Bosch Motorsport

Motorcycle System

MS 5.0 and DDU 8 for BMW S1000RR

BOSCH
Invented for life

ECU MS 5.0

Display DDU 8

Contents

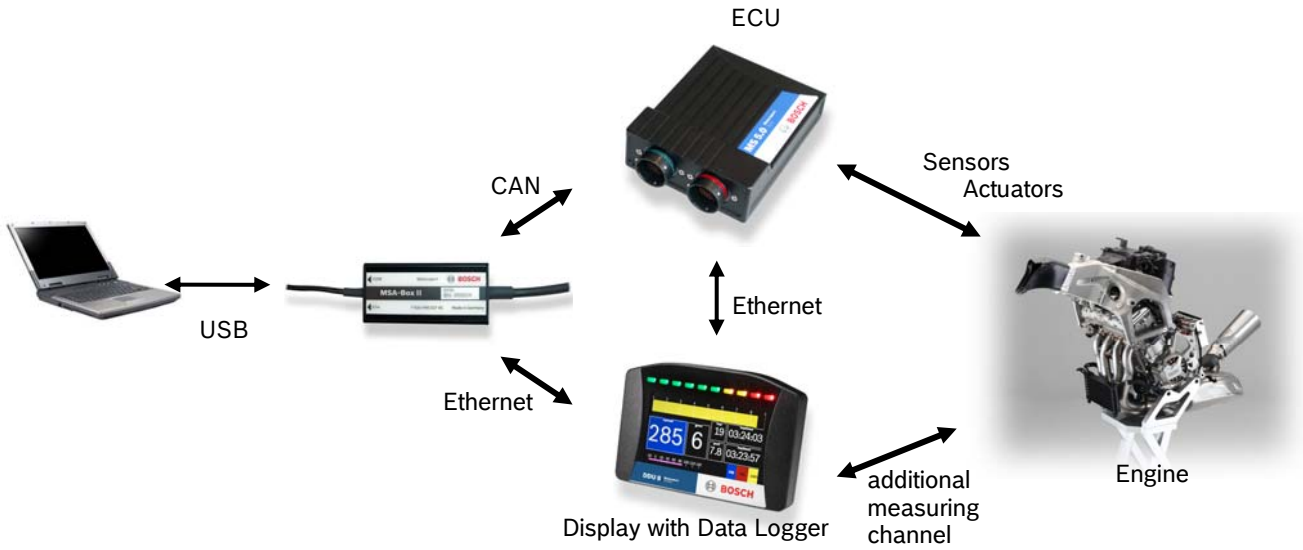
1 System Overview

The system is designed to run a BMW S1000RR with little modification in the highest level of international motorcycle races.

The bike proofs in various Stock Series to be a powerful basis for racing.

To be able to do easy adaptations to hardware modification or the driver's demands, the stock ECU (Engine Controller Unit) has to be replaced by a motorsport unit.

State of the art functionalities in the ECU permit the best driveability of the motorcycle and therefore best lap times. A comprehensive documentation describes all possibilities for calibration.



Logging the signals from the engine and chassis with high sampling rate up to 1 ms and a big memory of 2 GB provide the base for a perfect setup of the motorcycle.

2 Components

2.1 Engine Controller MS 5.0

The MS 5.0 engine control unit manages gasoline engines up to 8 injectors. As a member of the MS 5 family, it features a powerful digital processing core with floating point arithmetic and a high-end FPGA for ultimate performance and flexibility. The MS 5 family utilizes a new software development process based on MATLAB/Simulink. It significantly speeds up algorithm development by using automatic code and documentation generation. Custom functions can be quickly and easily generated. The flexible hardware design allows the MS 5.0 to support complex or unusual engine or chassis configurations.

2.2 Display and Data Logger DDU 8

The display DDU 8 integrates a programmable full color dash board display with a data logging system. This allows for synchronized acquisition and visualization of engine data from the ECU and chassis data from up to 24 analogue and 4 digital input channels. Additional input devices can be connected via the Ethernet and CAN buses. Recorded data from the internal 2 GB flash memory can be downloaded via high-speed Ethernet or via wireless connection with the BT 60 burst telemetry system.
Alternatively a C60 Data logger and a third party display can be connected.

2.3 Cable Loom

The cable looms are especially designed to fit in the S1000RR Chassis. The numbers of branches, intersections and connectors have been watched to keep the weight and costs at a minimum without limiting the system functionality. Robust connectors (in military specification) as well as high quality cables and coatings are used to guaranty the best reliability.
The Main Loom connects the ECU and the display and offers several connectors for the sensors and actuators.
For a fast and reliable connection of all sensors and actuators that are mounted at the Air box, a single intersection connects the main loom to the airbox loom.

2.4 Engine Sensor

Additional to the original airbox- and water temperature sensor, there is an Airbox pressure sensor mounted. These sensors enable to run the engine even at different ambient conditions and at a high ram air effect.
Two wide band lambda sensors (Bosch LSU4.9) permit a precise closed loop lambda control. The mapping of the fuel injection can be done with those and the maximum power and best driveability achieved.
Different oil temperature and oil pressure sensor as well as three auxiliary sensors with a supply voltage of 5 Volt and an analogue output voltage can be connected.
Various functionalities are depending on the gear position. The signal is calculated from the original gear potentiometer. The drivers demand for a gear shift is detected by the signal of the Gear shift sensor (quick shift sensor).

2.5 Chassis Sensor

The original wheel speed sensor (Bosch DF11) and its trigger wheel can be used. A special input stage in the ECU reads the signal current of the sensor.
The original Lean Angle Sensor can be used. To increase the accuracy in corners, a different algorithm is used and the sensor has to be installed horizontal with the connector facing backwards.
Different Spring travel sensor, IR-Tire temperature (infra red) and brake pressure sensor with a supply voltage of 5 Volt and an analogue output voltage can be connected.

2.6 Throttle Body

The throttle body is a complex combination of different sensors, actuators and mechanical parts to build an electronic throttle control on a high standard of safety. The Bowden cable from the throttle grip is connected to throttle body to measure the drivers demand. A safety clutch provides an additional protection to not open the throttle over the drivers demand. The butterfly is driven by an electric motor and the throttle position is measured by a potentiometer.
All parts can be used without mechanical changes. To increase the reliability in the rough environment of motorsport, all connectors should be changed to ones with military specification (Deutsch connectors)
To reduce the engine braking at higher engine speed, the throttle is opened more than the angle for the idle position. The maximum angle before the safety clutch will interfere can be adjusted by a set screw under a cap at the front side of the throttle body. If the regulations allow a modification of the throttle body, the safety clutch can be mechanically disabled.
The automatic downshift blipping liberates from manual double clutching.

2.7 Fuel Injection

The fuel pressure is measured by the stock sensor. To control the pressure on the target value, the fuel pump is driven by PWM Signal (pulse width modulation). Two fuel injectors per cylinder prepare the mixture in the intake manifold. The injector below the throttle ensure a good engine response in dynamic conditions, the injectors above the trumpets increase the maximum horse power at wide open throttle.

2.8 Ignition

The standard spark plugs can be used and the ignition coils are directly driven by the ECU. Variation in the battery voltage is compensated by different dwell times of the coil.

2.9 Variable trumpet control

A special signal sequence is driving the variable trumpet actuator. The trumpet position can be chosen at different engine speeds and throttle positions to generate best drivability and maximum power.

3 Functionalities

- Engine Brake Control (static & dynamic)
- Lean Angle Measurement
- Traction Control (PI- and Acceleration Control)
- Gear Lash damping (closed loop)
- Power Up- & Down Shift (Blipper)
- Parameters depending on Position on Race Track
- Launch Assistance
- Pit speed Control
- Fuel Saving Strategy
- Broadband or long range telemetry can be directly connected

Further functionality can be developed on customer demand.

4 Software Tools

The whole communication to the electronic is done by the MSA-Box II and a single connector at the bike. The calibration is done via a CAN and recorded data will be downloaded by a high-speed Ethernet communication.

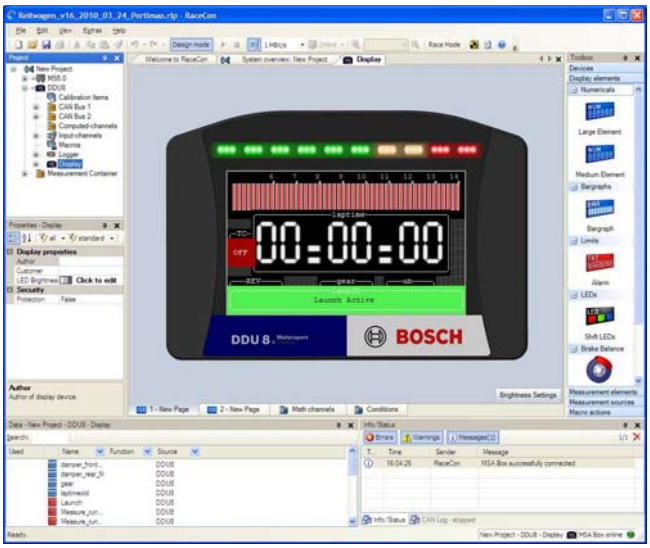
This connector can also be used to charge the battery.

4.1 System Configuration, RaceCon

Every signal of the ECU can be measured with the data logger. Different sampling times down to 1 ms and crank angle synchronous raster can be chosen.

Also the displayed information on the dashboard as well as other components from Bosch can be configured by RaceCon.

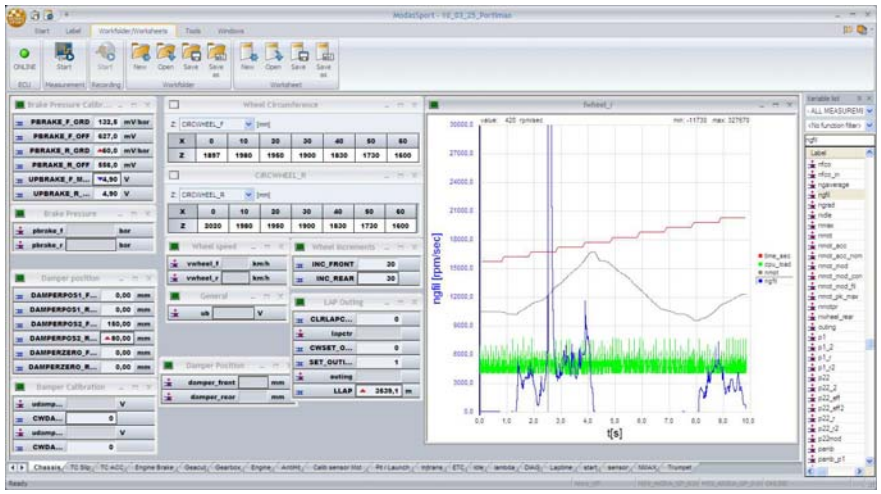
The tool is free of charge!



4.2 Calibration Tool, Modas Sport

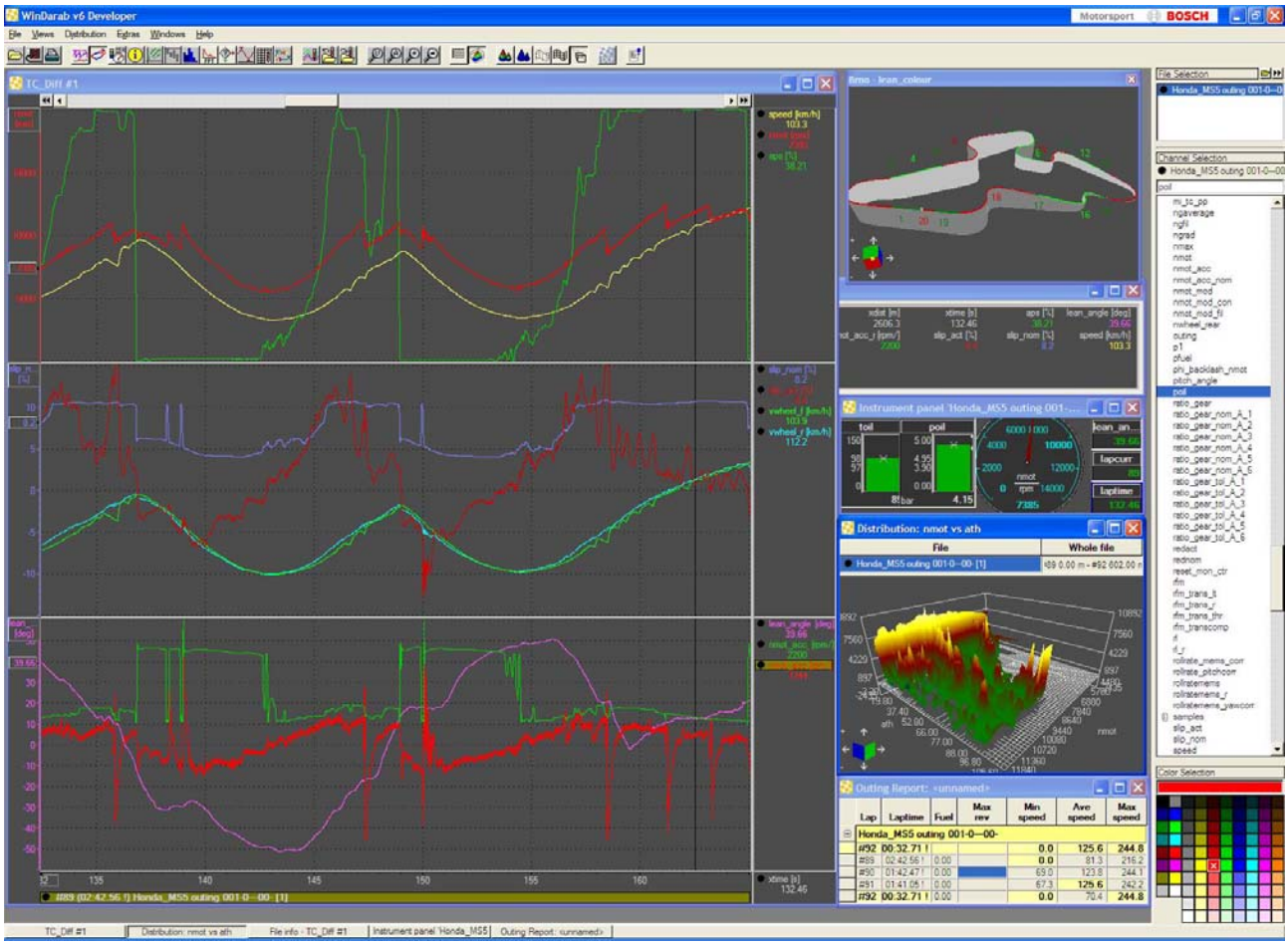
For a fast an efficient work at the engine dyno and race track, the appearance of the calibration tool can be customized. Different folders for different work tasks can be generated. Macros and parameter files facilitate periodic jobs.

The functionalities of the ECU can be optimized by several calibration values and maps.



Datasets can be achieved, compared and merged. The tool is free of charge!

4.3 Data Analysis, WinDarab



To enable a cost efficient step in, a WinDarab version free of charge is available.

The 'light' and 'expert' version offer additional functionalities.

Race track views, various display and calculation methods are possible. Comparison of laps and statistics makes it easy to find the best setup of mechanical parts and calibration.

5 Components, Order Numbers and Prices

	Component	Order Number	Price
1	Engine Controller MS 5.0	F 02U V00 740-01	7.500,00 €
1	Display DDU 8	F 02U V00.873-05	4.610,00 €
1	Upgrade 1 DDU 8; Data logger	F 02U V00 701-01	1.190,00 €
	C60 Data logger	F 02U V00 875-02, alternative to DDU 8	3.560,00 €
1	MSA-Box II Interface	F 02U V00 327-01	720,00 €
1	Chassis harness	F 02U V00 725-01	8.240,00 €
1	Airbox harness	F 02U V00 726-01	2.980,00 €
1	Coil harness	F 02U V00 727-01	570,00 €
1	Handle left cable	F 02U V00 729-01	234,00 €
1	Handle right cable	F 02U V00 730-01	154,00 €
1	Pump cable	F 02U V00 731-01	146,00 €
1	Absolute pressure sensor 0,1 - 1,15 bar	0 261 230 052	44,00 €
2	Lambda Sensor LSU 4.9	B 261 209 356-03	340,00 €
1	Gearshift sensor GSS-M	F 02U V00 354-01	690,00 €
1	Linear poti damper front	B 261 209 534, 150 mm	630,00 €
1	Linear poti damper rear	B 261 209 540, 100 mm	560,00 €
1	Main Relay	Y 261 A20 597	171,00 €
1	Starter Relay	0 986 332 002	16,00 €

Price reductions for Teams and OEM, as well as volume discounts are on request.

The following parts of the BMW S1000RR can be used without modification:

Alternator	Trumpet actuator
Voltage Regulator	Throttle position motor
Fuel pump	Throttle position sensor
Fuel pressure sensor	Throttle grip sensor
Fuel Injectors	Engine temperature sensor
Crank sensor (engine speed pickup)	Intake air temperature sensor
Crank trigger wheel	Spark plugs
Cam sensor (Cyl. 1 detection)	Ignition coils
Cam shaft and tooth position	lean angle sensor
Gear position sensor	Wheel speed sensor

The connection for second party components is prepared:

2D GPS sensor

Trans-X Lap trigger

Various displays with configurable CAN input

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