

# CASE STUDY

Ferrari S.p.A. – Scuderia Ferrari

Maranello, Italy

Automotive

PULSE Platform, Transducers, HATS, Conditioning

*Scuderia Ferrari was founded by Enzo Ferrari over 80 years ago in Modena. The original name is, still today, the name of the racing team division of Ferrari S.p.A.*

*Scuderia Ferrari recently invested in a 6-channel PULSE LAN-XI data acquisition system. This is mainly used for engine test bench balancing, a major issue when Ferrari's Formula One engines run at up to 20000 RPM.*

*Photos courtesy of Ferrari S.p.A.*



## Ferrari – Speed, Performance, Prestige



Italian sports car manufacturer Ferrari was founded in Modena by Enzo Ferrari in 1929 as Scuderia Ferrari. Originally, the main aim of the company was to allow owner-drivers to race. In time, it became a technical-racing outpost of Alfa Romeo and took over as its racing department in 1933. In 1939, Enzo Ferrari left Alfa Romeo and opened



Auto Avio Costruzioni in Modena at the headquarters of the old Scuderia Ferrari. In 1943, Auto Avio Costruzioni moved to Maranello where the first part of what would become the Ferrari factory was built and in 1946, the company started to design and build the first Ferrari. In 1960, Ferrari became a Limited Liability Company in which Fiat became a 50-50 partner in 1969.

Maranello, a town in northern Italy, near Modena, has been home to Scuderia Ferrari and Ferrari's road car factory since the 1940s. At more than 250 000 m<sup>2</sup>, the factory's 45 buildings house more than 3000 workers. It is here that passion, innovation and technology combine to create the company's GT and Formula One cars. The team owns and operates a test track on the same site, the Fiorano Circuit built in 1972, which is used for testing road and race cars. Although the costs involved in Formula One are phenomenally high, motor racing is, and always has been part of Ferrari's DNA and Ferrari's road cars benefit not only from the brand image of the racing cars but also from the unique technical expertise gained from Formula One racing.

## Getting the Right Balance

With Formula One cars, vibration is a critical issue. Under new FIA rules (Federation Internationale de L'Automobile), and in order to double engine life, each driver is only allowed to use a maximum of eight engines per driver per season plus a total of four for testing (that is, 20 per Formula One team) and each engine is expected to run for more than 2000 km. Testing has also been strictly limited and no in-season testing is allowed except during race weekends during scheduled practice.

Balancing and vibration have, therefore, taken on new importance. Unbalance is the most common source of vibration in engines. It is a very important factor to be considered in modern engine design, especially where high speed and reliability are significant considerations. By reducing these vibrations, deterioration of the engine and, ultimately, fatigue failure can be avoided. This can be done by balancing the crankshaft where masses are added or removed at certain positions in a controlled manner. Important factors in modern engine design are dictated by increasing speeds, higher performance/weight ratios and enhanced reliability. Balancing leads to more optimal design, superior performance, and increased safety and reliability.

*Lars Rønn,  
Brüel & Kjær's  
Managing Director  
handing over a 6-  
channel PULSE LAN-  
XI to Mr. Luca  
Marmorini, Engine  
Department Director*



Scuderia Ferrari works closely with Centro Ricerche Fiat S.C.p.A. (CRF) – Fiat Group's major source of expertise in innovation, research and development – to establish targets on vibration that are very important for engine and powertrain development. Consequently, a lot of durability testing is done in a dynamometer test cell (which can simulate the world's Formula One race tracks, including time history, torque, RPM, etc.) and the test results compared to actual data taken from a car on the test track.

Scuderia Ferrari recently invested in a 6-channel PULSE LAN-XI with Multi-plane Balancing software for test bench balancing of their Formula One engines. In addition to the PULSE LAN-XI system with its real-time capabilities for FFT analysis, Order Tracking and Time Data Recording on unlimited channels, Scuderia Ferrari also acquired two seats of Brüel & Kjær's new PULSE Reflex core application for post-processing.

In the past, Ferrari appointed a third party for this balancing task, which was carried out one plane at a time. With the new system they can save substantial time and money as a Ferrari engineer now does the task every time a test bench needs to be checked or shows balancing issues. Furthermore, Ferrari can now perform two-plane and multi-plane balancing.

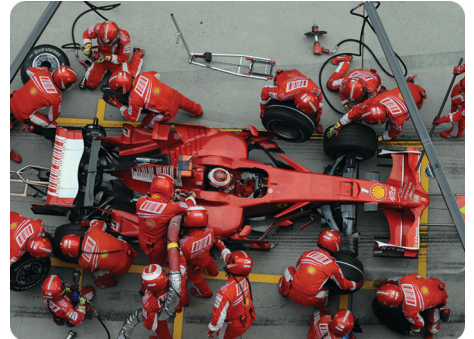
The intention is to evaluate the possibility of implementing the PULSE data acquisition and analysis system as the de facto vibration analysis platform for the Ferrari Formula One team. Ferrari's relationship with Brüel & Kjær goes back 30 years and they have a huge installed base of Brüel & Kjær transducers and conditioning amplifiers including many Piezoelectric Charge Accelerometers Types 4393 and 4326-A, and several DeltaTron® accelerometers including Types 4520, 4525-B and 4526-HT. The accelerometers are mainly used for vibration testing of Formula One engines. In addition, Ferrari has, for many years, used Charge Amplifiers Type 2634 connected to accelerometers Type 4393 for vibration testing on the Formula One car.

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## Driver/Pit Communication

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A second PULSE system including a Brüel & Kjær Head and Torso Simulator Type 4128 with built-in Mouth Simulator and calibrated Ear Simulators is used at Scuderia Ferrari to test the radio communication link between the racing driver and the engineers at the pit. Drivers are exposed to 140 dB(A), which is equivalent to a jet engine taking off, and miniature loudspeakers are built into special silicone earplugs that protect the driver's hearing while, at the same time, allowing him to listen to messages from the pit lane via the radio link. The PULSE-based solution tests speech intelligibility to evaluate and ensure reliable communication in these highly adverse conditions.



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## The Future

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The engineer in charge of Ferrari Formula One track testing will soon evaluate NOTAR, a multichannel LAN-XI data acquisition front-end that allows time data recording on up to 12 channels on each module, without connection to a PC but directly onto an SDHC card. This is intended to replace an existing system for data acquisition on the full vehicle and will also include subsequent post-processing with PULSE Reflex.

Brüel & Kjær looks forward to continuing the long relationship with Scuderia Ferrari and our aim is to continue to add value by providing cutting-edge technologies, efficient support, professional service and cooperation with Scuderia Ferrari's exceptional engineers.