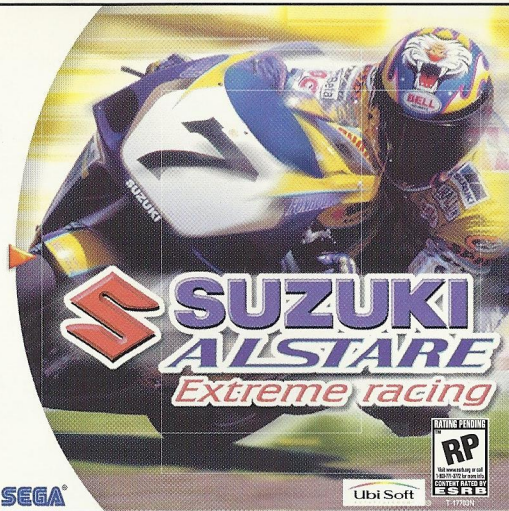


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MONACO GRAND PRIX™



T-17701N

WARNINGS Read Before Using Your Sega Dreamcast Video Game System

CAUTION

Anyone who uses the Sega Dreamcast should read the operating manual for the software and console before operating them. A responsible adult should read these manuals together with any minors who will use the Sega Dreamcast before the minor uses it.

HEALTH AND EPILEPSY WARNING

Some small number of people are susceptible to epileptic seizures or loss of consciousness when exposed to certain flashing lights or light patterns that they encounter in everyday life, such as those in certain television images or video games. These seizures or loss of consciousness may occur even if the person has never had an epileptic seizure.

If you or anyone in your family has ever had symptoms related to epilepsy when exposed to flashing lights, consult your doctor prior to using Dreamcast.

In all cases, parents should monitor the use of video games by their children. If any player experiences dizziness, blurred vision, eye or muscle twitches, loss of consciousness, disorientation, any involuntary movement or convulsion, IMMEDIATELY DISCONTINUE USE AND CONSULT YOUR DOCTOR BEFORE RESUMING PLAY.

To reduce the possibility of such symptoms, the operator must follow these safety precautions at all times when using Dreamcast:

- Sit a minimum of 6.5 feet away from the television screen. This should be as far as the length of the controller cable.
- Do not play if you are tired or have not had much sleep.
- Make sure that the room in which you are playing has all the lights on and is well lit.
- Stop playing video games for at least ten to twenty minutes per hour. This will rest your eyes, neck, arms and fingers so that you can continue comfortably playing the game in the future.

OPERATING PRECAUTIONS

To prevent personal injury, property damage or malfunction:

- Before removing disc, be sure it has stopped spinning.
- The Sega Dreamcast GD-ROM disc is intended for use exclusively on the Sega Dreamcast video game system. Do not use this disc in anything other than a Dreamcast console, especially not in a CD player.
- Do not allow fingerprints or dirt on either side of the disc.
- Avoid bending the disc. Do not touch, smudge or scratch its surface.
- Do not modify or enlarge the center hole of the disc or use a disc that is cracked, modified or repaired with adhesive tape.
- Do not write on or apply anything to either side of the disc.
- Store the disc in its original case and do not expose it to high temperature and humidity.
- Do not leave the disc in direct sunlight or near a radiator or other source of heat.
- Use lens cleaner and a soft dry cloth to clean disc, wiping gently from the center to the edge. Never use chemicals such as benzene and paint thinner to clean disc.

PROJECTION TELEVISION WARNING

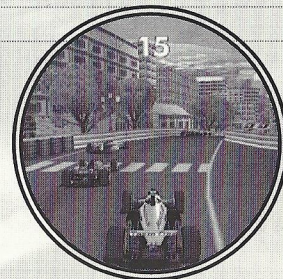
Still pictures or images may cause permanent picture tube damage or mark the phosphor of the CRT. Avoid repeated or extended use of video games on large-screen projection televisions.

SEGA DREAMCAST VIDEO GAME USE

This GD-ROM can only be used with the Sega Dreamcast video game system. Do not attempt to play this GD-ROM on any other CD player, doing so may damage the headphones and/or speakers. This game is licensed for home play on the Sega Dreamcast video game system only. Unauthorized copying, reproduction, rental, public performance of this game is a violation of applicable laws. The characters and events portrayed in this game are purely fictional. Any similarity to other persons, living or dead, is purely coincidental.

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THE MONACO GRAND PRIX: THE LEGENDARY RACE

Monaco is the most legendary race of all.

It's a challenge taken up every year by the best racing drivers in the world. The race has been masterfully organized by the Automobile Club of Monaco since it was formed in 1929.

Maximum speed: 270 kph. An average speed of more than 140 kph to cover just over 3 kilometers between manhole covers, pavements, barriers and walls.

And there are no escape routes! Only the best drivers win at Monaco to earn a page in the history of this legendary race.

A circuit full of danger

Less tortuous than it is today, the circuit used to form a loop that linked Monte Carlo, the harbor and Monaco. The track was 3.18 km long and more or less stayed that way until 1952. After this date, new chicanes and hairpin bends appeared, resulting in the circuit that we know today, the total length of which is 3.367 km, the drivers doing 78 laps in just under 2 hours.

But the streets are no wider now – in fact, they're narrower. The walls are still there, as hard as ever, and the engines have 700 horsepower and more.

One thing is certain: it's an exceptional driver who counts the Monaco Grand Prix amongst his list of achievements – one of the greats!

Monaco Grand Prix is a 2 player game. Before turning the Sega Dreamcast power ON, connect the controller or other peripheral equipment into the control ports of the Sega Dreamcast. To return to the title screen at any point during game play, simultaneously press and hold the A, B, X, Y and Start Buttons. This will cause the Sega Dreamcast to soft-reset the software and display the title screen.

INSTALLING

- 1 Install your Sega Dreamcast™ by following the instruction manual. Make sure that the console is off before inserting or removing a DISC.
- 2 Insert the MONACO GRAND PRIX DISC and close the cover of the DISC compartment.
- 3 Connect the controllers and switch on the Sega Dreamcast.
- 4 Follow the instructions that appear on the screen to start a game.

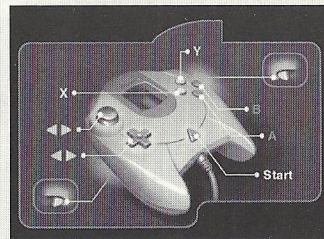
GAME CONTROLS

Up/Down Left/Right
Validate
Cancel

Analog Thumb Pad
A Button
B Button

Default configuration

Direction to Operation	Analog Thumb Pad
Accelerate	Right trigger
Brake	Left trigger
Change gears	B Button
Change down	A Button
Rearview mirror	X Button
Change playable views	Y Button



Never touch the Analog Thumb Pad or Triggers L/R while turning the Sega Dreamcast power ON. Doing so may disrupt the controller initialization procedure and result in malfunction.

When Using Sega Dreamcast Race Controller:

When playing one player Arcade or Championship, please insert a Sega Dreamcast Controller in Control Port A and the Race Controller in Control Port B. Use the Dreamcast Controller to navigate menus, and the Race Controller to race.

When playing Monaco Grand Prix with 2 players and two race controllers, please insert a Sega Dreamcast Controller in Control Port A and the Race Controllers in Control Port B and Control Port C. Use the Dreamcast Controller in Control Port A to navigate menus, and the Race Controllers in Controller Ports B & C to race.

To return to the title screen at any point during game play while using the Race Controller, simultaneously press and hold A, B and Start Buttons. This will cause the Sega Dreamcast to soft-reset the software and display the title screen.

When using the Race Controller, never touch the steering wheel or left and right levers when turning the Sega Dreamcast power ON. Doing so may disrupt the initialization procedure, and result in malfunction if readjustment is not properly carried out via the Options menu. If the handle or levers are accidentally moved while turning power ON, immediately turn power OFF and ON again making sure not to touch the Race Controller.

GAME MODES

1. Arcade

This is the simplest mode to select a car and circuit and go straight out onto the track. The cars are easier to maneuver and you don't risk damaging them, though they still behave in a realistic way.

You have a choice between:

- **Simple Race**
 - **Championship**
 - **Personalized Championship**
 - **Time Attack**
- Free Run
Ghost

In Simple Race, Championship and Personalized Championship modes, you not only have to beat the other competitors but also the clock. Each circuit includes several control points which can help you gain time, provided you reach them. If you don't pass these checkpoints in time your race will be terminated.

2. Simulation

This mode allows you to drive under real racing conditions on one of 17 suggested circuits. Don't forget that the behavior and technical specifications of the car are at their most realistic, so this mode requires the greatest skill.

As in real life, you'll be able to set your car up for your own driving style and for the different circuits, then pit yourself against opponents at whatever level you choose: Amateur, Pro or Expert.

You have a choice between:

- **Simple Race**
- **Grand Prix**
- **Personalized Championship**
- **Time Attack:** Free Run
Ghost

3. Retro

Relive the fun of driving racing cars from the early days of motor racing!

Choose from 4 teams and 8 cars from the 1950s.

In their time, these racing cars were not as easy to drive as today's single-seaters so you need a lot of skill to win this race.

Only the Simple Race is available in this mode.



SUGGESTED RACES:

1. Simple Race:

All you have to do is choose your circuit and you'll find yourself instantly at the steering wheel and ready for the start of the race. You do not need to qualify and your position on the starting grid is the pole position by default, but you are free to increase the level of difficulty and choose the last position on the starting grid by going to the 'Options' page.

2. Grand Prix:

When you choose Grand Prix, you are letting yourself in for a whole weekend of racing.

Here are the different stages that await you:

- Practice runs 1 and 2: these help you get acquainted with your car and the layout of the circuit. You can even make some preliminary adjustments in the pits. You can access these runs in one of 2 ways: either by going there with your car or by pressing the Start Button during the game and selecting 'return to pits'.
- Qualifications: your position on the starting grid depends on your time in this session.
- Warm-up: the last laps and car adjustments before the actual race.
- Grand Prix: the race begins ...

3. Championship:

Live through the unique experience of an entire season by fighting for victory in the 17 Grand Prix races which take place on as many different circuits.

The points allocated in the championship depend on the final position at the end of each race. Only the first six drivers score points on the following scale:

1st: 10 points

2nd: 6 points

3rd: 4 points

4th: 3 points

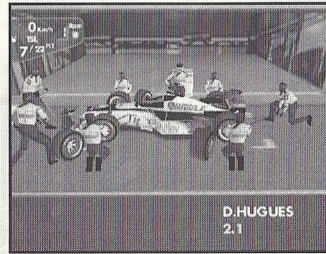
5th: 2 points

6th: 1 point

The points acquired in a Grand Prix are accumulated from one Grand Prix to the next; the driver who becomes World Champion is the one who has accumulated the most points at the end of the 17th Grand Prix.

In 'Arcade' mode, your position on the starting grid is the opposite of your ranking. This mode also includes an against-the-clock system (checkpoints).

Return to Pits (only active in 'simulation')



When you leave the track to enter the pits, a dialogue box appears in the center of the top of the screen to tell you that the mechanics are ready to get to work (to fit another type of tire, refuel or mend a wing). When you've decided what you want done, press on the Start Button to validate your choices. The mechanics then get into action and, when they have finished, all you have to do is accelerate to set off again.

The meaning of the flags in the race

- **The Yellow Flag means there is danger on the track.**
- **The Blue Flag means a competitor is about to lap you.**
- **The Checkered Flag means the finish of the race.**
- **The Black Flag orders you to stop the race. You have been disqualified for dangerous driving or failure to respect the rules.**

Participating in a complete championship takes a long time, but you can save your points and ranking after each Grand Prix.

4. Personalized Championship

You can create your own championship by choosing both the Grand Prix races to be included and the drivers taking part.

■ Edit the list of circuits:

Select 'custom', then go to 'edit list' and validate with the A Button. On the new page, all the circuits are selected by default: they all have a blue cross. If you wish to remove a circuit from the list, choose the name of circuit in question and press the A Button.

If 3 circuits with blue crosses remain, your championship will be made up of 3 Grand Prix races.

■ Edit the list of drivers:

When you have selected the circuits and validated your choice by choosing 'OK' and pressing the A Button, you go directly to the driver selection page.

On this page, you decide which drivers will or will not take part in your championship. As for the circuits, a driver with a blue cross in front of his name is selected. If you remove this cross by selecting the driver and pressing the A Button, the driver in question will no longer take part in the competition.

Your name is the only one in a white font: your participation is obligatory.

5. Time Attack

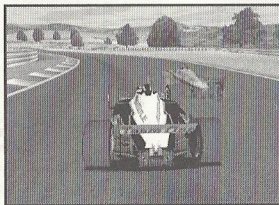
This mode is intended particularly for players who are trying to break lap records.

For this, the car is indestructible: there is no fuel consumption and the tires do not wear out. The player can therefore do as many laps as he likes, improving his time each time he passes the line. You can choose between two options:

Free Run

The player's car is placed just in front of the starting line so that it can be crossed at maximum speed, starting the stopwatch. The goal is to get the best possible time, but this mode is also very useful for learning how to handle the car or get to know a new circuit without being bothered by other competitors. The race against the clock only stops if you press the Start Button and choose 'Quit'.

Ghost



If you choose Ghost Mode, you will always compete against the best time that you have obtained. As for Free Run, you automatically start a little in front of the starting line. On the first lap you race alone, but from the second onwards, you race against the Ghost (who represents your best lap record), and the ghost races forward as soon as you cross the starting line.

But don't forget that the Ghost is only an image and it is impossible to collide with it.

Since the Ghost's time is recorded for one lap, the procedure begins again for each lap.

You can go on indefinitely like this, until such time as you press the Start Button and choose 'Quit'.

If you want to record one of your Ghosts, you need to connect VMU, press the Start Button during the game and select 'Quit'. Once you are back in the menus, select 'Save'.

GENERAL MENU

1. Choosing a circuit

On the 'main menu' page, choose the circuit selection line using the 'up/down' keys, then with the 'left/right' keys choose the circuit that you want to race. If you validate your choice by pressing the A Button, you enter a summary page which gives extra information about the layout.

2. Choosing a driver

On the 'main menu' page, choose the driver selection line then choose your driver by turning the selection disc. You can give the driver whatever name you like by pressing the A Button, which takes you to the 'edit' page (please see "Editors" section).

3. Choosing a team

Same procedure as for choosing a driver.

4. Editors

- The drivers' names:

Choose the driver selection line and press the A Button.

You will go to a page where you can edit the driver's first name and surname. For example, select the name and press the A Button: a table of letters appears. Now choose the letters using the Analog Thumb Pad and validate with the A Button.

- The names of teams: Same procedure as for drivers' names.
- Saving edited names: All your modifications can be recorded on a VMU. There is only one list of names per VMU which loads automatically with the game if your VMU is correctly connected. Saving new names is done by selecting 'Save' and pressing the A Button. This accesses the 'save' page where you choose your VMU and the location for the save. If several VMUs are connected, the default edited list will be for the first VMU.

5. Option / Configure

Option:

- Arcade mode : On this page you can edit the 'unit of speed', 'gearbox', 'number of competitors' and 'duration of race' options.
- Simulation mode : You can adjust the following options on this page:

'Car'

Unit of speed	Kph - Mph	Kilometers or Miles per hour
Changing gear	Auto	Gears change automatically whenever the player brakes or accelerates.
	Manual	The player has to change gear himself.
Anti-sliding device	Yes - No	Aids re-acceleration when exiting from a bend and stops car from running off track.
Anti-skidding device	Yes - No	Aids acceleration to stop the wheels from skidding.
ABS	Yes - No	Device to stop the wheels locking during braking.
Steering lock	Yes - No	Makes road holding easier when entering a bend.

'Failure':

The following breakdowns are ranked in increasing order of seriousness :

OPTIONS

Radio breakdown (no more communication with the pits)
Cockpit display breakdown (dashboard failure)
Broken exhaust (loss of engine power)
Overheating brakes (decrease in brake efficiency)
Gearbox breakdown (one or more gear ratios)
Electronic engine damage
Oil or water leak
Engine explosion

'Race':

OPTIONS

Weather
Competitors
Percentage of Laps
Wear and Relative Fuel Consumption
Position on the Grid
Damage

'Rules':

False start	Yes	At the start of the race, the player has control of the car as soon as the five red lights are lit. However, before starting, he must wait for the lights to go out, otherwise he will be penalized for a false start.
	No	The player has control of the car as soon as the 5th light goes out!

Limit of 30 laps per session on practice run	Yes	In a practice run session, the player cannot do more than 30 laps (including entering and leaving the pits).
	No	Unlimited number of laps.
Limitation of 12 laps per qualifying session	Yes	During a qualifying session, the player cannot do more than 12 laps (including entering and leaving the pits).
	No	Unlimited number of laps.
The 107% rule	Yes	The player can only take part in the race if his qualifying time is less than 107% of the time of the car in pole position.
	No	No restriction on qualifying times.
Limit of one replacement vehicle per weekend	Yes	On a Grand Prix weekend (practice runs, heats, warm-ups, race), the player has the use of only 2 cars: his own and the reserve car.
	No	Unlimited number of cars.

• **Configure:**

By going to the 'Configure' button, you can access the following tabs:

- **Controller:**

Using the Analog Thumb Pad, go to the configuration selection disk controller and choose from the 6 available configurations.

- **Sound/Screen:**

Using the Analog Thumb Pad, you can adjust the sound level for messages, the engine, special effects and music. The 'Calibrate' button is accessible with the Analog Thumb Pad and you can activate it with the A Button. On this new page, you can center the image in relation to your screen so that you can see the game screen in its entirety.

MULTIPLAYER MODE

In this mode, 2 players can compete on a single split screen.

Accessible modes: Arcade / Simulation / Retro

Accessible race: Simple Race

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Apt. # _____

Sex _____ Age _____

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Maximum number of competitors: 1

All menu-navigation is done as in 'one-player' mode.

You need to have two controllers connected for the '2 players' option to be selectable.

While saving the game file, never turn OFF the Sega Dreamcast power, remove the memory card or disconnect the controller. While saving a VMU/VM Specific Game file, never turn OFF the Sega Dreamcast power, remove the memory card or disconnect the controller or other peripheral equipment. Never disconnect the VMU/VMs while performing a battle or exchanging data when connected to another VMU/VM. Also note that leaving two VMU/VMs connected for a long period of time will considerably shorten the life of the batteries.

SAVING AND LOADING

1. Saving:

- **Names of drivers and teams:** select the drivers or teams line and press the A Button. Using the keyboard, edit the new name and validate with 'OK'. You can then go to the 'save' icon and press the A Button. Select your VMU and validate.

Advice: if you want to save a complete list of names, save them all on the same VMU. When you start the game up again and your VMU is connected, your list will be loaded automatically!

- **Ghost and Championship:** when you have created a ghost or begun a championship, all you need do is select the 'Save' icon and then choose the VMU on which you wish to save. You are then asked to give a name to your backup which you validate by pressing 'OK'. You can only save a championship before or after a race.

2. Loading a Ghost or a Championship:

This operation can only be carried out if a VMU is connected.

On the Arcade/Simulation/Retro selection, go to the VMU icon and press the A Button.

On this new page, choose the VMU that you want to use and press the A Button.

You will then call up a page which gives details of the selected VMU.

Next choose the file to load and press the A Button.

For the record, lists of names of drivers and teams are loaded automatically.

ENGINEER'S GUIDE

THE SECRETS OF SIMULATION MODE

CONTENTS

1. The 'driver' set-ups
2. The 'engineer' set-ups

You have decided to play in simulation mode. To be truly competitive, in addition to a lot of skill you will need to be able to set up your car for the different championship circuits and your driving style. So this guide tells you all about the set-up techniques for single-seaters - from the simplest set-ups (driver set-ups) to the most complex (engineer set-ups), and lastly how to configure your car correctly.

'DRIVER' SET-UPS

- **Transmission:** Choose between manual and automatic gearbox. In automatic, the computer will make the optimal gearchange for the player - i.e., with maximum torque. If you are a beginner, you will find it easier to go for the automatic option.
- **Gearbox ratios:** The gearbox ratios must be adjusted and adapted to the style of each circuit. Adjusting the sixth gear ratio sets the car's maximum speed: a long ratio will mean a faster straight line speed - but will also take longer to reach it. A short ratio gives significantly sharper acceleration but a weaker top speed. After setting the sixth gear ratio, adjust first gear for the slowest bend. Only then start spacing the other ratios between sixth and first.
- **Long - Short:** A gear ratio is the quotient of the teeth in the two gearwheels of the gearbox. The sixth gear ratio is generally near to 1 (this could be 62/64, 71/72 or 46/48 for example). The ratio of first is the smallest or the shortest, the ratio of sixth the longest. Lengthen the ratio by increasing its value, shorten it by reducing it.
- **Steering:** The steering ratio is that between the steering lock angle and the wheel lock angle. Adjust this ratio well enough to be able to turn into the slowest bend on the circuit: for example set-

ting the steering ratio to a high value for the Monaco circuit would mean no problems tackling Loews corner. Note: the higher the wheel lock, the quicker the tires will wear.

- **Break balance front/rear:** Brake balance is the ratio between the front and rear braking force. If brake balance is badly set, the 4 wheels will not brake at their maximum potential. Since brake balance also influences the approach to a bend, the more that the balance is set to the rear, the more the rear brakes are likely to jam first making the car oversteer. In all cases, a car that locks its front wheels first is easier to steer than one that locks its rear wheels first. Because inertia is applied to the car's center of gravity under deceleration, braking is accompanied by a transfer of vertical load, which tends to remove the burden from the rear axle loading it onto the front. An axle tire to ground adhesion limit is relative to the vertical load: the higher the load, the greater the grip and vice versa. The drag can then exceed the tire to ground adhesion limit forcing the rear wheels to lock and lose their grip. Brake balance therefore is an adjustment of front and rear drags so as to either prevent the rear wheels from locking or make them easier to lock.
- **Understeer (car understeering):** A car understeers in a bend when the front tires lose their grip (slip) before the rear tires do. The front wheels then no longer respond well to the steering; the driver, no matter how much he turns the wheel, finds that the car continues on a path that tends to make it leave the road by the outside. In order to re-gain control of a car that's understeering, it's important to immediately increase the vertical load at the front by lifting the foot off the accelerator, perhaps even braking lightly. A car that understeers remains stable, contrary to one that oversteers.
- **Oversteer (car oversteering):** A car oversteers in a bend when the rear tires lose their grip (slip) before the front ones do: the car then goes into a rear skid which, more often than not, finishes with the car facing in the opposite direction. To avoid this awkward situation, you have to lightly steer into the skid by gently lifting the foot from the accelerator in order to try and re-establish rear wheel grip. Don't lift the foot too suddenly though or even worse brake too sharply because vertical load on the rear will drop, further reducing rear wheel grip. The best drivers manage to maintain the car's skid by playing on the counter lock and accelerating very lightly. A car that oversteers is unstable, contrary to one that understeers.

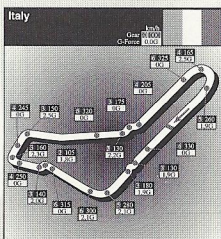
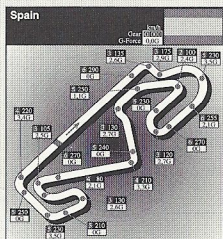
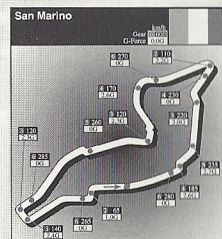
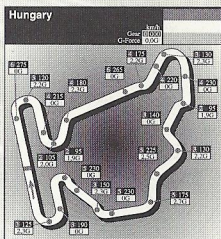
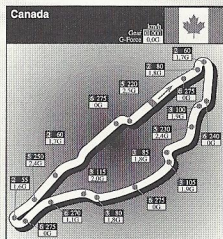
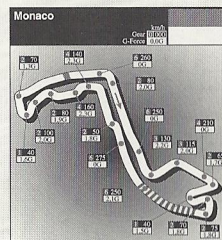
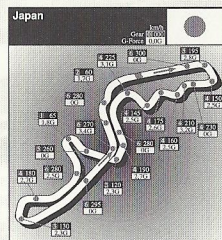
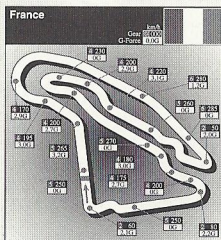
- **Stable/unstable behavior:** A car is said to be stable if, when the speed drops sharply, it returns to its initial trajectory. A car that understeers is as stable as a car, which behaves neutrally. A car that oversteers is, by definition, unstable because dropping the speed sharply makes the car suddenly spin forcing it into the opposite direction.
- **Aerodynamics - wings:** The front and rear wings allow the car to 'stick' to the road thanks to the downforce that they generate. They give more grip to the car in bends by increasing the vertical load, but also lower the straight-line top speed by generating drag. The wing set-up allows you to adjust their incidence angle: the greater this value, the greater the car's grip and the lower the maximum speed. The wing settings can also influence braking: the lower the incidence, the greater the need to brake earlier. The car's bodywork also helps create downforce, depending on the car incidence. The bodywork or bodyshell, which refers to the whole of the car with the exception of the wheels and suspension, also creates another force: ground effect.
- **Downforce:** The wings are like inverted airplane wings. For the same reason that a plane flies, a wing, when placed in a relative wind (i.e., a wind generated by the car's displacement against its environment) will create a downward force which increases the vertical load, planting the vehicle more firmly to the ground with greater effectiveness the faster it goes. The downforce is relative to the car's speed squared and this force can be 3 to 4 times the car's weight.
- **Vertical load:** The vertical load is the total of all vertical pressures supported by the vehicle. These are the weight of the car, aerodynamic forces, and inertia forces when accelerating or braking (transferring load). The vertical load has a major influence on a car's behavior: the greater the force on the suspension, the more this will be passed onto the tires. So as a general rule, the greater the vertical load, the more the car will 'stick' to the road.
- **Drag factor:** The bodywork and aerodynamic extras, like all bodies in an airflow, slow the car down – this is known as aerodynamic drag. This force is also proportional to the speed squared, therefore the faster you go, the more you are slowed. When the wing incidence increases (especially at the rear), the drag factor is raised.

- **Wing incidence angle:** This is the angle that the wing makes against the airflow. The larger the angle, the larger the downforce, but also the greater the drag factor. In the aerodynamic set-up, it is the angle that is adjusted.
- **Car incidence:** Bodywork contributes, like the wings, to the downforce. The bodywork through the suspension settings (ride height) also has an incidence. The more this is increased, the greater the downforce. However, the influence of this downforce in comparison with the downforce created by the wings is less important. On the other hand, the car incidence plays an important part on the drag factor: the greater it is, the greater the drag factor and the slower the maximum speed. It's always important to set the car incidence in such a way that the front is lower than the rear.
- **Ground effect:** Due to the flat bottom and extractor behind, there is a depression under the bodyshell which has the effect of improving the car's grip on the road. It varies according to the height of the bodyshell against the ground. This depression creates a suction force between the car and the ground increasing the vertical load. The lower the bodyshell the greater the suction forces.
- **Fuel:** The more fuel you have in the car the heavier it becomes. This means that acceleration becomes slower, braking takes longer and your maximum speed drops. However you must make sure that you have enough fuel so that you do not run out.
- **Tires:** Tire quality is a crucial factor to your car's performance. The tires of a single-seater never last longer than one race, or even a few laps, and this is even true of the most resistant ones. There are two types of tires: smooth tires – used in dry conditions (known as 'slicks') and treaded tires – used in the wet. Only one quality of rubber exists for wet tires while there are four types for slicks. Select the highest performance tires (soft) for qualifying practice runs: runs last a maximum of 12 laps, which corresponds roughly to half the average life-span of this kind of tire. Select your tires thinking about the number of refuelling stops you'll make and your style of driving: choose hard if you've planned 0 or 1 stop, soft if you'll make several stops in the pits. Wet tires will not wear out too much in the rain (in fact, they can last for the whole race), but in dry conditions they will wear out quickly. If the track dries out, change your tires for some slicks.

THE 'ENGINEER' SET-UPS

- **Springs:** The suspension is made up of springs, anti-roll bars and dampers. The springs control the wheels' vertical movement against the bodyshell, this is known as travel. The firmer the springs (stiffness), the greater the force needed to make the wheels travel. Setting the spring rate for each wheel influences the car's behavior, notably the roll and the pitch. The firmer the springs, the less the car will roll in corners and the less it will pitch under acceleration and braking. In a straight line, the softer the springs, the more the suspension will absorb the bumps, allowing the tires to stick to the road better. However, the vertical load transfer is greater when braking, removing the weight from the rear wheels, which provokes a loss of braking efficiency. In corners, softer spring settings mean the wheels stick to the road but if the setting is too soft, entering and leaving corners becomes difficult and the car is slower to react. The front and rear anti-roll bars re-enforce the springs only when the car rolls. Therefore, the firmness of the suspension can differ in a straight line where there is normally no roll, to corners where the car will roll. In corners the suspension is firmer because of the anti-roll bars.
- **Pitch and roll:** The pitch and the roll angles affect a car's position in relation to the road. Roll describes the angle between the body and a longitudinal horizontal axis. Centrifugal force in corners creates this angle, as does a wheel going over an obstacle or banking a slope. Roll has some annoying repercussions for road holding: the tires can slip more easily and vertical load transfer is greater. Pitch is the relationship between the body and a transversal horizontal axis, which depends not only on the inertia that occurs under braking or acceleration, but also when a wheel goes over an obstacle or an uphill road. Pitch has the same consequences as roll.
- **Travel:** Travel is the wheels' position against that of the body of the car. For example, in a right-hand corner, the front outside wheel will lower the distance between itself and the body while the inside rear wheel gap increases. All four wheels have travel.

- **Anti-roll bars:** Anti-roll bars are a part of the suspension in that they help to control roll. They help out in corners and harden the suspension. The anti-roll bar set-up has a major effect on how the car will behave in a corner: if it understeers, soften the front anti-roll bar. If the car oversteers, soften the rear anti-roll bar.
- **Ride height:** Ride height, is the height between the car and the ground and is measured from the front and rear axles. The height is given while the car is stationary and varies when the car is moving due to: downforce, wheel travel, pitch and roll. Ride height affects car behavior by lowering the center of gravity making the car pitch and roll less. Lowering ride height also raises downforce.
Note: The front of the bodyshell must always be lower or equal to the height of the rear of the car, otherwise downforce will be zero. Minimum ride height is when the bodywork touches the ground.
- **Bump stops:** Bump stops are pieces of very hard rubber fixed to the dampers. They allow the springs to stiffen when a certain amount of wheel travel occurs. You adjust the travel setting from which the bump stops will have an effect. Stops are used once the spring rate has been set and the car still continues to touch the ground. You can, of course, choose not to use bump stops if you don't want to. It's something that's used to complement the spring rate.
- **Dampers:** The dampers, like the springs and the anti-roll bars, form part of the suspension. They absorb travel, dispersing the accumulated energy in the springs and prevent excessive wheel travel. When the car enters or leaves a corner, brakes, accelerates or goes over an obstacle, the dampers will limit the travel. The role played by the dampers is not the same depending on whether the wheel moves towards (bump) or away (rebound) from the bodyshell. When bumping, the dampers control the movement of the car as it goes over a bump. When they rebound, they control the roll and contribute to the car's handling when entering and leaving a corner. In general, the dampers are set to provide three to four times more force on rebound than on bump.



PROOF OF PURCHASE

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CREDITS

PROJECT MANAGER

Claude Farge
Special Thanks to
Stephane Decroix and
Thomas Belmont

EXECUTIVE PRODUCER

Pierre Szalowski

GAME DESIGNERS

Christophe Cavelan
Brahim El Belquasmi
Emmanuel Rougier
Fabrice Cuny

CAR BEHAVIOUR DESIGNERS

David Douillard
Christophe Gandon

2D ARTISTS

Alain Bernhard
Marc Chevalier
Stephane Huguet
Arnaud Cremet
Helene Maurel
Bertrand Fanonnel
Bruno Serre
Cyril Masquilliere
Emmanuel Ville
Vincent Gaigneux

3D ARTISTS

Olivier Conorton
Marc Pot
Christophe Faivre
Christophe Neverre
Michel Vibert
Renaud Person
Eric Prevost

Frederic Lefebvre
Sithik Tran

MENU INTEGRATION

Julien Lirochon

TECHNICAL PROJECT MANAGER

Lionel Bouchet
Sebastien Serrano
and
Fabien Fumeron

DEVELOPERS

Sylvain Glaize
Frederic Decreaux
Olivier Pesle
Laurent Halter
Francis Jentey
and
Frank Delattre
Jerome Liard
Louis Choquet
Jerome Hubert
Benoit Javet
Dominique Duvivier
Stephane Lavergne
Wilfried Mallet
Olivier Munier
Norbert Redon

SOUND PRODUCTION MANAGER

Sylvain Brunet

PRODUCTION ASSISTANT

Joelle Caroline

SOUND PROGRAMMING

Cedric Morel-Francoz

SOUND EFFECT

Guillaume Billaux

MUSIC

Daniel Masson
POST-PRODUCTION
Myriam Houee

INTRO SCENE

FINAL SEQUENCES

Xavier Le Dantec
Guillaume Marcel
Olivier Bonenfant
Charles Beirmaert

TEST MANAGER

Jerome Antona
Nikola Milisavljevic
Alain Bouliane
Eric Tremblay
Daniel Germain
Cedric Altes
and the Canadian team

WORLDWIDE STUDIO MANAGERS

Eric Huynh
Dominique Bordenave
Cyril Derouineau
Serge Hascoet
Christine Chosson
Alexis Nolent

LOCAL STUDIO MAN- AGERS

Fabien Fumeron
Gilles Vanvallegheem
Sandrine Maigret
Ahmed Boukhefifa
David Reizer

PRODUCER

Gérard Guillemot

INTERNATIONAL MAR- KETING

Aurélia Barth

ARTWORK DESIGNER

Ludi Factory Studio

PHOTOGRAPHY

Bryn Williams

MediaSpart Licensing
Sponsoring

North American

Marketing Manager

Dennis Roy

Package Design

Mari Sakai,
Gregory Harsh

Public Relations

Sandra Yee, Melanie
Melton

Special Thanks to

Laurent Detoc, David
Bamberger, Carrie Tice,
Megan Byrne, Libby
Brown, Tats Myoyo, Jen
Groeling, Lisa Hootnick,
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