

# Common Rail Pump Driver CRPD200

## *Operating manual*





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## Introduction

Common Rail Pump Driver is actually a simulator that controls the high pressure valve or the fuel metering valve in Bosch Common Rail systems. It maintains a constant pressure in the system due to the feedback with the High Pressure Sensor signal.

It's used in a self-made test benches for testing all Common Rail solenoid and piezo injectors.

The Common Rail Pump Driver can drive two valves simultaneously: the high pressure valve and the fuel metering valve.

User sets the desired system pressure with a 50bar or 100bar steps in the 200÷1600bar range.

Note that when using the Bosch CP1 high pressure pump, a maximum pressure of 1400bar can be reached. If the Bosch CP3 high pressure pump is used, pressure can reach up to 1600bar.

A constant pressure can be maintained at the fuel rail according to the set pressure value.

Actual pressure in the Common Rail is being displayed on a LCD screen.

There are two independent driving channels – one for the fuel pressure valve (on the Bosch CP1 high pressure pump or at the fuel rail) and one for the fuel metering valve on the Bosch CP3 high pressure pump.

## Typical applications

- The Common Rail Pump Driver allows maintaining a constant pressure in the system and thus testing Common Rail Injectors at various modes thereby assessing their efficiency.
- Can assess the Common Rail High Pressure Sensor working condition.



## Technical specifications

Number of simultaneously connected valves	2
Internal power supply for the high pressure sensor	5V
Operating pressure range	200bar ÷ 1600bar (max 1400bar when using a 1500bar high pressure sensor)
Power supply	12V from car battery or other power source with output voltage from 11V DC to 15V DC
Maximum output current for single output	3A
Maximum output current for both outputs	6A
Indication	LEDs indicate the selected operating mode
Power supply	220 ÷ 240V 50/60Hz from mains
Display	8x2 LCD display
Dimensions	130mm x 67mm x 29mm
Weight	0.5kg

## Possible test bench configurations

### Variant 1:

Bosch CP1 high pressure pump with a 1500bar high pressure sensor. With this high pressure pump a pressure of max 1400bar can be achieved.

### Variant 2:

Bosch CP3 high pressure pump (with present or cupped fuel metering valve), high pressure valve at the Common Rail and 1800bar high pressure sensor. Maximum working pressure is 1600bar.

### Variant 3

Bosch CP3 high pressure pump (with present or cupped fuel metering valve), high pressure valve mounted in a separate self-made fuel rail\* and 1800bar high pressure sensor.

\*The self-made fuel rail must have a very well ribbed design to cool the fuel.

# Common Rail Pump Driver CRPD200

Device appearance and buttons location



## Operation of the Common Rail Pump Driver CRPD200

Common Rail Pump Driver CRPD200 has 4 push buttons, 3 LEDs, 1 connector for the high pressure sensor and valves, 2 banana type connectors for the power supply.



## LEDs

- **CP1 Pump Control Valve** LED indicates that **CP1 Pump Control Valve** mode has been entered.
- **CP3 Pump & Rail Pressure Valve** LED indicates that **CP3 Pump & Rail Pressure Valve** mode has been entered.
- **Start/Stop** LED flashes when device is generating output pluses to the solenoid valve(s).

## Buttons

Changing the operating mode and starting a measurement, as well as the change in the parameters of generated variable periodical signal, is made by means of 4 push buttons – **↑**, **↓**, **Start/Stop** and **Select mode**.

- Use **↑** and **↓** buttons to choose sensor type and to set the pressure.
- Use the **Start/Stop** button to start generation of output pluses to the solenoid valve(s).
- **Select mode** button is used to start a measurement of resistance or inductance and it is active only when **CR injector R meter** or **CR injector L meter** modes are selected.

## Connectors

Common Rail Pump Driver CRPD200 has 2 connectors:

- 9 pin D-sub connector for CP1 High Pressure Valve, CP3 Pump Valve and the High Pressure Sensor.
- Two 4mm female banana type connectors for power supply

Choice of the High Pressure Sensor type is remembered and it's not affected from the power supply. All other settings will be lost when the power supply is switched off. There is no possibility the tester to save the settings. At second turn on of the device, the adjustments as per its internal program are activated.

## Working modes

### 1. Operation mode/Sensor type

User can select the sensor types/modes. Following choices are available:

**Sen1500** – Selects 1500bar Bosch High Pressure Sensor and activates **CP1 Pump Control Valve** mode.

**Sen1800** – Selects 1800bar Bosch High Pressure Sensor and activates **CP3 Pump & Rail Pressure Valve** mode.



Fig.1 Main menu – default mode is **CP3 Pump & Rail Pressure Valve** and default sensor is **1800bar (sen1800)**.

### 2. CP1 Pump Control Valve

This mode is activated when a 1500bar (sen1500) sensor is selected from the main menu.

Waveform	Rectangular
Frequency	1 KHz



Fig.2 **CP1 Pump Control Valve** mode – Set pressure is 200bar and actual pressure is 200bar.

Note: When **CP1 Pump Control Valve** mode is selected only the CP1 output is active! CP3 output is not active!

### 3. CP3 Pump & Rail Pressure Valve

Waveform  
Frequency

Rectangular  
180 Hz



Fig.3 **CP3 Pump & Rail Pressure Valve** mode – Set pressure is 200bar and actual pressure is 200bar.

Note: When **CP3 Pump & Rail Pressure Valve** mode is selected both outputs are active!

## Device protection

### Device has an internal protection against the following events:

If any of the below mentioned events occur, the following messages will appear on the LCD screen. In order to continue operation, device must be restarted by switching off for at least 2 seconds.

- Overpressure protection due to malfunction or break at the high pressure sensor electrical circuit



Fig.4 Overpressure protection is activated – rail pressure has exceeded 1470bar for a 1500bar pressure sensor or 1750bar – for 1800bar pressure sensor

- Output short circuit protection: Activates when output current exceeds 10A



Fig.5 Overcurrent or output short circuit protection is activated

- Power supply low voltage protection (below 11V)





Fig.6 Low voltage protection is activated – power supply voltage is less than 11V

- Power supply overvoltage protection (over 16V) \*



Fig.7 High voltage protection is activated – power supply voltage is more than 16V

**\*Overvoltage protection is software based so device should not be powered with more than 16V!!!**

- Pressure sensor missing or failure detection



Fig.8 Pressure sensor failure or pressure sensor is not connected. This protection activates if sensor output is less than 0.35V when pressure is 0bar.

- Pressure sensor circuit protection: Output short to +12V or short to ground.
- Power supply reverse polarity protection

NOTE: If after switching on the LCD message appears again, any of the above mentioned events still persist!

## Common Rail test bench: Components selection

### 1. Choosing the Bosch high pressure sensor

By default, each device is set for a 1800bar Bosch high pressure sensor.

Suitable Bosch 1800bar high pressure sensor catalog numbers are:

**0 281 002 398; 0 281 002 472; 0 281 002 504; 0 281 002 534; 0 281 002 767; 0 281 002 842; 0 281 002 846; 0 281 002 937; 0 281 002 964**

If you use the Bosch CP1 high pressure pump, the following Bosch 1500bar high pressure sensor catalog numbers are suitable:

**0 281 002 238; 0 281 002 283; 0 281 002 405; 0 281 002 498; 0 281 002 522; 0 281 002 592**

**Important note:** When using the Bosch CP1 high pressure pump, a 1500bar sensor must be used due to insufficient pump flow for pressures over 1400bar.

There are two connector types for the Bosch high pressure sensors as shown below:

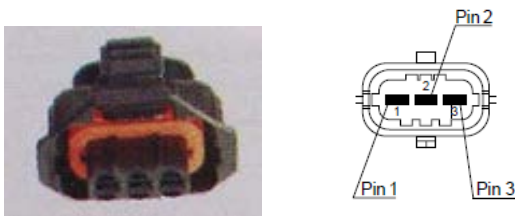


Fig.9 Bosch High Pressure Sensor – Type 1

PIN1 – sensor ground

PIN2 – sensor output signal

PIN3 – sensor +5V power supply

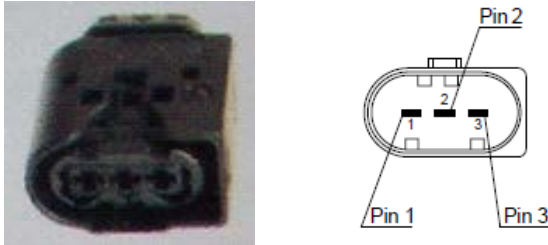


Fig.9 Bosch High Pressure Sensor – Type 2

PIN1 – sensor ground  
PIN2 – sensor output signal  
PIN3 – sensor +5V power supply

**Important note: It's absolutely forbidden to connect the Common Rail Pump Driver to a test bench with the Bosch CP3 high pressure pump and without a high pressure valve at the fuel rail!!!**

## **2. Bosch Common Rail High Pressure Pump selection**

The Common Rail Pump Driver can operate with Bosch CP1 and CP3 high pressure pumps. It can also control the rail pressure valve at the fuel rail. The Bosch CP3 high pressure pump can be found in many variations, depending on the flow rate, which may provide, but for this purpose flow rate has no significant effect.

Note: When using the Bosch CP1 high pressure pump and the pressure exceeds 1200bar, significant pressure fluctuations are possible due to insufficient pump flow.

## **4. Fuel Rail selection**

Fuel rail must be Bosch with a high pressure valve on it if the Bosch CP3 high pressure pump is used. If a Bosch CP1 high pressure pump is used, fuel rail must not have this valve installed.

## **5. Electric motor selection**

The electric motor should be at least 2.2KW (single phase or three phase) and with 1500rpm or less!

## **6. Selection of an additional precision manometer**

Manometer must be with at least with 1600bar range but a 2000bar is better. Contact us if you want to buy such manometer.

**7. Choice of an external power supply if a battery is not used**

If you are planning to use a different power supply, it should have the following specifications:

Output voltage: 11-15V

Output current: at least 6A

**Circuit diagrams**

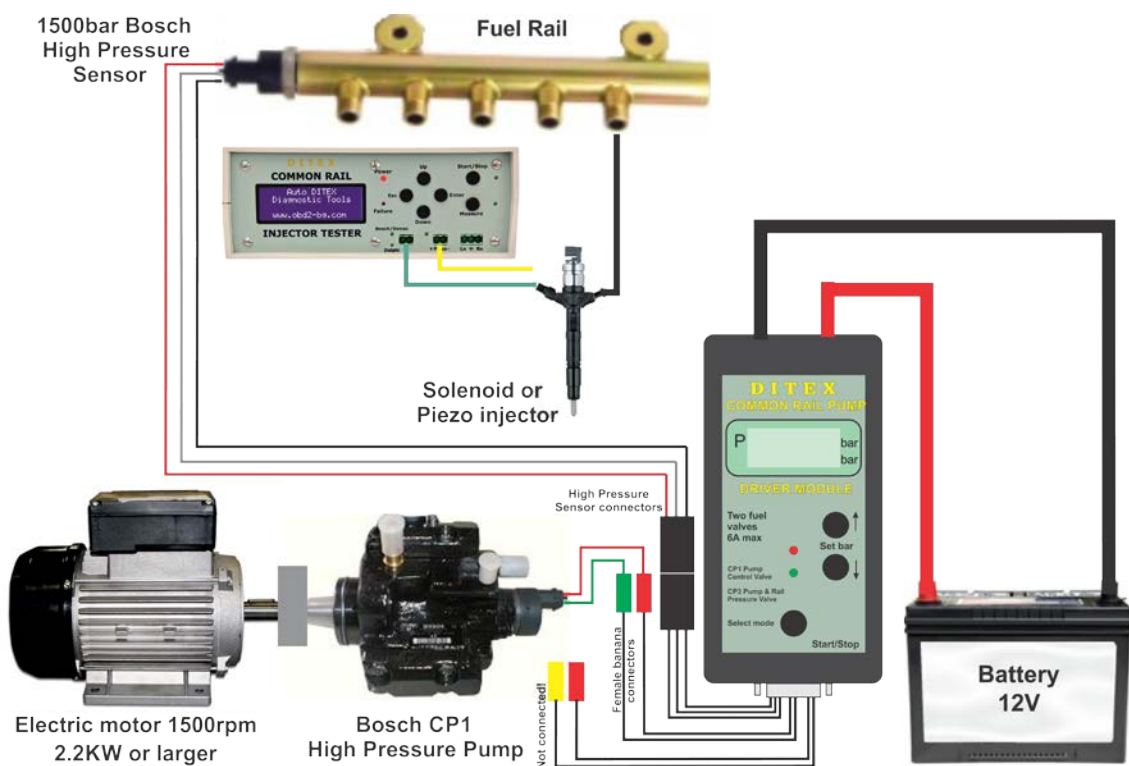


Fig.10 Connection of the Common Rail Pump Driver CRPD200 to a test bench with a Bosch CP1 high pressure pump and 1500bar Bosch high pressure sensor.

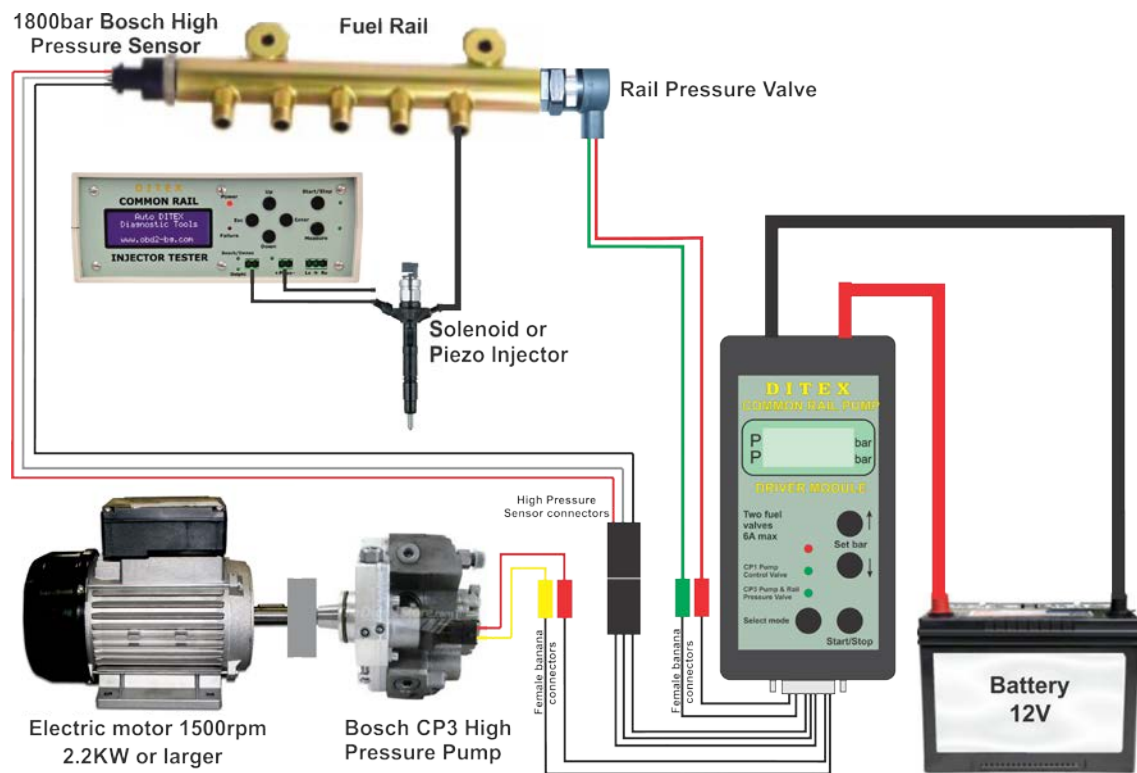


Fig.11 Connection of the Common Rail Pump Driver CRPD200 to a test bench with a Bosch CP3 high pressure pump, a rail pressure valve and 1800bar Bosch high pressure sensor.

## How to start a test?

- Connect the 9 pin canon type cable (see Fig.12) to the Common Rail Pump Driver CRIT200, the pressure sensor and the valve(s).
- Switch on the Common Rail Pump Driver CRIT200.
- Choose the pressure sensor type from the main menu.
- Select the desired\* **Pressure** by pressing the  $\uparrow, \downarrow$  buttons.
- Turn on the electric motor that drives the high pressure pump (Bosch CP1 or Bosch CP3).

- Press the **Start/Stop** button to start test. Common Rail Pump Driver CRIT200 will start driving the solenoid valve(s).

\*Parameter value is chosen according to the current injector test data plan. Injector test data plan (injector test plan or injector calibration data) are list of test parameters unique for each injector.

### Electrical pinout diagrams



Fig.12 9 pin canon type cable

<b>Common Rail Pump Driver</b>			
<b>Electrical Pinout Diagram - Valve outputs</b>			
<b>Connector</b>	<b>Description</b>	<b>Where to connect</b>	<b>Additional description</b>
red banana	+12V	Bosch High Pressure Valve	At the fuel rail
green banana	valve output		On the Bosch CP1 high pressure pump
red banana	+12V	Bosch Fuel Metering Valve	On the Bosch CP3 high pressure pump
yellow banana	valve output		

Fig.13 9 pin canon type cable pinout

Electrical Pinout Diagram - High Pressure Sensor			
Cable	Description	Where to connect	Additional description
black	sensor ground	Sensor PIN1	see photos of the sensor connector
grey	sensor output: 0.5÷4.5V	Sensor PIN2	see photos of the sensor connector
red	sensor power supply: +5V	Sensor PIN3	see photos of the sensor connector

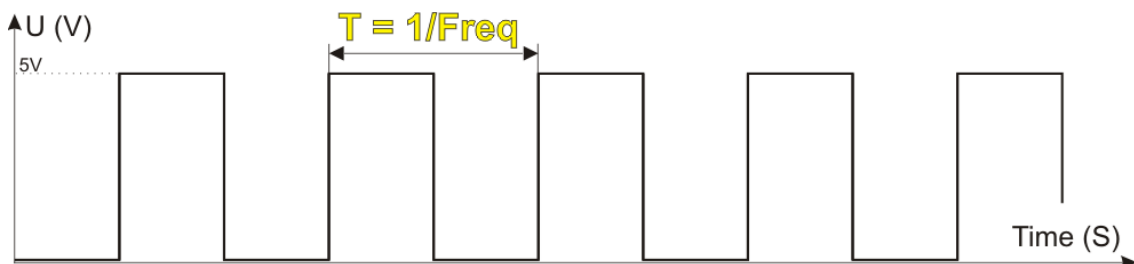
Fig.14 Connection of the Bosch High Pressure Sensor

## Definition of terms

### Frequency

Frequency is the number of occurrences of a repeating event per unit time. Usually the frequency is marked with  $F$  as the measurement unit is Hertz (Hz). Frequency of 1 Hz means, that the event occurs once per second.

In the practice the device used for frequency measurement is the oscilloscope. It measures the period and not the frequency directly.



Interval of time in which some event repeats is called period. In the SI system the period is marked with  $T$  and it is measured in seconds [s]. The period  $T$  is inversely proportional to the frequency and the formula for calculation is  $T = 1 / f$ .

### High Pressure Sensor and Rail pressure

In Common Rail system rail pressure varies between 200bar and over 3000bar on the newest systems. In third-generation common rail diesels now feature piezoelectric injectors for increased precision, with fuel pressures up to 3000 bar (300MPa). Rail pressure is measured in **bar** or in **MPa**.  
1MPa=10bar



Common Rail Pump Driver CRPD200 operates only with Bosch High Pressure Sensors. Their output voltage range is from 0.5 to 4.5 volts. Output voltage is 0.5V when pressure is 0bar and output is 4.5V when pressure is 1500bar or 1800bar depending on the type of sensor being used.

### **Standard package list:**

- Common Rail Pump Driver – main unit
- Main cable with 4 female banana connectors and high pressure sensor connector set (male and female).
- DC power cable.