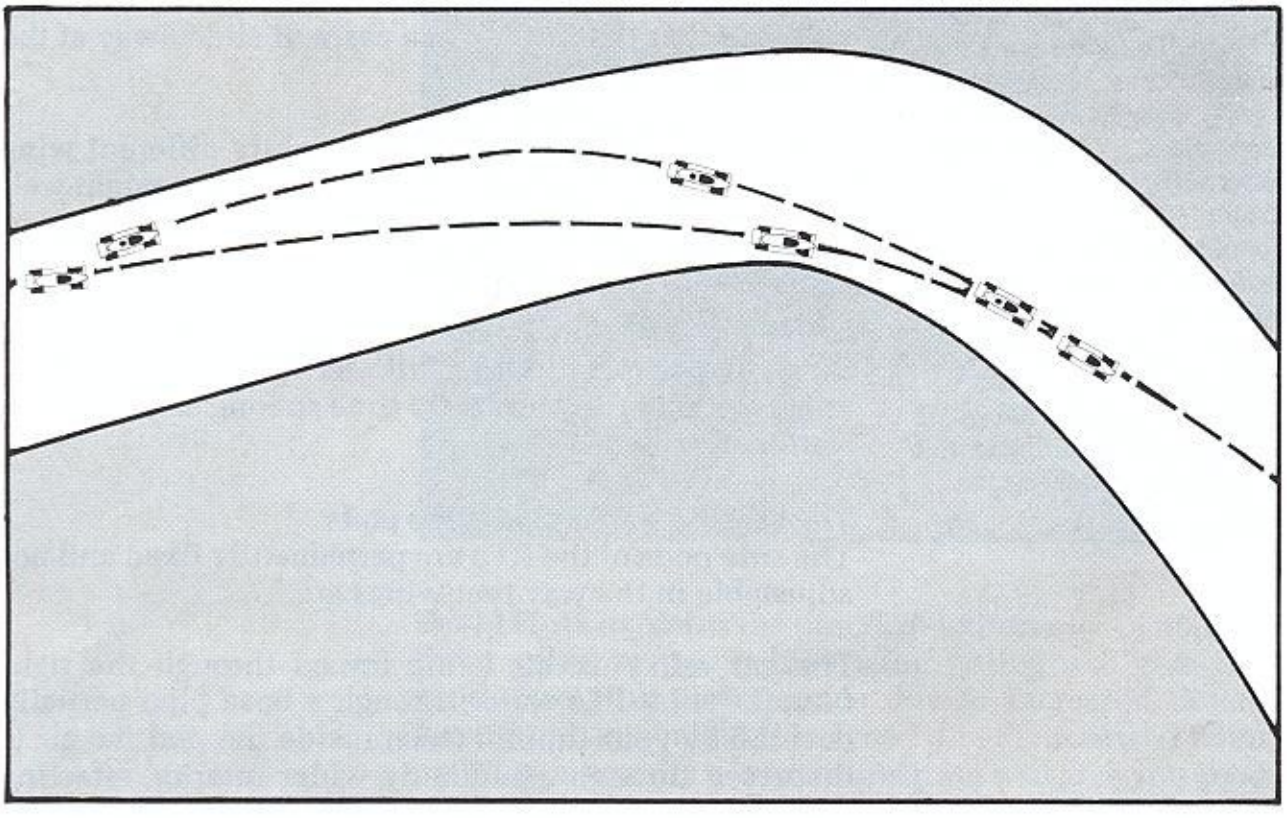
The car relies on air being forced through the tight funnel – a bit like water through a hose pipe partially covered by your thumb. Once inside the pod the air is dispersed through a suddenly wider interior, effecting an artificially low pressure – creating a partial vacuum, if you like – and pushing the car onto the ground.

In an attempt to have the best of both worlds – maximum downforce at tight bends, minimum downforce on straights – Formula 1 drivers once experimented with sliding skirts. 'Unfortunately,' explains David Hunt, 'occasionally a skirt would stick in its groove, stay up, and the driver would go into a corner . . . it would be like an aircraft accident.'

The Art of Overtaking

Overtaking is easiest at the start of a race, where a driver's art will depend to a great extent on his ability to think fast, judge opportunities and act upon them at once. (See The Start)

'You're never actually sitting, cruising behind someone, unless it's early in the race and you've got rid of everyone behind, and you're just so confident that you're going to pass him later on in the race. The point is that while you sit behind him, there's always the chance he may make a mistake and you may collect him. If he has a spin, you'll hit him. So the sooner you're in the clear, the better. You never really cruise.



Exit previous corner fast; close up on the straight; come alongside before brake area; brake at last moment; dive down the inside into the corner.

'Overtaking is done largely into corners. You come out of the previous exit a little faster than the guy in front, and close up on him down the straight; try and get alongside him before the brake area; then dive down the inside, and into the corner. If you brake too late, you'll go wide on the exit. Furthermore, it's very easy to say you've got to come out of the corner faster than the guy in front, but in reality it's very difficult because he's running in clean air and you're running in turbulence created by his car.'

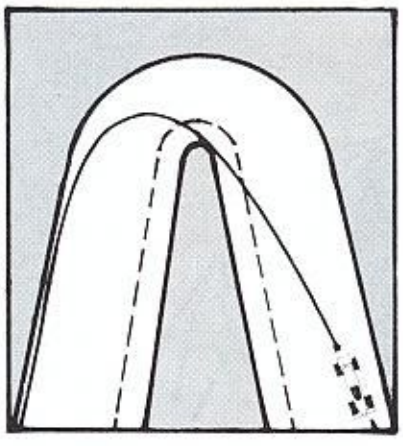
The Principles of Cornering

In the hands of the novice, every corner is a deathtrap and appears to demand foot off the throttle, brake and gear-change down within split seconds. The novice keyboard driver is likely to begin all fingers and thumbs; the novice joystick racer may make his car sing all the right tunes, but he still won't win if he doesn't understand how to bring his car onto the ideal line.

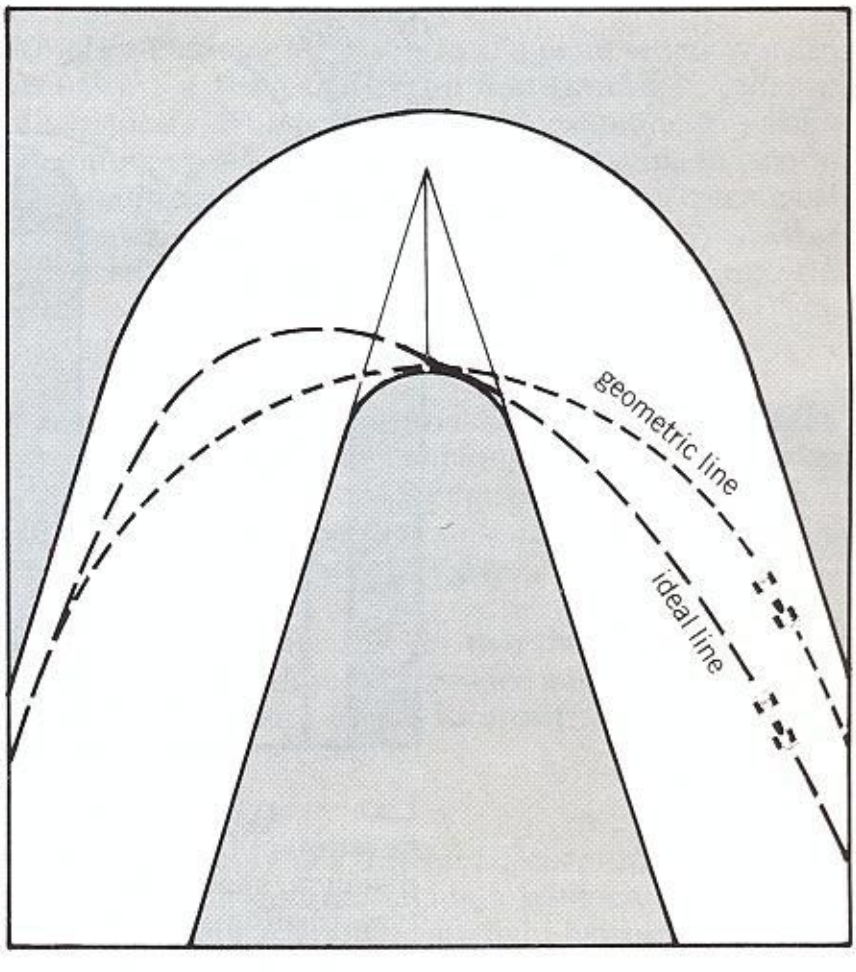
First decide the best line to follow. There's a big difference between the line you might choose on the road – 'the granny line', as it's known – and the line you must attack to take a bend on a racetrack at speeds often in excess of 100 mph.

The 'granny line' may be the shortest distance, but drastic braking would be required, which would lose valuable seconds.

Equally, the outside of the track is also slower.



The 'granny line' may suit the road but is very much slower than the wider arc of the ideal racing line.



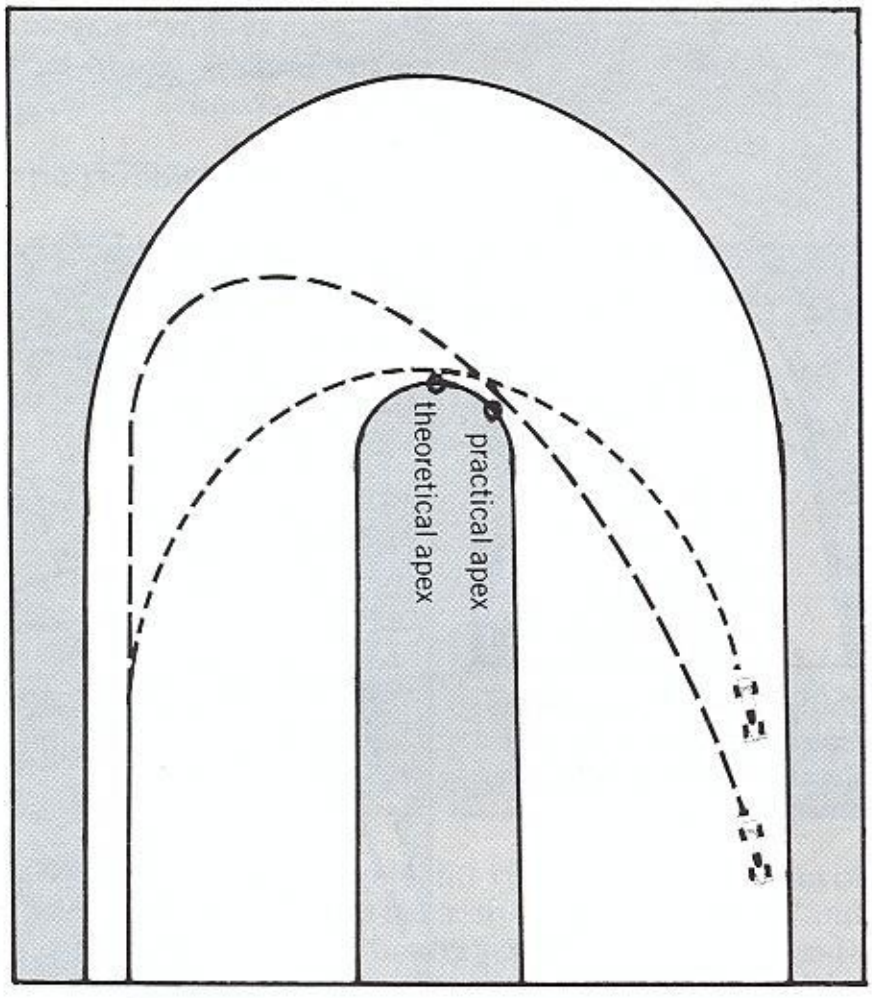
Between inner and outer lines is the geometric line, drawn with a compass. But none of these is ideal.

We are looking for the ideal line between these two extremes.

Working out the ideal line

You could draw a scale drawing of a corner, and with a compass and protractor work out the apex of the inner line, but it wouldn't help you in practice because no corner is perfect. In fact if you did use geometry to work out a point at which the car should attack the inner line, you would discover that the tighter the bend, the greater the difference between geometrical theory and racing practice. This can be clearly seen in the illustration of the hairpin.

Slow in; fast out; turn as much of the corner into a straight as possible.



Like everything else in racing, fast cornering is a question of fine balance, in this case a balance between distance, speed, and the resistance which is set up by tyres turning on the track.

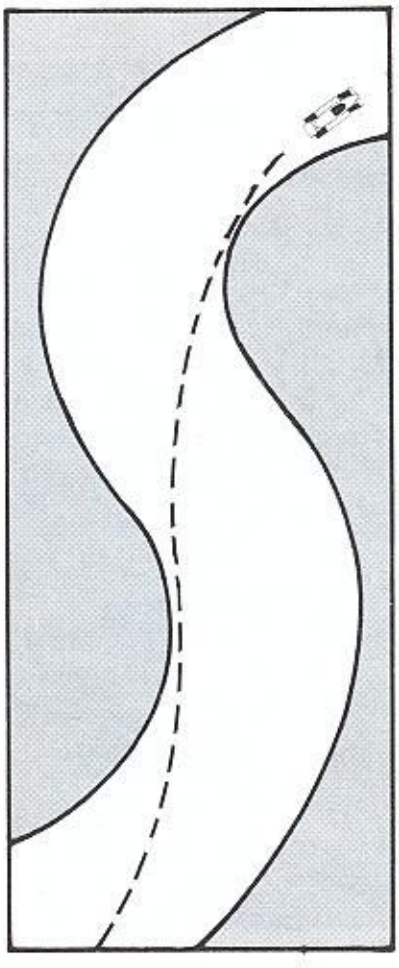
Finding the path of least resistance
Think of turning each corner into a straight. We know that the straighter the line we drive, the higher the speed attainable, but let's spell out the reason why: turning the tyres obliquely to the road sets up resistance to speed.

One vital principle, therefore, is that the ideal line is the line of least resistance.

That cornering tyres resist speed is well illustrated by an example: Stowe at Silverstone is flat out for a good driver, but if you hammer down Hangar in 5th at 6000 revs, and go into Stowe with your foot still flat on the boards, you'll exit at only about 5200 revs. The reduced power is not due to increased air resistance; it's the tyres doing the work and taking their toll on both power and speed.

Every time you turn the wheel, you're slowing the car down.

Turn in at a point where you can virtually see through to the other side.



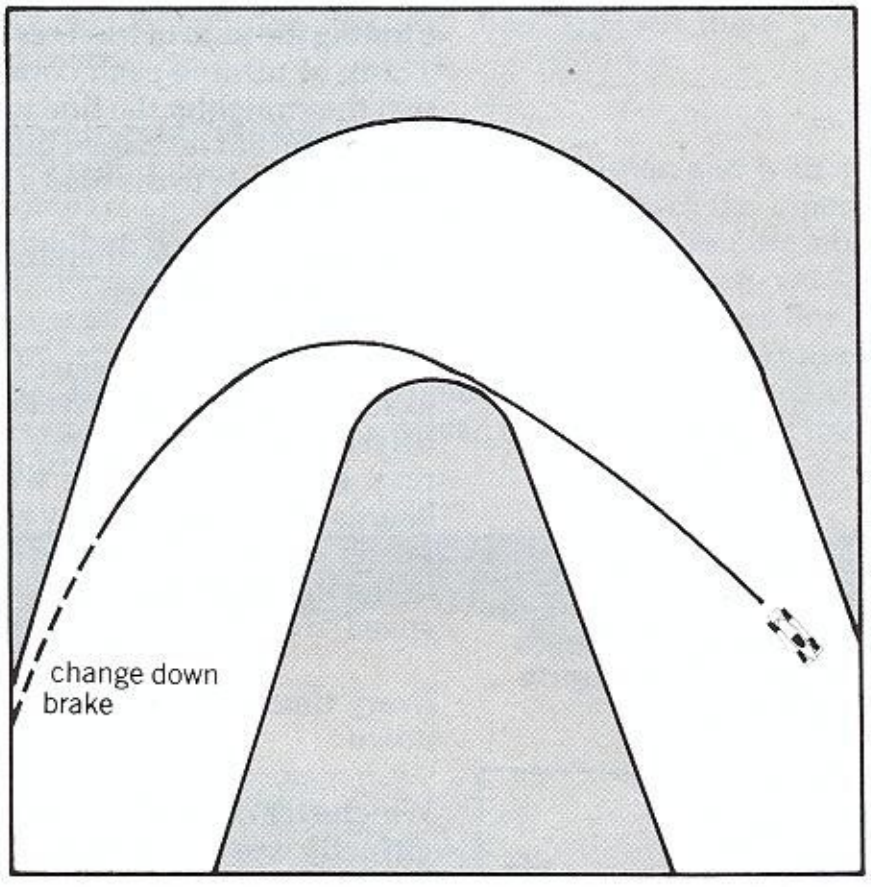
Whichever corner it is, turn in at a point where you can virtually see through it. The first turning-in point at Silverstone's Woodcote is a good example; to ensure maximum speed, you'll find yourself having to turn in really quite late . . . at a point from which you can almost see right through Woodcote to the other side. A whisker – first left then right – on the joystick, or a finger-tip touch of ❮/❯ on the keyboard, simply wiggles you through in 4th.

If you misjudge which line to take and come in too tight, you'll lose precious time stabbing at the controls in an effort to get back on course. If you come in too late, you'll either overshoot altogether or – if there's still time – brake and lose speed accordingly.

So we can go further and say that the ideal line is one which allows minimum resistance and maximum grip. There is some more useful information on this in the section about aerodynamics.

Look for a fast exit
The illustrations show different corners and how to take them. Whether you are taking a wide-arc bend in 5th with your foot hard down, or a tight hairpin which will

In tight corners, the timing of the brake-gear change scenario is crucial and should be completed comfortably before turning in.



require you to brake and change down, the essential principles of cornering remain true.

The art of taking any corner is to judge the point to turn in which allows you to begin accelerating out as soon as possible. For fast exiting is what high-speed cornering is all about. You have got to begin by thinking, 'What line will allow me to accelerate out soonest?' The problem each corner poses is how to get your foot back down on the throttle and the car back up through the gears, at the earliest possible moment.

Remember, it takes about twice as long to accelerate as it does to decelerate.

Going into a corner

How fast to make an approach? 'Look at it in terms of a spectrum of what is possible,' advises David Hunt. 'Let's say that in perfect conditions a corner can be exited at 103mph – top speed – still permitting maximum grip and minimum resistance (no sliding) from tyres. It is

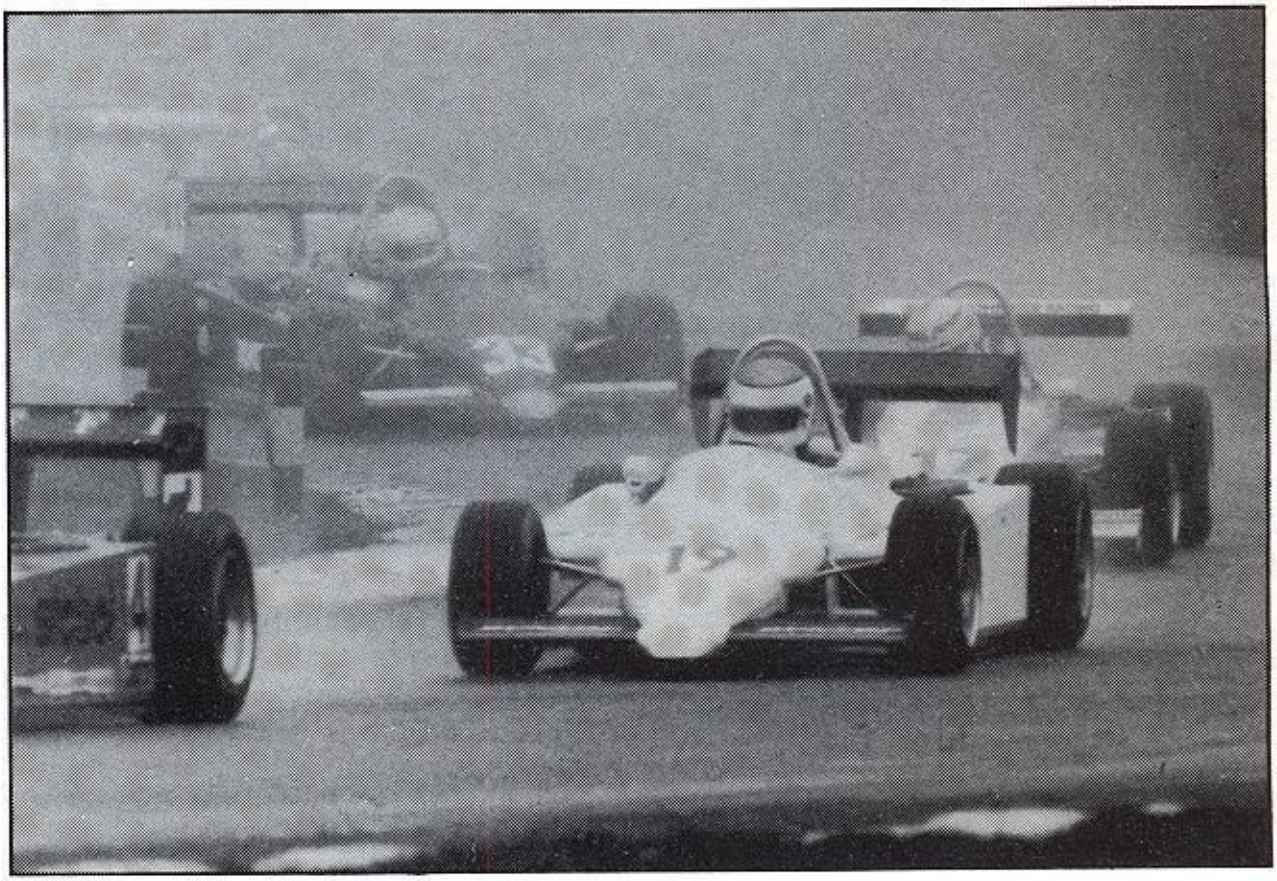
physically impossible in perfect conditions to exit that corner faster than 103 mph. 103 mph is the aim.

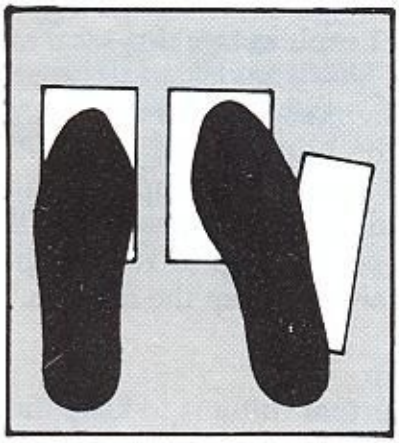
'If you're giving it 100 mph, obviously you're not going fast enough; you're not using the tyres. You'll notice it, you'll feel the difference. Equally if you start approaching too fast you'll start sliding, and scrub off speed. You'll delay your exit and then never get back up to 103. Judge your speed by the rev counter; always keep the revs up.'

Braking and keeping the revs up

On an ideal line, the most important thing is to keep the power on as hard as you feel is safe, remembering always that when the revs are too low or too high your car is racing less efficiently. Your car bites at between 5000 and 5800. Keep the revs between these figures.

On a tight corner, or any bend which involves a reduction in speed, keep within the ideal rev band by changing down. David Hunt explains the almost balletic





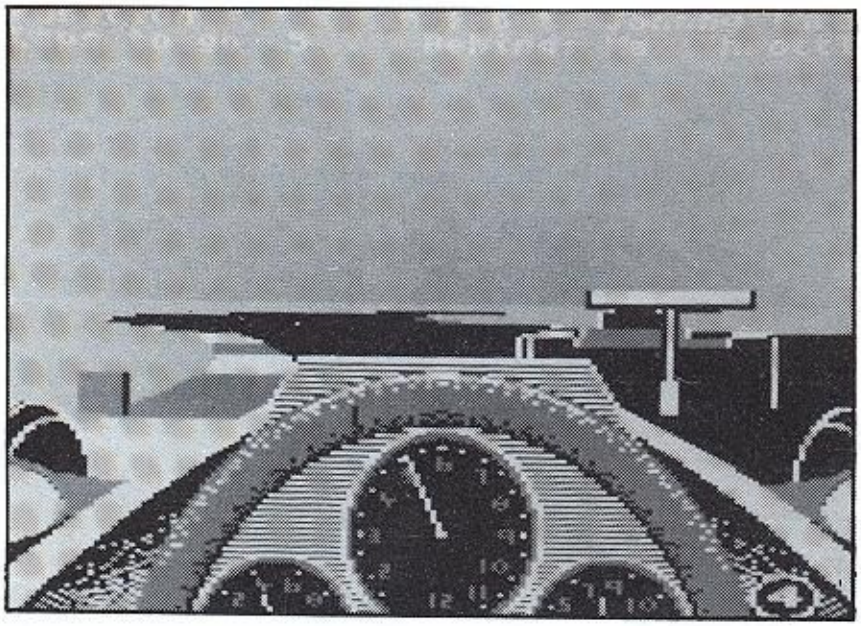
Keep the revs up at all costs; in a real car, it's a skilful rolling of your foot from brake to accelerator. Heeling and toeing, it is called.

skill required from the real racing driver: 'You've got the brake pedal on the left and the throttle pedal next to it on the right. Most of the ball of your right foot covers the brake pedal, and the rest of it manipulates the throttle every time you move through neutral and change down. It's a skilful rolling of your foot.'

When to brake

The precise timing of the brake/gear change scenario on the approach is of crucial importance. Make the most of speed built up on the straight by easing up at the very last possible moment. Losses of even one tenth of a second on each lap can add up to places at the finish.

Equally, braking too late can be suicidal. Braking (as opposed to accelerating which has an opposite, stabilising effect) pulls the weight of the car onto its front, and as you turn into a bend the car pivots around the front wheels.



There are three markers at intervals of 100 feet before each bend, and one on the apex.

Use markers for brake and gear points, turning points, and practical apexes. 'Use anything that you can lay eyes on, but DON'T use anything that can be moved. You get novice drivers saying, "Oh, I was using the third hay bale," and while they were round the back of the circuit some joker has come along and moved the bale! They come screaming down the straight – no bale, just the corner.'

FIREBIRD SOFTWARE · WELLINGTON HOUSE
UPPER ST MARTIN'S LANE · LONDON WC2H 9DL