FZR 1000

THE 1989 YAMAHA FZR1000 - SECOND GENERATION GENESIS

The dictionary defines genesis as "development into being by growth or evolution" - which perfectly describes Yamaha's Concept that led to the award-winning FZ and FZR models and the race-winning YZF which swept to victory in the last two successive Suzuka Eight Hours Races.

The "Genesis" concept as stated by Yamaha was the parallel development of engine and chassis design. each playing its part in making the other more effective. lt was evolved by engineers who realised that building a good engine and a good chassis did not necessarily mean a good motorcycle unless the two were in technical harmony with one another.
That "development by growth or evolution" continues with the 1989 Yamaha FZR 1000 updated and uprated by lessons learned on the racetrack with the YZF.

Featuring a new Deltabox frame, shorter and more compact dimensions, the remarkable EXUP exhaust power control system and improved engine design and performance, the latest evolution of the FZR1000 is the most balanced performer in the sportbike world.

The original FZR 1000 won "Machine of the Year" awards from magazine readers around the world as soon as it was announced. Yamaha are confident that this "second generation Genesis" will be equally well received. After all, it's the only sensible choice for those who demand the very best.

TECHNICAL HI~HLIGHTS

- 1OO2cc, 4-stroke, 5-vaive, DOHC engine with liquid cooling
- EXUP exhaust control system
- FAI-air intake system
- Transistor-controlled digital ignition
- New aluminium Deltabox frame with increased rigidity
- Preload adjustable front fork with rigid 43mm stanchions
- Rising-rate Monocross rear Suspension with damping- and preload-adjustable shock absorber with reservoir
- Aluminium Deltabox swingarm with YZF-type chain pullers
- Hollow-spoke alloy wheels with wide radial tyres
- Dual 320mm front disc brakes with 4-pot opposed-piston callipers using different sized pistons
- 267mm rear disc brake

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ENGINE

With its brilliant 5-valve cylinder head, slant block and efficient intake and exhaust systems. the FZR 1000 engine has an established place in motorcycling history. For 1989 it has been improved even further.

A brief summary of the new engine's features are: a higher redline thanks to a lighter valve train, more displacement (1002 cc). a higher compression ratio and redesigned combustion chamber with straighter intake ports. bigger carburettors, a reduction in frictional losses with thinner rings, and the addition of the remarkable EXUP exhaust control system. Now let's take a look at the details.

The new engine has been shortened by 8mm. This was accomplished by shortening the length of the valves and lifters and using a new camshaft case. The shorter valve stem length also allowed for a slight increase in valve angle. The middle intake valve angle has increased from 9 degrees to 10.5 degrees, the outer intakes from 17 to 18.5 degrees, and the exhausts from 13 to 13.5 degrees. These more idealized angles and the complementary improvements to port shapes increase engine efficiency for higher power output. Other changes to the valve train include exhaust lifters increased in diameter from 20mm to 22.5mm for improved reliability, and an overall reduction in valve weight, thanks to shorter sterns and a reduction in stern diameter from 5mm to 4.5mm. This lighter valve train, combined with stiffer valve springs, permits a 500 mm higher redline and, consequently, more top-end power. Valve head diameter remains unchanged.

An increase in bore from 75rnm to 75.Smm brings displacement up from 989cc to 1002cc. Combined with reshaped combustion chamber and ports and slightly less dished pistons, this raises the compression ratio from 11.2: 1 to 12:1. The result is increased power and torque throughout the mm range and improved engine efficiency.

The shape of the intake tracts has also been changed. Short and straight, they allow for smoother air flow and increased intake performance. A change in carburettors from Mikuni BDS37 to BDST38 improves breathing even further. In addition to offering more venturi area and a rounder venturi cross section, the venturi itself is much straighter and shaped like an air funnel. These changes greatly reduce flow resistance for improved efficiency and more power. Throttle response is also better. And to make sure these bigger carbs get plenty of fuel regardless of engine bad, fuel pump capacity has also been increased.

Moving further down, we find new pistons and rings. While the top ring remains unchanged, the second ring has been thinned from 1mm to 0.8mm, and the oil ring from 2mm to 1.5mm. The result, when multiplied by four, is a significant reduction in frictional losses and consequent gain in engine output.

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The connecting rods have also been changed to reduce friction and the resulting power loss. By increasing the diameter of the piston pin from 18mm to 19mm, rotating frictional loss has been reduced. This reduction in friction also means increased reliability at the piston pin. In this way, many small improvements can add up to big gains in power and reliability. Power was also found by increasing the air cleaner volume from 7.1 liter to 8.1 liter for improved engine breathing.

To better control temperatures in this more powerful engine, radiator capacity is increased from 17,000 cal to 21,000 cab. This prevents overheating during sustained periods of high-rpm, high-load operation.
Even the transmission benefits from detail improvements. By using counter-tapered (back-cut) engagement dogs on the gears, gear engagement is much more positive and transmission reliability is increased to cope with the increase in power.
In summation, virtually every area of the FZR 1000 engine has been improved. More powerful and more reliable, it is also more compact and more refined. It's the second generation

EXUP (Exhaust Ultimate Powervalve)

One of the most significant features on the new FZR1000 is the EXUP exhaust control system. Another Yamaha invention; in principle it is much like the YPVS system which improves 2-stroke engine performance by changing exhaust tuning in response to changes in engine mm.

As more horsepower is designed into production engines, the smooth powerband so desirable for the street is replaced by the "peaky", lumpy power curve of the racing engine. Especially pronounced with high-performance, 4-into- 1 exhausts, this results in a fiat spot at about two-thirds of peak-torque mm and a rough idle.

Technically speaking, when the exhaust valve opens, residual combustion pressure in the cylinder rushes in to the exhaust pipe, creating a primary "positive" pressure wave moving towards to collector (muffler). Upon reaching the collector, it expands, sending a primary "negative" wave back toward the cylinder. The header continues to reverberate, alternating positive and negative. primary, secondary and tertiary.

Header pipe length is set so that the primary "negative" wave reaches the cylinder at valve overlap (the brief instant when both intake and exhaust valves are slightly open). This negative or "suction" wave does two things. It pulls residual exhaust gas out of the cylinder, and it starts the flow of fresh fuel/air mixture through the intake valve.

Unfortunately, because these positive and negative pressure waves move through the header pipes at uniform speed regardless of engine rpm, at lower rpm the primary "negative" wave arrives too soon (before overlap), and in its place a primary "positive" wave arrives at valve overlap. This positive wave forces exhaust gasses back into the cylinder, diluting the charge, and it blows back through the carburettor, delaying intake and causing double carburetion (carburetion in the wrong direction). This is what causes the dreaded race-engine flat spot.

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Prior to EXUP, the only way to smooth out power delivery was to sacrifice performance (less overlap, use of less resonant exhaust pipes, etc.).
Think of EXUP as an exhaust throttle. By placing a rotary valve driven by a microcomputer-controlled servomotor between the header pipes and the collector, Yamaha engineers were able to control the pressure waves. The Computer senses engine speed from the ignition. By choosing this valve progressively as rpm decreases, the harmful positive pressure wave is prevented from reaching the cylinder at valve overlap. Double carburetion is eliminated, torque rises back to a normal level and driveability is restored.

EXUP also reduces exhaust emissions at idle by producing back pressure that reduces boss of fresh charge through the exhaust. The idle is also smoother and steadier. And a new muffler has enlarged capacity to efficiently quiet the increased power.

Equipped with EXUP, the engine produces about 10% more top-end power than an engine without EXUP. Most importantly, driveability and throttle control are greatly improved in that critical upper portion of the power band. There is an astonishing 30 to 40% increase in bow- and mid-range torque and smoother acceleration. The idle is much smoother: 30 to 50% less fluctuation at idle mm. The exhaust note at idle is quieter. And, hydrocarbon emissions are reduced.

In short, riders enjoy the best of both worlds - high-performance power with street engine tractability. Another first from Yamaha.

NEW DELTABOX FRAME

The aluminium Deltabox frame is the most technically refined frame on the market. Light, rigid, and extremely resistant to flexing, its equal is found only on the YZR factory road racers where it was developed. A slightly modified version of this frame carried Eddie Lawson to his 500cc World Championships and Carlos Lavado to the 250cc World Championship. It makes a level of handling and control possible which has to be experienced to be believed.

For 1989 the FZR 1000 benefits from the next-generation Deltabox. Gone are the dual front down tubes of last year's frame. The engine now bolts directly to the frame at the cylinder head, at the top of the upper case and, like before, at the rear. By making the engine a stressed member (essentially, part **of** the frame) overall frame rigidity and stiffness are greatly increased.

This increase in frame rigidity translates into improved high-speed cornering performance. And, as the stopwatch so conclusively proves, when a frame is made stiffer, lap times go down. lt also permits a more compact design of the engine/frame combination.
This more compact design makes possible a shorter wheel-base - 10mm shorter, for a wheelbase of only 1 ,460mm. This shorter wheelbase and 26-degree fork angle improve responsiveness to turning inputs for accurate steering control.

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The new frame is complemented by a new Deltabox aluminium swingarm. Featuring a triangulated design for added strength, this new swingarm is strong, light and flex resistant. The results are improved rear wheel control and tracking. Rear wheel maintenance has also been improved with the use of YZF-type chain pullers.
In terms of appearances, both the frame and swingarm have been treated by a special "chemical polish" process for a better-booking finish.

In summation, the frame has undergone a similar transformation to the engine. lt is more compact, stronger and higher performing - the next generation.

SUSPENSION

To cope with the increased steering loads of the new frame and steering geometry, the front fork has also been strengthened. The stanchions of the telescopic fork have been increased in diameter from 41 mm to 43mm. This greatly reduces their tendency to flex under heavy braking and cornering loads. The result is more precise steering control. The fork is also adjustable for spring preload. Bolting to the stanchions are new aluminium handlebars. These beautifully crafted aluminium extrusions are something found usually only on racing machines.

The rear wheel is controlled by our famous rising-rate Monocross Suspension system. A direct descendent from our factory racers, it delivers progressively stiffer rear wheel damping as the Suspension compresses. For 1989 a modification to the linkage arms increases shock absorber stroke from 50mm to 70mm for improved shock action.
The hydraulic rear shock comes equipped with a separate reservoir for better cooling of the damping fluid and is adjustable for spring preload and damping.

WHEELS AND BRAKES

The most noticeable change in this department for 1989 is the change in rear wheel diameter from 4.50 x 18' to 5.50 x 17". This smaller diameter wheel and the use of very wide, bw profile radial tyres further improves cornering performance. The wheel design - lightweight. hollow-spoke, cast alloy - remains unchanged.

Unlike traditional bias ply tyres which use multi-directional fibres in the tyre casing. radial tyres use uni-directional fibres. This permits flexing of the tread and sidewall, allowing the tread to better conform to and grip the road surface better. Radial tyres also run cooler because uni-directional fibres build up less friction heat than bias-ply tyres when the tyre flexes. And cooler running means longer tyre life.

Dual 320mm front disc brakes feature 4-pot opposed-piston callipers using pistons of different sizes:
the top piston is larger than the bottom piston (33.96 and 30.23mm, respectively) for improved "feel". The same 267mm rear disc with dual-pot opposed-piston calliper is used at the rear wheel. Braking power is even more reliable, as befits a machine of this calibre.

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New for 1989 are larger diameter, hollow wheel axles and swingarm pivot. These axles permit an increase in strength without making them heavier. The front axle diameter has increased from 15 to l7mm, the rear from 17 to 2Omm, and the swingarm pivot from 16 to 2Omm. Both of these features come directly from the YZF racers.

FAIRING, FAI AND ELECTRICALS

The full fairing has also been redesigned for improved aerodynamic efficiency. The dual headlights are flush with the front cowling, and the degree of rearward slant of the cowling has been increased. The result is smoother, more efficient air penetration and a lower coefficient of drag.

The FAI (Fresh Air Intake) system routes cool, fresh air to the airbox via tubes running from openings at the front of the fairing. This fresh air improves engine performance because being cooler, it is also denser. Hence, cylinder filling is improved as more air per volume unit is sucked into the engine. For 1989 the ducts are straight, rather than curved for more direct routing of air.

With the addition of EXUP to the new FZR 1000, the transistor-controlled digital ignition and the control unit for the EXUP are integrated into one unit. This unit not only alters ignition timing in response to changes in mm for maximum performance at all power levels, it controls the amount of EXUP valve opening in the exhaust collector.

Another nice touch is the new electrically operated fuel reserve switch. Like that used on the FJ 1200, it allows the rider to switch over to reserve with a minimum of effort.

The instrument panel has also been redesigned for more compactness. Meter diameters are smaller, and the tach is located higher than the other instruments for quick reading.
And finally. the tail light assembly has also been redesigned for better looks

SUMMARY

As the FZR 1000 draws ever closer to the YZF factory racers in terms of performance, design and styling, we see a fulfilment of the Genesis concept.

The 1989 FZR 1000 is still very much the FZR 1000, knowledgeable sport riders and racers have come to love. But it is also considerably refined. Lt is faster, better handling and harder accelerating. In short, a balanced performer - balanced on the cutting edge of Sport bike technology.

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Technical Specification FZR 1000

Engine Type	Liquid cooled 4-stroke, DOHC, forward inclined parallel 4-cylinder
Displacement	1002 cc
Bore & stroke	75.5 x 56.0 mm
Compression ratio	12:1
Maximum power (DIN)	145 PS/100000r/min
Maximum torque (DIN)	10.9 kg-m/8500r/min
Starting System	Electric
Carburation	BDST38/4 MIKUNI
Lubrication	Wet sump
Transmission type	Constant mesh 5-speed
Primary reduction ratio	68/41(1 .659)
Secondary reduction ratio	47/17(2.765)
Clutch type	Wet, multiple-disc
Gear ratio ist	36/14(2.571)
Gear ratio 2nd	32/18(1 .778)
Gear ratio 3rd	29/21(1.381)
Gear ratio 4th	27/23(1.174)
Gear ratio Sth	28/27(1.037)
Oilpump type	Trochoid
Ignition System	T.C.I. Digital
Generator	A.C. generator
Battery	12 V 14 AH

Chassis	
Overall length	2200 mm
Overall width	730 mm
Overall height	1160 mm
Seat height	765 mm
Wheelbase	1460 mm
Minimum ground clearance	135 mm
Dry weight	209 kg
Frame type	Diamond DELTABOX II
Caster angle	26,75°

Trail	110 mm
Fuel tank capacity	19 Litres
Steering head bearing type	Taper roller bearing
Front Suspension	Telescopic fork
Fork stroke	120 mm
Fork tube outer diameter	43mm
Rear suspension	Swingarm (link suspension)
Rear shock stroke	70mm
Wheel travel-front	120 mm
Wheel travel-rear	130 mm
Tyre-front	130/60VR17 V280
Tyre-rear	170/60VR1 7 V280
Rim-front	MT3.50x17 Aluminium
Rim-rear	MT5.50x17 Aluminium
Brake-front	320 mm ø dual disc
Brake-rear	267 mm ø single disc