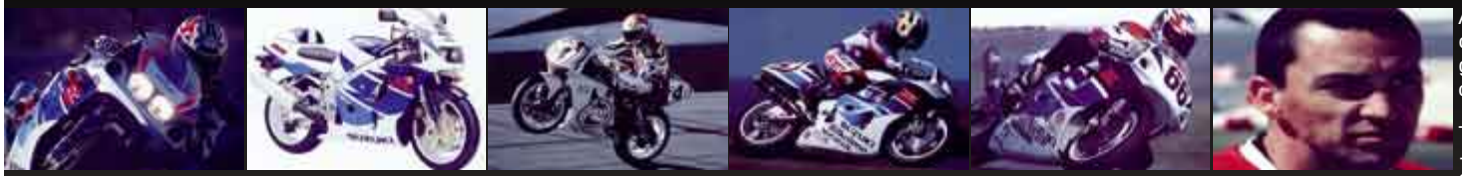
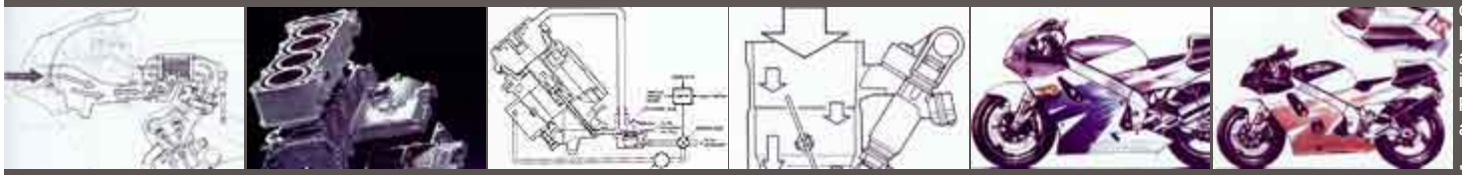
Gsxr 600 Gsxr 750 Gsxr 1100: 1996 - 1999

SUZUKI MOTORCYCLES GSX R 600, GSX R 750, GSX R 1100
Generation 4: 1996-1999

Gsxr 750 SRAD: a revolution renewed





A decade after the last of the "legacy" **Gsxrs** rolled off the line, the engineers who were in place for its gestation are quick to move on to the next chronological topic.

They are in no way ashamed of the 1992-95 **Gsxrs** - which were, after all, extremely successful for **Suzuki moto** on many levels-but what the company had in store for the next generation was nothing short of astonishing. And they're eager to talk about the effort.

In many ways, the 1996 **Gsxr 750 T** was as much a departure for **Suzuki moto** and as daring a leap into the future of sportbiking as the original **Gsxr**. It opened up new technological avenues for the company, causing it to rethink a considerable portion of its engineering efforts in addition to pushing its suppliers and production division to embrace new forms and higher expectations.

The '96 **Gsxr** also had finally broken free of the long shadow cast by Mr. Yokouchi's amazing machine: no longer did the **Gsxr** have to look like the classical notion of a **Gsxr**. Say so-long to fins on a liquid-cooled engine. Offer a wave of good-bye to the over-the-top alloy frame.

Welcome, instead, a move toward the mainstream of sportbike design that did not copy what Honda, Kawasaki, and Yamaha were doing but dramatically advanced the state of the art. Low weight was back in style. High horsepower had moved up the menu. Function had, once more, pushed form aside and asserted itself.

"The **Gsxr 750 T** was a big step forward for us," says Kunio Arase, who spearheaded the engine effort for this generation. "Much of what we did with that engine we wanted to do earlier, but we were held back by production concerns. Our casting






technology was not advanced enough to do much of what we wanted with this new engine family." Better late than never, so they say.

Again, context is useful. Honda had dramatically reset the weight/performance expectations with the Cbr 900 RR, a bike sized like a middleweight but packing a near-liter bike punch. It was certainly popular enough in the u.s. but it was a sales steamroller in Europe, a very strong market at the beginning of the 1990s. Kawasaki continued to develop the ZX-7 and, unbeknownst to **Suzuki**, was readying an updated model, the ZX 7 R, for'96 that featured a significant weight reduction. Kawasaki had also done well with the ZX 9 R, offering a relatively comfortable sportbike with performance that beat the '95 **Gsxr 750** and dramatically less weight than the **Gsxr 1100**.

Yamaha's **750** was more expensive than its nearest competitors and failed to sell well in 1994 technically there was no '95 model in the U.S. Yamaha was expected to return for '96. All around sportbiking, performance was on the rise and weight was on the way down. The trends of the previous few years were playing out. Big-inch bikes continued to get faster and larger, which suited **Suzuki moto** as it watched the liter class closely and elected to continue the **Gsxr 1100** through 1998 with minor changes; it retained the first generation of water-cooled engine, traditional **Gsxr** double-cradle frame, and bodacious power. The **Gsxr 1100** retained its mantle of asphalt-searing torque and seriousness of intent.

But the **600** cc sportbikes had become the hottest class in town, offering a lot of performance for the dollar. The scene was being set for the obsolescence of the **750** class. Theoretically this category was caught in the middle-not as much raw performance as a full-liter bike and without the feathery handling and accommodating powerband of the **600s**. None in the press would blame **Suzuki moto** for leaving the **750** class behind.
Except that **Suzuki moto** had other plans. The new **Gsxr 750** would return with a vengeance to the light-is-right mantra, forcing many riders to question the belief that the only way to get a low-mass sportbike was to buy a **600**. Consider the numbers: dry weight of 395 pounds, nearly 50 below the previous liquid-cooled **Gsxr 750**, and 125 crankshaft horsepower. Close, dangerously close, to the 900 class machines.

Suzuki moto achieved these laudable numbers in a way totally familiar to **Gsxr** fans, by scrutinizing every component, every shape, every choice of material on the motorcycle. In this quest for low weight, nothing was sacred. Except it had to be an inline-four. when the engineering team today is asked about alternative layouts, they answer almost in unison, "No. The inline-four is the best configuration." Period. End of discussion. Yet, in the new **Gsxr** power plant, nothing of the old remains. From the bottom up, **Suzuki moto** created a unique three-level crankcase assembly, with two major split lines-one on the crankshaft axis and one just below for the two transmission gears.

There is another split where the cylinder assembly fits into the upper third of the main case, another (obviously) at the head, and another at the oil pan. Traditionally, the overall length of the engine is set by the space required to pack the crankshaft, primary drive, clutch, main transmission, and countershaft along a single axis. It's possible to shrink the engine's length by making the transmission smaller, but this tactic can sacrifice strength in the face of ever-increasing engine power. The other possibility is to stagger the gears to place the transmission's mainshaft below the crankshaft, which allows everything else to move forward.

Suzuki moto placed the crankcase splits at an angle from horizontal, actually perpendicular to the bore axis for increased strength. It's a fine balance. Cant the cylinders way forward and you'll achieve a desirable front-end weight bias at the risk of making the engine effectively longer. Modern inlineengine sportbikes, with their steep steering geometries, have precious little room to spare between the front wheel and the exhaust system.
It was becoming more common for sportbike manufacturers to build engines with the cylinder block cast as one with the top of the crankcase, but **Suzuki moto** didn't follow this trend for a simple reason: its engineers anticipated building more than one displacement from one engine design.

Design a single monoblock assembly, and you're instantly limited in what you can do with bore and stroke measurements. Bore can expand or contract slightly, depending upon how beefy the cylinder liners are designed to be, but stroke is trickier. Move to a shorter stroke than the original design without changing the deck height, and there will be more cylinder wall than is necessary. In turn, the connecting rods will need to be longer, which mayor may not be to the engine's mechanical advantage but surely will not help weight. On the other side, engineers trying to make a **750** into a **1000**, for example, face another set of challenges if the relationship between the crank main bearings and cylinder-head surface cannot be easily modified. **Suzuki**'s solution allows for a relatively simple change of the cylinder casting to accommodate changes in bore and stroke without tearing up the blueprints on the rest of the bottom end.

For the new **Gsxr 750**, **Suzuki moto** aimed to make the engine as compact as possible. The previous engine was based heavily on the earlier oil-cooled model, so the bore spacing was wider than it really needed to be in a purely water-cooled engine, and the central cam drive was less compact than the end-drive that appeared on the new engine. (An air-cooled engine worked well with a central cam drive because it created a cooling passage between the two hottest cylinders and kept from blanking one of the end cylinders as would an end-drive system. Advancing technology-stronger cases, stiffer cranks, more precise drive systems-helped make end-driven cams compact and accurate.)

By moving the cam drive to the end, the cylinder bores could be moved very close together, further reducing engine width. In the **Gsxr 750**, **Suzuki moto** used a special plating process that applied a nickel-silicon-carbide coating to the aluminum block casting and called it SCEM, for **Suzuki** composite electro-chemical material. This long-wearing surface doesn't just create a lighter block; it also transmits combustion heat to the water jackets more efficiently than traditional steel liners. The **Gsxr 750** is an open-deck design, with exposed water jackets fully encircling the bores. With the engine now 1.2 inches narrower than the previous **Gsxr 750**, **Suzuki moto** could abandon the behind-the-cylinders alternator placement with its associated gearing and turn to a compact unit on the left end of the crankshaft. This change simplified the engine and helped lower its overall center of gravity. That tiny increment of power required to turn the alternator gear was put back into the drivetrain.

Those SCEM-lined bores were home to 72 mm pistons, a 2 mm increase over the '95 **Gsxr 750** but still shy of the very short-stroke '88-'89 bikes. Stroke for the'96 bike was reduced from 48.7mm to 46mm, making way for a 13,500 rpm redline. Oil jets cooled the pistons, just as on the original **Gsxr**, but now from a gallery in the case itself. No longer did the **Gsxr 750** have an oil cooler in

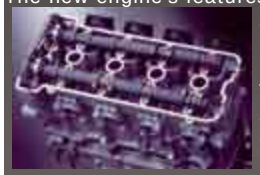
the conventional sense. In place of the familiar radiator, **Suzuki moto** used a simple oil-to-water heat exchanger at the base of the oil filter.

Everything changed at the cylinder head, too. The included valve angle was pulled in to 29 degrees, which helped create a more compact and efficient combustion chamber. The compression ratio remained at 11.8:1, but efficiency was clearly up based on comparative dyno charts of the period. Despite packing considerably more top-end power, the new **750** also had more midrange punch than the outgoing **Gsxr 750**.
With this generation, **Suzuki moto** joined the industry in using downdraft carburetors, in this case a special set of 39 mm Mikunis with electronically controlled slide management.

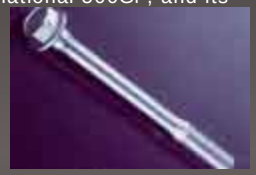
A solenoid controlled by the ignition computer managed an air passage linked to the top of the carburetor slide chamber. Under certain circumstances-low rpm, for example-the system would prevent the slides from rising too quickly, preventing low-speed stumbling that would otherwise occur with such large carburetors. This idea would, of course, return in totally electronic form in the 2000 **Gsxr 750**, which is perhaps as good an indication as any that thoughtful engineers rarely put ideas in the trash but save them for another day.

A straight-shot intake tract is more efficient, but there's more to it than that. Kevin Cameron, in the December 1995 Cycle World, explained the new system: "Lift the tank, pull the airbox cover, and look down the carbs with a light; you will plainly see the valves. The more streamlined the port, the smaller it can be made for a given airflow. Smaller ports make midrange."
With the four carbs now pointing straight up, the airbox moved from behind the engine-right in the path of hot air-up under the forward edge of the fuel tank, where orthodoxy says it should be even today. This change, in turn, allowed **Suzuki moto** to fit real ram-air induction for the first time, via large tubes and reinforced pass-throughs in the main frame out to a pair of ovoid ducts on the face of the fairing.

The new engine's features would not have worked in the old frame, of course, but they didn't have to. **Suzuki** had been campaigning its **Rg 500 Gamma** race bike in international 500GP, and its



star rider, Kevin Schwantz, was on the way to the World Championship for 1993 when the'96 **Gsxr** was being developed. With the mandate to return to race bike technology - spurred on by Schwantz's success - the engineering team chose to emulate the **Rg 500 Gamma** as much as possible.
This desire, as much as the drive to reduce weight and improve handling, pushed the engineers to a twin-spar frame. Suddenly, the bike could be smaller and lighter. Wheelbase shrank by 1.5 inches to 55-shorter, even, than the stubby Honda CBR 900 RR. Rake came in by 0.5 degree to 24, even while trail increased slightly to 3.8 inches.



The frame itself was made up of familiar materials-castings at the steering head and swingarm pivot-with new vertical extensions to meet the alloy subframe along with a few extruded pieces and stamped-and-welded main spar pieces. The massively braced swingarm was also made up of stamped and extruded aluminum pieces, with some cast items thrown in for good measure. **Suzuki moto** had learned to be resourceful in design to use materials in ways that would minimize cost, hence the variety.
Typically, the running gear was updated considerably. Six-piston front brake calipers replaced the four-pot items from '95. The rear wheel was now up to 6 inches wide and wore a massive 190/5017 tire, up from the 170/60 on the '95 bike.

Suzuki moto wrapped the new technology in sleek bodywork styled by Toshiyuki Nishino. "Engineering dictated the placement of all the major components, of course," he says. "One of the big challenges was to create a pleasing shape to the fuel tank while still having some capacity. The airbox was quite large." The tank also had to follow the frame with a minimum of visual fuss, which made it quite deep near the back. "We used contrasting paint across that corner of the tank to reduce its visual depth," recalls Mr. Nishino.
That tail hump? Strictly for racing. "We did wind-tunnel tests," explains Mr. Nishino, "and found that this shape was more efficient and made the airflow behind the bike smoother." In other words, the hump made it harder for following racers to draft.

Contemporary press reports praised the new **Suzuki Gsxr** lavishly: "The results of our performance testing were truly eye opening," said Cycle World of its March 1996 road test. "The **Gsxr** blazed through the Carlsbad Raceway quarter-mile in 10.61 seconds at an astounding 132.68 mph. Then, during high-speed testing at our top-secret, high-desert test site, it uncorked a mind-blowing 167.5 mph pass, This was balanced against a 165.3 mph run in the other direction, however, yielding a 166 mph average...

These figures are absolutely unreal for a **750**, and are more in line with open-class machines." Two months later, Cycle World named it the "Ultimate Sportbike" against such luminaries as the Ducati 916 and Honda CBR 900 RR. Kent Kunitsugu, editor of Sport Rider, recalls: "The'96 model **Gsxr 750** was the groundbreaker for **Suzuki moto**. It not only shattered the previous performance standards for the class, it also created a benchmark for the sportbike world, regardless of displacement. One needed only to look at the grids of both professional and amateur races swollen with **Gsxrs** that year (and for many years afterward) to realize that **Suzuki** had indeed created the winner-both in the dealerships and on the racetracks-they were looking for. That **Gsxr** created a whole new arms race between the manufacturers that has not abated since. And we're all the luckier for it."
Without question, **Suzuki moto** had hit its mark. Glowing magazine reviews were followed by brisk sales. The machine that many critics believed had rested upon its laurels for too long was suddenly, vigorously back in the fight.

And it was starting to make a mark in racing. "The '96 bike was a huge improvement for us," says Don Sakakura, racing manager for Yoshimura in the U.S. "Racing is hard on the machines. We had some trouble with the cooling of the ['95 and earlier] bikes. But it was better than the oil-cooled engine. Hot running led to a lot of distortion in the head and barrels. Maybe the radiators weren't as good as they are now. We played with different-size coolers all the time. **Suzuki moto** started sending us much bigger coolers; some of them were three rows deep."
The new engine was not only more powerful but far more consistent on the racetrack. And the new chassis was an improvement as well. "The **Gsxr** became a much more neutral **motorcycle**. On the track, it didn't do anything bad, or exceptionally well, but it was consistent," says Mr. Sakakura. Consistency in racing is sometimes its own reward.

Yoshimura's boat was raised by more than just the tide of a new **motorcycle**. In '96, an Australian by the name of Mat Mladin joined Yoshimura. Continues Mr. Sakakura: "Mat is a very intense competitor. From a team's perspective, he has a lot of influence. He's a machine on the **motorcycle**; he's fast and very repeatable. He could go out and do laps on consistent times and give us incredible feedback: thorough, accurate, repeatable. The development cycle of that period really accelerated when Mat came to the team. The results came much quicker." With those results came a renewed respect from the home office. "**Suzuki** followed our lead in development," says Mr. Sakakura. "As a result, we were able to compete." At the same time **Suzuki** was churning away with **Yoshimura** for an AMA Superbike title, the **Gsxr** was mopping up in the Superstock class.

And still there were improvements waiting in the wings. "Aspects [of design] we hadn't had to consider in the early days were things like recycling and emissions," says Sadayuki Inobe, managing director of **Suzuki**. In fact, increasing emissions regulations had begun to force compromises in jetting for certain markets, including the U.S. Carburetors are inexpensive and may have a nice "human" feel when jetted properly, but they're hard to get set up with emissions in mind. To that end, **Suzuki** fitted the '98 **Gsxr 750** with a Denso-controlled injection system using Mikuni throttle bodies and injectors. A rack of 46 mm throttle bodies replaced the 39 mm carburetors and provided a slight (5 hp) increase in peak power but much-improved "carburetion" in the midrange. Cycle World said, "We found none of the off-idle surging evident with the previous model's too-lean carburetion."

Suzuki moto was an early adopter of fuel injection for Supersport **motorcycles**, a feature that is completely common today. At the time, few performance bikes had anything but conventional carburetors, and riders of the time recall that some of the jetting required to meet emissions left a lot to be desired from a ridability standpoint. **Suzuki**'s system was better, but almost as important, it gave the engineers useful experience developing and tuning such a system for a lightweight **motorcycle** with a powerful, low-crank-mass engine, one of the most difficult applications there is. This is development experience that would hold **Suzuki** in extremely good stead in the years to come.

Also in store for the '98 machine-the '97 was essentially unchanged from the '96-were juggled cam specifications, a revised airbox with electronic flapper valve, and subtly altered headers aimed at improving midrange power. Weight-saving measures included a thinner primary gear drive and a smaller chain-a #525 replaced the previous #530.

Gsxr 600 SRAD: building a better 600






Suzuki moto took the opportunity to reenter the **600** class on the new **750**'s platform, this time expecting considerably more success. It helped greatly that the new bike was much smaller and lighter than the previous **Gsxr 750**, so retaining the major (read: expensive) components such as frame, engine, and bodywork made sense.

Introduced in 1997, the **Gsxr 600** started its development at the same time as the **Gsxr 750**; rather than being an afterthought, it was part of the planning for this generation of **Gsxrs**. Although it shared a great deal with the **Gsxr 750**, the new **Gsxr 600** was destined to be slightly lighter (11 pounds, now 384 dry) and more economical to build. Part of this economy came from the shared components, but other savvy cost-cutting measures were put in place.

Those measures were not specifically in the engine. Sharing the cases with the **Gsxr 750**, the **Suzuki Gsxr 600** nonetheless received a new head atop the revised upper cylinder casting that supported 65.5 mm pistons moving through a 44.5 mm stroke. The compression ratio was up slightly (12.0 vs. 11.8) compared to the **Gsxr 750**, and the valves were, as you'd expect, slightly smaller. The bank of Mikuni carburetors had 36.5 mm throats in place of the **750**'s 39 mm units, although they consumed air through a **750**-size airbox and ramair ducts. At the other end, the exhaust system had head pipes 20 mm shorter than those on the **750**.

Suzuki moto also debuted direct ignition on the **Gsxr 600**, a year ahead of the **Gsxr 750** receiving the same technology. Sometimes known as "stick" coils, each spark plug cap held a small ignition coil, which reduced the length of the high-voltage circuit and improved spark energy. This technology also allowed for individual cylinder timing. **Suzuki moto** would turn to mapping each cylinder individually on later **Gsxrs** to improve power and throttle response. **Suzuki moto** retained the **Gsxr 750**'s frame for the **Gsxr 600** but fitted a lighter swingarm without the upper bracing-it wasn't needed on the lighter, lower - power **600** - which resulted in a shorter wheelbase of 54.7 inches (0.3 inch shorter than the **Gsxr 750**'s). In a similar vein, the **Gsxr 750**'s inverted fork was replaced by a conventional Showa fork, and the six-piston calipers from the **Gsxr 750** gave way to four-pot Tokicos on the **Gsxr 600**. Suspension rates were reduced as well.
Those are the specifications. What was important to **Suzuki moto** was that it had a competitive **600** class sportbike to uphold the **Gsxr** name. Road tests hailed the **Gsxr**'s taut chassis and good power. Like the **Gsxr 750**, it was considered much more serious, radical even, compared to the **600** class weaponry of the age: Honda's CBR **600** F3, still aiming for street manners over outright sporting demeanor; Kawasaki's ZX 6 R, improving with every generation but still considered" comfortable"; and Yamaha's YZF **600** R, very much out to be all things to all riders with a near-sport-touring riding position and (still) a steel frame.

For pure sporting prowess, nothing was in the **Gsxr 600**'s class.
Proof of that came from the racetrack, where the **Suzuki Gsxr 600** was competitive immediately. In 1998, Steve Crevier won the AMA Supersport title on a **Gsxr 600** campaigned by Yoshimura. More important, particularly to **American Suzuki Motor Corporation**, by the end of this generation Mat Mladin had taken the AMA Superbike crown on the **Gsxr 750**, ending a ten-year drought. "Racing has always been part of the **Gsxr** strength, and winning with Mat in '99 was an important outcome for us," says Mel Harris, vice president of the **motorcycle**/ ATV division. "It proved the strength of the bike and without question spurred sales of the streetbike." These were the earmarks of a company on the move, raising its game in part because it returned to its roots. Those guiding concepts were to make the **Gsxr** the best-performing bike in the category, to resist diluting that endeavor with compromises for the street rider, and to make the most of its expensive technology by leveraging it across several models.

All smart manufacturers are good at spreading the development dollar, but **Suzuki moto**, only a fraction the size of Honda, would soon become the industry leader in doing more with less. **Suzuki moto** proved that the intelligence of the engineering staff and the drive of the designers matter more than a big R & D budget. As the fourth generation of **Gsxr** wound down, few realized that **Suzuki** had some amazing improvements in store for the **Gsxr** that would usher in the new millennium.


Suzuki Gsxr 750-Gsxr 1100: 1985 - 1987


Suzuki Gsxr 750-Gsxr 1100: 1988 - 1991


Suzuki Gsxr 750-Gsxr 1100: 1992 - 1995


Suzuki Gsxr 600-Gsxr 750-Gsxr 1100: 1996 - 1999


Suzuki Gsxr 600-Gsxr 750-Gsxr 1000: 2000 - k1 - k2 - k3


Suzuki Gsxr 600-Gsxr 750-Gsxr 1000: k3 - k4 - k5


Suzuki Gsx R 600-Gsxr 750-Gsxr 1000: k5 - k6 - k7