

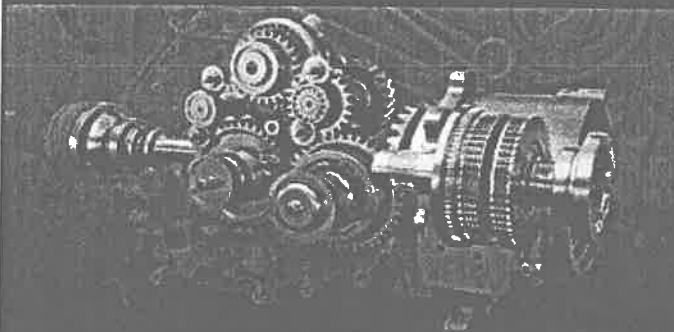
4RM



The 4RM is an entirely new system that transmits torque to all four wheels of the car. A Ferrari patent, it is the main innovation sported by the new FF. Unlike a conventional four-wheel drive system fitted to a front-engined car, it allows the retention of the traditional mid-front engine architecture, with rear transaxle connected to the engine by a single driveshaft. Added to this is the new Power Transfer Unit or PTU for the front wheels, which is connected directly to the engine and located over the front axle.

This layout permits:
- a 50% saving in weight compared to a traditional four-wheel drive system. This greatly benefits the FF's weight-to-power ratio and thus its performance;

- a low centre of gravity to be maintained and the retention of Ferrari's sports car weight distribution with more than 50% of weight over the rear axle despite it being a front-engined car.

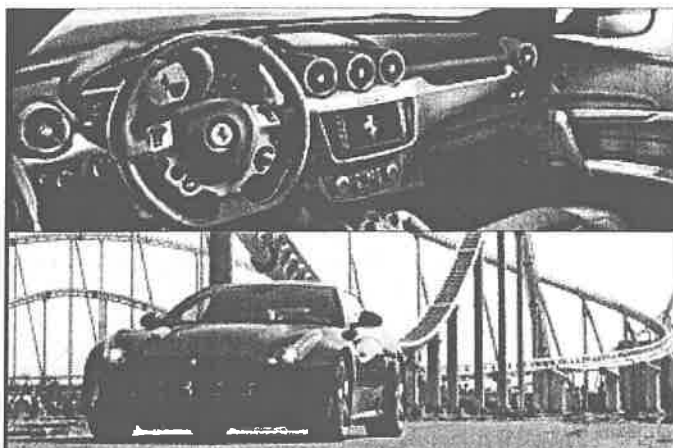


The PTU is the main mechanical component of the 4RM and manages the difference between the engine and wheel speeds. It also controls the amount of torque sent to the front wheels in general and distributes it between left and right as required. The PTU gets its power and torque directly from the crankshaft through a system of gearbox ratios. Two independent carbon-fibre oil-bath wet multi-plate clutch packs then vector the torque to a half-shaft connected to each front wheel. Thus, there is no mechanical connection between rear and front axles as they are linked to two completely independent traction systems. This means the FF can be rear-wheel drive-only so that none of the exhilarating driving pleasure associated with this kind of car is lost.

Lastly, the multi-disc clutches also deal with the different speeds of rotation between the front and rear axles, and between the individual front wheels, fulfilling the function of the centre and front differentials in a traditional 4WD system. Furthermore, the front clutches are completely independent and have torque vectoring functions to allow different amounts of torque to be sent to the left and right wheels. The amount of torque transmitted is controlled by closing the disc packs in the individual clutches. The PTU is also very compact (barely 170 mm long) and extremely light with the result that the 4RM weighs 50% less than a conventional 4WD system.

The hydraulic gear and clutch actuation system is integrated into the PTU, as with the F1 Dual Clutch gearbox, and this delivers absolutely blistering gear-shifting times and thus improved system responsiveness.

Technical specifications



Dimensions and Weight

Length

193.2 in (4907 mm)

Width

76.9 in (1953 mm)

Height

54.3 in (1379 mm)

Wheelbase

117.7 in (2990 mm)

Front track

66.0 in (1676 mm)

Rear track

65.4 in (1660 mm)

Kerb weight*

4145 lb (1880 kg)

Dry weight*

3946 lb (1790 kg)

Weight distribution

47% front - 53% rear

Boot capacity

15.9 cu ft (450 l)

Fuel tank capacity

24 US gal - 20 UK gal (91 litri)

Tyres and rims

Front

245/35 ZR 20 8.5 J x 20"

Rear

295/35 ZR 20 10.5 J x 20"

Rear Winter

285/35 ZR20 10.5 J x 20"

Brakes

Front

15.7 x 1.5 in (398 mm x 38 mm)

Rear

14.2 x 1.26 in (360 mm x 32 mm)

Engine

Type

V12 - 65°

Total displacement

382.13 cu in (6262 cc)

Bore and Stroke

3.70 x 2.96 in (94 mm x 75,2 mm)

Maximum Power**

486 kW - 660 CV at 8.000 rpm

Maximum Torque

683 Nm - 504 lbft(70 kg)m at 6.000 rpm

Specific Output

77 kW/litre - 105 CV/litre

Maximum revs per minute

8000 rpm

Compression ratio

12.3:1

Performances

Maximum speed

208 mph (335 km/h)

0-62 mph (0-100 km/h)

3.7 sec

0-124 mph (0-200 km/h)

11 sec

0-62 mph (0-100 km/h)

114.8 ft (35 m)

Dry weight/power ratio

2.7 kg/CV

Fuel consumption / CO2 emissions (ECE+EUDC)***

Fuel consumption (european market version)

15.4 l/100km

CO2 Emission (european market version)

360 g/km

Transmission and gearbox

4RM

7-speed F1 Dual-Clutch gearbox

Electronic controls

4RM control (integration of F1-Trac, Ediff and PTU controls)

ABS/EBD

ESC

Suspensions

SCM3 (third generation of magnetorheological suspension control)

Note

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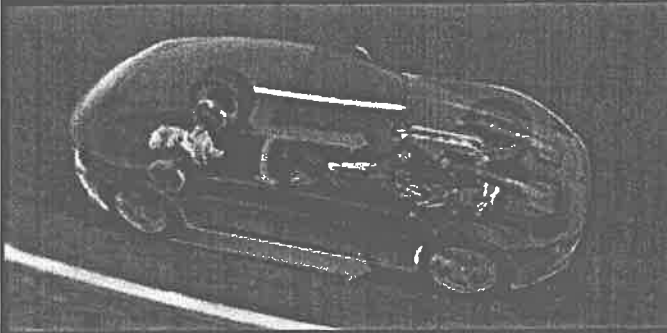
European market version

**

Engine power is expressed in kW, in accordance with the International System of Units (SI) and in CV for reasons of homogeneity. The horse power (hp) can be calculated as follows: 1

Combined cycle with HELE system (ECE+EUDC)

Dynamic Controls



Dynamic vehicle control is managed first and foremost by the Evolved GT Manettino on the F1-derived steering wheel. It has five settings: ESC OFF, which disables all traction and stability control systems; SPORT, to enhance driving pleasure in high grip situations; COMFORT, for maximum stability and ease of use in high grip situations; WET and ICE-SNOW, with electronic controls specifically calibrated for maximum stability and ease of use in low and very low grip conditions.

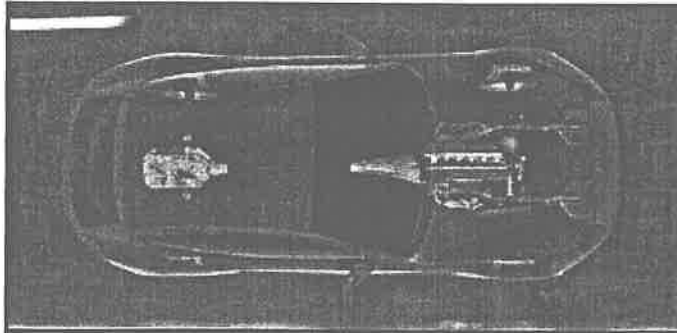
The Evolved GT Manettino also controls the SCM3, the third generation of the Ferrari Magnetorheological Suspension System. The latter uses a fluid the viscosity of which is altered by an electronically-controlled magnetic field generated inside the damper. Control software adjusts the intensity of the magnetic field every millisecond. Thanks to the SCM3, damping is now five times faster than with conventional shock absorbers. The FF also has ABS/EBD, the anti-lock braking system which intervenes individually on all four wheels. The ESC (Electronic Stability Control) also intervenes during braking on all four wheels independently. The E-Diff, on the other hand, distributes torque to both of the rear wheels while the race-derived F1-Trac traction control system manages the torque to the rear axle. Lastly, the 4RM Control integrates the F1 Trac + E-Diff + PTU control functions, and manages both traction and stability by distributing exactly the right amount of torque to each of the four wheels, thanks to seamless integration of all the systems. The predictive software logic that underpins the 4RM Control estimates grip. For the first time on the FF, it covers all possible driving conditions from ice to dry track surfaces. Grip estimation was first used in motor racing and then developed for road cars. It also underpins the F1-Trac system and allows the FF to instantly and accurately estimate the maximum amount of torque that each wheel can transmit to the road without wheel spin occurring. What this means in practice is that 4RM Control always guarantees maximum traction regardless of the road conditions, because it independently distributes the maximum amount of torque that can be transmitted to each individual wheel.

The 4RM Control works on the principle that torque is only sent to the front axle when absolutely necessary i.e. when the driver needs more torque than the rear axle can deliver in a given grip situation. When the driver requires less torque than the maximum amount transferable by the rear wheels in a specific grip condition, then traction is controlled by the F1-Trac but on the rear wheels only. The E-Diff then works to ensure the optimal distribution of the torque to the rear wheels in the various situations that can arise, such as a partial locking of the differential coming out of bends (as is already the case with the 458 Italia). When the driver needs more torque than the rear axle can deliver, the extra torque is transferred by the 4RM Control to the front axle via the PTU. The 4RM Control actually distributes the torque completely independently to the front right and left wheels.

This means that drive only goes to the front wheels when the FF's weight distribution combined with the F1-Trac and E-Diff controls alone aren't enough to transfer the amount of torque required by the driver to the road, i.e. in all low and very low grip conditions in which the driver still demands performance driving from the car. The 4RM Control features multiple logics specifically developed for the various low and very low grip conditions the FF may be faced with.

When accelerating out of bends in low grip conditions, the F1-Trac, E-Diff and PTU work together to distribute maximum torque to each individual wheel for optimum performance. However, torque is transmitted to the front wheels only in a balanced, progressive way to guarantee maximum stability.

The system can also recognise under- and oversteer situations and variations in grip. It instantly corrects them by modifying the amount of torque transmitted to each wheel. Once again, this guarantees maximum stability.



The 4RM Control also has a specific high-performance start logic optimised for low and very low grip surfaces integrated into the Performance Launch feature active in all Manettino positions. This recognises the amount of grip available to each individual wheel and then sends the maximum amount of torque it can to the road without causing wheel spin. The result is that the car can achieve smooth maximum longitudinal acceleration in all grip conditions without wheel spin. This is very different to conventional 4WD systems in which wheel spin during standing starts is controlled by the ASR and/or by locking the differentials.

Thus, the 4RM Control redistributes torque to the wheels but doesn't act as a brake as it does with systems used by our competitors. The result is that performance is still optimised in all grip conditions and traction is maximised to the benefit of longitudinal acceleration. This translates into improved stability, handling and control on the limit as well as superb high-performance starts from a standstill even on snow-covered inclines.

Braking is perfectly controlled too, by the Ferrari Pre-Fill logic which activates the pistons in the calipers when the driver takes his foot off the accelerator pedal, helping to reduce response times. The result: shorter stopping distances, better pedal feel, less drag and lower fuel consumption. The FF's new suspension features traditional double wishbones at the front (with lower L arm) and a redesigned multi-link system at the rear. This boosts transverse and vertical rigidity by 20 per cent. It also enhances handling and that sporty driving feeling, thanks to extremely fast response times, a more direct steering ratio (-20 per cent) and absolutely minimal body roll. Longitudinal flexibility has been tripled too, resulting in lower suspension noise and even more efficient absorption of bumps and asperities.

The FF is also the first car in the Ferrari range to sport third generation Brembo carbon-ceramic material (CCM) brakes. The principal innovation here is the new material used for the pads which has allowed disc dimensions to be reduced by 10 per cent, despite the fact that braking performance has not just been maintained, but improved upon. This is courtesy of a higher and more stable coefficient of friction between caliper and disc, and greater stress-resistance. All of this translates into lighter weight with the same impressive, fade-free performance, lower maintenance costs, and shorter stopping distances. The brake pads now also last seven to eight times longer than those of the previous generation which means that they will probably never need to be replaced in the car's lifetime under normal conditions.

- 2012 Ferrari FF Picture

All roads, all-out, all year: You'll never have to consult the weather forecast before heading out in this Ferrari. | March 23, 2011 | Ferrari of North America

75 Photos

All Roads, All-Out, All Year

Published: 06/09/2011 - by [Dan Edmunds](#), Director of Vehicle Testing

It's Sunday afternoon, and our last glimpse of Venice came in our rearview mirror an hour ago. We're barreling north into Italy's Dolomite mountains to sample the 2012 Ferrari FF while a conga line of restless Italians inches south in the opposing lanes, their ski weekend over as they head home.

They're piloting various crossovers, some Range Rovers and a surprising number of Audi Quattro wagons and sedans. After awhile we realize we've driven for hours — in Italy — without seeing a single well-heeled Italian in a Ferrari of any description.

No surprise, really. The sun is out now, but fresh snow fell here over the last few days. And with their high horsepower and rear-wheel drive, Ferraris are environmentally constrained three-season cars, sunbelt cars. Ferrari thinks that's a deal killer for some potential Ferraristas.

The 2012 Ferrari FF is slated to address that problem via an ingenious "4RM" four-wheel-drive system that's coupled with hyper-advanced traction management. In the words of Ferrari engineering boss Roberto Fedeli, the FF is intended for "every day, every condition."

Blank Sheet

The 2012 Ferrari FF began as a thought experiment as Ferrari sought to replace the [612 Scaglietti](#), Ferrari's more traditionally laid-out V12-powered 2+2 coupe with pretend rear seats.

Mr. Fedeli, who could easily pass for Jon Stewart's quieter brother, tells us the new machine would have to meet the every day, every condition requirement, "without changing the weight of the car, without changing the size of the car."

So the brand-new FF weighs just 13 pounds more than the retiring Scaglietti (4,147 vs. 4,134 pounds) and its 193.2-inch length exceeds that of the 612 by a scant 0.2 inch. Their overall widths come within a tenth of an inch of one another.

Its four-passenger seating configuration does raise the roof by 1.4 inches, but the FF still stands 1.5 inches shorter than a [Porsche Panamera](#).

Slipping Behind the Wheel

Our 6-foot 2-inch frame slips easily into the driver seat, where the view is all business. The steering wheel has progressive shift lights built into its upper rim. Two prominent fixed-position shift paddles sprout from the column behind — no other stalks or levers are to be seen.

That's because the controls for the headlights, turn signals and wipers have been moved onto the steering wheel to keep those paddles close at hand. The familiar rotary "manettino" switch dominates the lower right quadrant, but in the FF it has five positions instead of the usual three. Settings for Snow and Wet have been added alongside Comfort, Sport and Track.

Another button controls the damping range of the Magna-Ride magnetorheological shock absorbers. Nominally, these continuously variable suspension dampers operate in a normal range when the Manettino is set to Snow, Wet or Comfort, and they stiffen when it's set to Sport or Track. The button allows the driver to override the stiff program in Sport or Track if the road or racetrack isn't particularly smooth.

There's one more very important button on the wheel. It's big and it's red, but we push it anyway. The 6.3-liter V12 barks to life and settles into an expectant idle. We select 1st with the right-hand shift paddle and we're off.

F140 EB

That's the code name for the FF's all-new 6.3-liter V12 engine. The FF wouldn't qualify as a

suitable 612 replacement unless it was also quicker and more powerful. The F140 EB delivers with 651 horsepower and 504 pound-feet of torque, a massive infusion of 119 more vigorously prancing horses and 70 additional lb-ft of torque than found in the Scaglietti.

Direct-injection (DI) is a big reason for this, as it allows the compression ratio to climb to a healthy 12.3:1 while delivering rated power on 91-octane super unleaded. Continuously variable intake and exhaust cam timing plays a big role, too, especially when it comes to torque. Fully 80 percent of peak torque, some 403 lb-ft of it, is available with only 1,750 rpm showing on the tach.

Myriad exotic coatings and other friction-reducing strategies operate invisibly, the most interesting of which may be the reed valves in the dry-sump oil pan that create negative pressure to help "pull" the pistons down. Multiply that by a dozen other little tricks and you get the big gains of the F140 EB.

On the Move

Our massively propulsed FF responds like a much lighter car, as there's plenty of torque for even the tightest uphill hairpins. The FF leaps from one end of its tach to the other just as quickly as it shoots from one tight corner to the next. A new multilink rear suspension maintains a firm, well-behaved footing throughout. Revised third-generation carbon-ceramic brakes offer immediate response and impeccable feel.

All the while the wailing V12 echoes eerily off the stone retaining walls, turning the heads of nearby skiers as we rapidly bang through the short-spaced gears of the new seven-speed dual-clutch automated manual transmission. It's a beefed-up version of the rear-mounted seven-cog transaxle found in the 458, making the FF the first ever V12 Ferrari with this many ratios.

But we're not bemoaning the lack of a third pedal here, not at all. This is one of the few AMTs that's actually riveting to drive. Shifts are crisp and fast, the software never balks at giving us a downshift at high revs and those shift levers are always close at hand.

A quick 11.5:1 steering ratio helps, too, as few of our steering inputs are ever large enough to lose track of those shift paddles. The 2012 Ferrari FF responds with the directness and precision of a two-seater, even though we're currently flogging this mostly clear asphalt road on winter tires.

You read that right — winter tires.

4RM Factor

It's probably time to mention that the name FF stands for Ferrari Four. The second F stands for one of two things: four seats or four-wheel drive. But the so-called 4RM part-time four-wheel-drive system is like no other.

It's easiest to start by thinking of the FF as a typical rear-drive Ferrari. A seven-speed transaxle feeds engine torque to the rear tires through an electronically controlled E-diff that uses a pair of wet clutch packs to shunt power right or left depending on which tire has more traction at any given instant.

4RM builds on that at the front end, but there is no transfer case to send power to the front wheels via a second driveshaft. That would be heavy; that would eat into interior room. That would negate the design goals of the FF.

Instead there's a second smaller gearbox on the front end of the engine that's driven directly off the nose of the crankshaft. As with the E-diff in the back, two wet clutch packs vector the torque left or right. But here, by working together, they can also feather the total amount of torque sent to the front wheels, and that's why there are only two forward gear ratios up front.

Gear one operates when the rear transaxle is in 1st or 2nd. The clutches slip and deliver partial torque in 1st and firm up considerably in 2nd. Gear two operates the same way when the rear transaxle is in 3rd and 4th. The 4RM shifts to neutral and departs the scene in gears five through seven, at which time the FF is a pure rear-drive machine.

A central computer oversees it all, controlling the E-diff and the 4RM clutches to continuously ration torque among all four tires at any given moment, using highly accurate wheel speed sensors to make rapid-fire adjustments that are less perceptible than wheelspin would otherwise be.

Snow Kidding

This is where the snow tires come in, as Ferrari has prepared a mountaintop handling course of pure packed snow for us to play in. The 4RM system and the E-diff are hooked into the Manettino and its five settings.

Each of the five switch positions allows a different degree of tire slippage. In the Snow position, the FF navigates the course with no slip, no drama. It easily starts from rest on an uphill slope with no detectable wheelspin. Engine output is being managed throughout, but we're barely aware of it. Anyone could drive this.

Each position up from there allows a higher degree of wheel slip, vehicle speed and, if you're up for it, slip angles. We ratchet up through to the Sport setting, position four, at which point the system allows us to drift through corners, rally-style, at something like 45 degrees. We have to countersteer and work it, but the FF drifts right where we're aiming.

We get the point. With 4RM, Ferrari really has added something to the automotive engineering landscape. This is new. This is different. This really works. As long as the snow isn't too deep, you can drive this V12 Ferrari all year 'round.

Actually, Ferrari has an answer to that, too, in the form of an optional hydraulic lift system that raises the front and rear spring seats to gain 1.6 inches of additional ground clearance at the touch of a button.

Loose Ends

Ferrari says the FF will accelerate from zero to 62 mph (100 km/h) in 3.7 seconds. We're in no position to doubt that here, but it'll be some months before we can measure a U.S. model on our own track on summer tires. For reference, the same "they say" scale says the 612 Scaglietti is good for 4.0 seconds.

And we can't comment on the feel of the car on the standard 245/35ZR20 and 295/35ZR20 summer tires. We didn't feel put out by squishier winter tires that were 10mm skinnier, so we're not worried. It won't suck.

The least impressive aspect of the car is probably the navigation system, which stands out in an otherwise well-trimmed interior because it's the same one found in our departed Dodge Ram 1500 long-term test truck. Sure, it brings Bluetooth streaming and iPod compatibility to the party, but the parts-bin nature of the thing is off-putting and it frequently lost its way, and ours, in the Dolomites.

In our mind the two-box GT styling looks fantastic. The only thing we notice from the driver seat is improved rear visibility over that of a standard coupe. Rear-seat passenger room is tight, though. With the driver seat adjusted to our liking, the seat behind it is only comfortable for an average size adult at most. Front and rear passengers will have to pair themselves off by height.

The Case for Lottery Tickets

No official pricing is available, but various hints pointed to a base price in the neighborhood of \$300,000. That's a bit surreal, but based on what the 2012 Ferrari FF can do and what it is, this is entirely reasonable and consistent within the Ferrari context.

But suggested prices may not matter because we're hearing the FF is already sold out for the first two years before anyone has read driving impressions like these. Perhaps the FF's four-place, four-wheel-drive concept is resonating strongly enough on its own.

From where we've just sat, however, we fully expect to hear reports of Ferrari FFs headed into the Dolomites with ski racks on top next year. Aspen, Vail, Lake Tahoe — prepare to see your first Ferraris out and about in the dead of winter on a sloppy day.

Edmunds attended a manufacturer-sponsored press event to facilitate this report.

Perhaps you've seen Ferrari's zoomy video depicting the 4RM all wheel-drive system in the 2012 Ferrari FF, but felt it was lacking in specifics.

You're not alone. In order to better understand the nuances of 4RM, Ferrari's first production AWD system, we sat down with Ferrari technical director Roberto Fedeli who explained the gory details of the company's twin-gearbox, nine-speed all wheel-drive system.

No doubt, an all wheel-drive Ferrari is a puzzling -- some might say sacrilegious -- concept to the Tifosi.

It's perhaps no surprise that the company's first foray into four driven wheels was carefully considered. If you can remember the terminal understeer present in the first AWD Porsche 911, the late-'80s 964 Carrera 4, then you understand the concern.

Philosophically, Ferrari's 4RM system in the FF is more of a traction aid than a handling aid. Fedeli explains, "We don't want to use the four wheel drive in order to enhance the performance in the dry because we think that the best solution for the sporty car is to have all the torque at the rear."

Mostly Rear Wheel-Drive

The amount of torque you're trying to transmit directly dictates the size of the bits needed to transmit it, and in the FF the front wheels receive a maximum of just 20% of the engine's torque. The mild torque split is borne out by the puny diameters of the front driveshafts compared to the monstrous ones out back.

That the requirement of relatively low torque-handling resulted in relatively small and light front-drive bits was just the beginning. Ferrari located the engine completely aft of the front axle line which presented an opportunity to get nutty with the AWD layout.

Were the FF to employ a traditional AWD system, power would flow down the driveshaft to the rear-mounted transaxle and on to a center differential, from which a second driveshaft would then redirect power to the front differential and then on to the front wheels.

This is a needlessly heavy -- and space-robbing -- layout when you're only trying to send a maximum of 20% of the total torque to the front wheels. "We don't want another driveshaft between the gearbox and front axle because this means weight and space. Space means, again, weight, and if you don't want to lose the space inside you have to make the car bigger and bigger," says Fedeli.

Instead, the FF's front wheel-drive equipment is completely divorced from the main gearbox. A familiar rear-mounted seven-speed transaxle handles the power to the rear wheels, while a second gearbox with two forward speeds (plus a reversing mechanism) manages the power to the front wheels.

Gearboxes Front And Rear

Yes, the FF has two gearboxes. The front gearbox is driven off the nose of the crankshaft

and the entire unit is largely integrated into the engine block. According to Fedeli, the front power take-off hardware weighs "35-40 kg [77-88 pounds], while saving the same amount of kilos compared to a traditional [AWD] solution."

Power for the front wheels is thus taken directly from the crankshaft, through one of the two gearbox ratios and then on to two electronically-controlled wet clutch packs, each of which can vector torque to a halfshaft connected to the front wheels. There is no center differential.

The two ratios in the front gearbox work like this -- the first ratio is used when first or second gear is selected in the main gearbox. The second cog up front is selected when the main gearbox is in 3rd or 4th gear.

When the main gearbox is in fifth, sixth or seventh, no power flows to the FF's front wheels since the car is not traction-limited in such high gears. Fedeli elaborates, "In 5th gear, all the torque that our engine is able to give us we can transmit only on the rear axle. In all conditions, also in snow when the surface is 0.3, 0.2 mu, we only need the rear axle in order to transmit all the torque."

Due to the nature of gearing and the desire to vector torque variously to the front wheels, it is imperative that the front gearbox ratio always be taller than the corresponding ratio engaged in the rear gearbox.

First gear in the front 'box is some 6% taller than second gear in the main gearbox. Second gear in the front gearbox, too, is 6% taller than fourth. The mismatched front-rear drive ratios require that the front clutch packs always operate with some slippage in order for the front and rear wheelspeeds to match.

Most of the time the FF will behave like a conventional rear-drive car. When there's plenty of traction present, the front clutches will be open, transmitting zero torque to the front wheels. Predictive algorithms derived from throttle position, steering angle, yaw and wheelspeed sensors allow the ECU to close the clutches to vector torque to the front wheels as needed.

This "on-demand" strategy avoids constant slippage of the carbon fiber-lined clutch packs. Still, the system is said to be able to withstand hard use, as the heat liberated in the clutch packs is dissipated by an independent fluid cooling system.

In-House Brainchild

So, Ferrari just licensed this clever AWD concept from a supplier, right? No. The 4RM system was developed and patented by Ferrari, and the various gears and bits are manufactured by Italian supplier Carraro.

In terms of performance, 4RM indeed improves launch performance, although Fedeli stresses "this is not the main goal of this system." The FF hits 100 kph (62 mph) in 3.7 seconds and would be "two or three tenths" slower without AWD.

We'll be driving the FF in the coming weeks, where we'll hopefully address the pressing question of what burnouts look like in an AWD Ferrari.

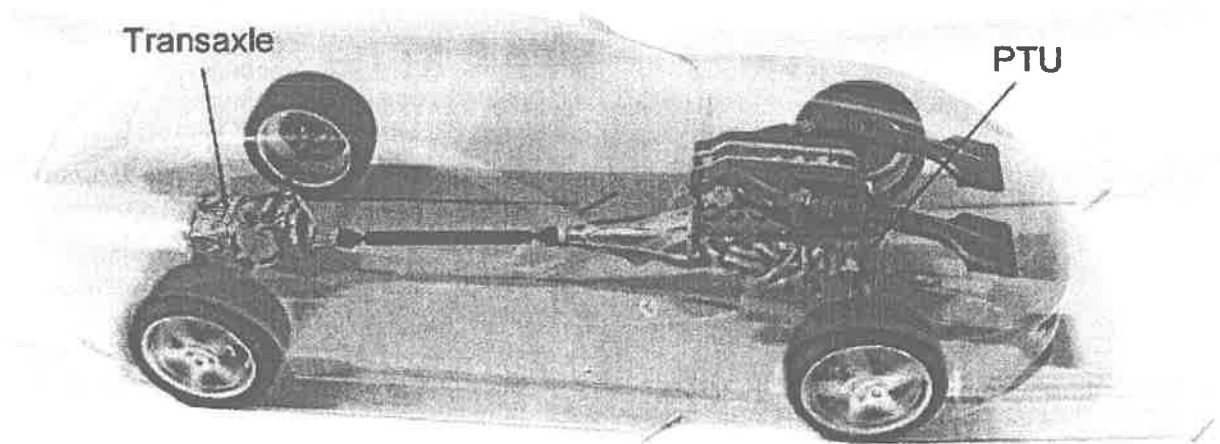
--Jason Kavanagh, Engineering Editor

Different types of 4WD (Cont'l)

5) Part-time slipping transfer case - Ferrari 4RM

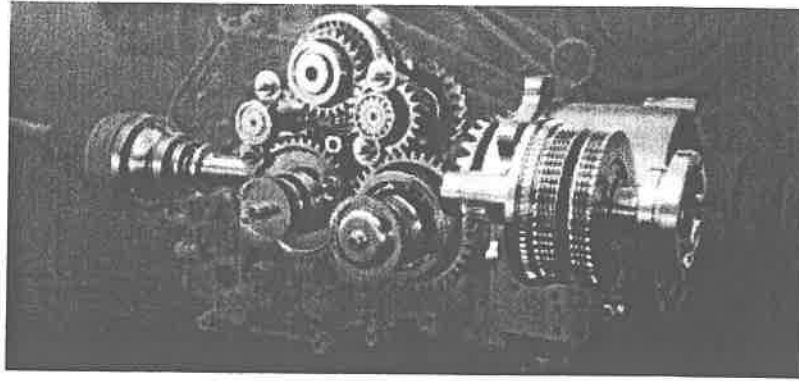
Ferrari has long been refusing to adopt 4-wheel drive. To Maranello, conventional 4WD systems are just too heavy and bulky for its cars. They would benefit roadholding in rare occasions like running on snowy or wet roads, while most other time the extra weight and size would only worsen performance. Without deviating from its philosophy, Ferrari developed a very special kind of 4WD system called "4RM" in 2011. The technology was first fitted to its new 4-seater GT, FF.

The 4RM is a niche design for Ferrari's GT cars. It is built upon Ferrari's traditional FR architecture with a front-mid-mounted engine and a rear-mounted transaxle. The engine must be positioned completely behind the front axle line, something very few cars other than Ferrari can achieve.



4RM system on Ferrari FF

The rear wheels get power just like a conventional FR car. What makes it special is the front-drive hardware. A PTU (Power Transfer Unit) is added just in front of the engine, taking power directly from crankshaft to supply the front wheels. This means the crankshaft has output at both ends, one goes to the rear transaxle and another goes to the front PTU. The PTU contains a gear set and two wet multi-plate clutches. Each clutch is responsible for engaging a front wheel. By applying hydraulic pressure on those clutches, PTU can alter the amount of torque transferred to individual front wheels. This means it achieves not only 4-wheel drive but also torque vectoring !



PTU

But what's the purpose of the gear set in PTU? It offers two gear ratios (plus a reverse), so you can see it as a 2-speed gearbox. Now you may question how the speed of front wheels can match those at the rear, which is driven by a 7-speed gearbox. The answer is: they don't match. The gear ratios in PTU are chosen such that the front wheels always spin faster than the rear if the car is lifted up in the air. On the road, this mismatch will force the clutches in PTU to slip all the time. This situation is similar to the PSK system used in Porsche 959 - that car employed front tires slightly larger than the rears, so the multi-plate clutch in its transfer case was always slipping. The case in Ferrari 4RM is far more severe due to the different gearing front and rear. This put its durability into big question.

Never mind. The 4RM is not supposed to be a permanent 4WD system. Ferrari wants to preserve the rear-drive characteristic of its cars as far as possible, thus it needs drive to the front wheels only at extreme moments, e.g. when the car is slipping in hard cornering, or running on slippery surfaces. Therefore it does not need to engage the front wheels all the time. Thanks to modern computer power, the 4RM's control module can engage/disengage the front wheels in a fraction of a second, and for multiple times in a second. Those short moments are already sufficient to put the car back on course. Moreover, the PTU takes at most only 20 percent of the engine torque, so there is no worry of overheating and overstressing it. Of course, one precondition is the gearing difference shall not be too big. That's why Ferrari gives the PTU two forward gears, with the lower gear serving the main gearbox's 1st and 2nd, and the higher gear serving 3rd and 4th. Above 4th, Ferrari considers the car should not be struggling for traction, so the PTU is disengaged, leaving the car to run by rear wheels.

The simplicity of 4RM means it has the advantages of lightweight and compact size. The PTU and its associated hardware on Ferrari FF weighs only 45kg, about half the weight of a conventional 4WD system. Compare with other 4WD systems working with front engine and rear-mounted gearbox, such as Nissan GT-R's, its weight and space efficiency are even more obvious. Moreover, it keeps the low center of gravity of FR cars, because the PTU takes power directly from the engine, saving the need to put an additional drive shaft underneath the engine.

Advantage: Light, compact, low center of gravity.

Disadvantage: Part time only, limited torque to front wheels, packaging requirement: engine must sit completely behind the front axle.

Who use it ? Ferrari FF