

CarScope i-Tester

User's manual

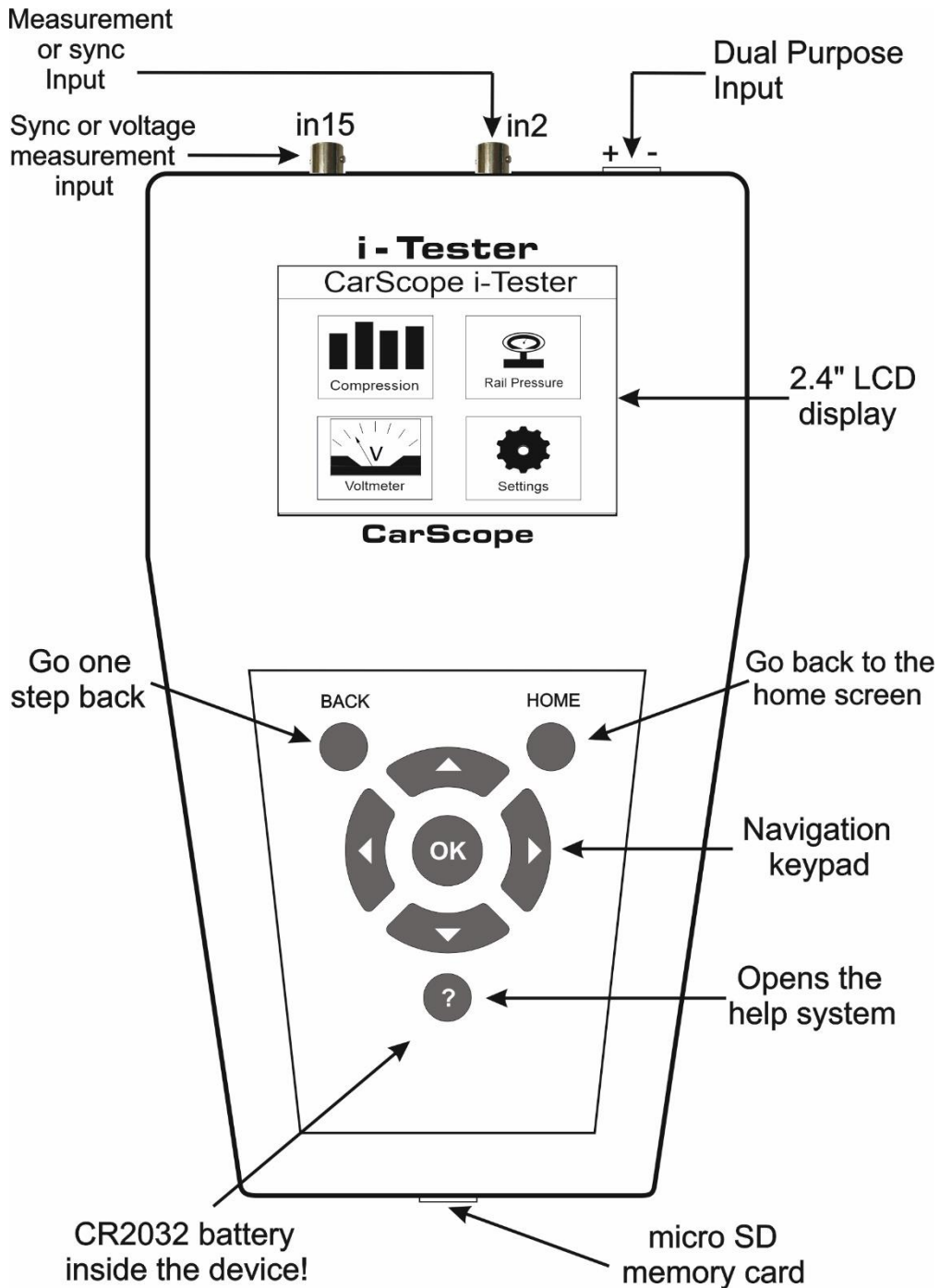
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Important note: Because of lithium-ion battery shipping restrictions, we do not include CR2032 lithium-ion battery inside in the post packages! When you receive the tester, you have to buy a Li-Ion battery type CR2032 yourself and put it into battery holder socket inside the CarScope i-Tester. To do so, you should unscrew and remove 4 screws to open the bottom cover. We apologize for the inconvenience!

1. Introduction and appearance

CarScope i-Tester is a portable engine test tool and essentially a specialized type of engine analyser. It is a complex, multi-function tool, which can help diagnosing the engine and finding engine problems. i-Tester can be used with both gasoline and diesel-powered vehicles. Oscilloscope knowledge skills are not needed. You can skip the training and set-up time of an ordinary oscilloscope and get directly to a quick, precise engine analysis.



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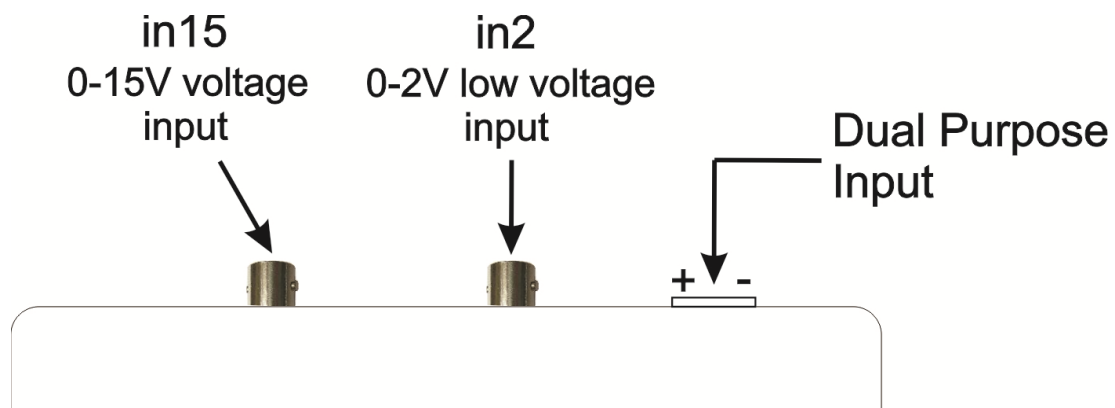
2. Features

- 2.4" TFT LCD 320x240;
- External power adapter not needed;
- 3 Channel - 3 measurement channels provide the ability to use a variety of voltage and current probes at the same time;
- Protection against reverse polarity connection;
- The Relative Compression mode helps you quickly find a low compression cylinder;
- Relative compression test function and automatic waveform analysis;
- Ultra fast boot time;
- Simple to use and connect, easy to use keyboard;
- Internal Micro SD card to save/review measurements and firmware updates;
- Works on 4 stroke, diesel and gasoline engines with 3, 4, 5, 6, 8, 10, 12 cylinders;
- Works on DIS, conventional and Coil-on-Plug ignition systems;
- Common Rail pressure test is super easy – only one wire hooked to the high-pressure sensor output;
- Only 12V electrical systems supported;
- Excellent industrial design.

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3. Inputs and connectors

Warning: All inputs have a common ground respective to the power supply ground at the Dual-purpose input!



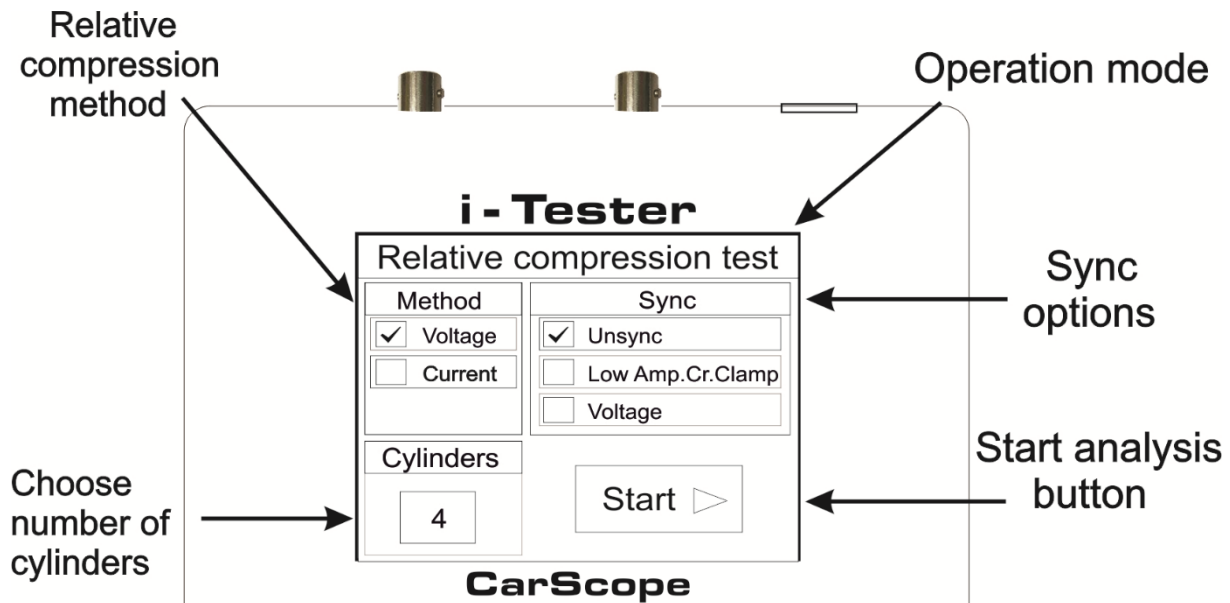
CarScope i-Tester has 3 measurement inputs:

1. **Dual purpose input:** power supply terminal block connector with an additional function.
 - This input is used always when we want to measure the relative compression by DC Voltage method. If you do not want cylinder synchronization, you do not have to use any other inputs.
2. **"in15"** – from 0 to 15V voltage input with a BNC connector. Used for:
 - External synchronization from Inductive pick-up;
 - External synchronization from any gasoline solenoid injector, to get voltage signal;
 - In Common Rail pressure test mode for signal from the high-pressure sensor.

3. **"in2"** – from 0 to 2V low voltage input with a BNC connector. Used for:
- measuring the relative compression with 500, 600A or 1000A current clamps;
 - As a synchronization input when using 10A or 20A current clamps;
 - As a synchronization input from gasoline high impedance (saturated) injectors with an inductive pick-up clamp.

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4. Mode "Relative Compression"



4.1. Description and advantages

Description

This test is only a comparison between cylinders so we can use this method to "see" if we have a cylinder (s) with low compression by comparing one cylinder to the next. Hence the term "relative".

Relative compression is the fastest, simplest way to find a low compression cylinder. This test has previously been available only on large and expensive diagnostic systems, requiring a laptop and an oscilloscope. Now it is easier than ever — with the new CarScope i-Tester that combines both functions - relative compression test and automatic waveform analysis. So, the final results are displayed in an easy to understand format.

You do not have to check each individual cylinder, all cylinders can be tested in one go. CarScope i-Tester works on 3, 4, 5, 6, 8, 10, 12-cylinder cars, 4 stroke, diesel and gasoline engines, DIS, conventional and Coil-on-Plug systems, and 12V electrical systems.

Note: This test cannot be performed on rotary (Wankel) engines!

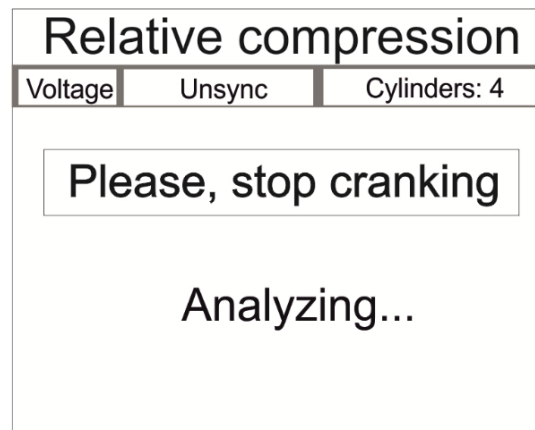
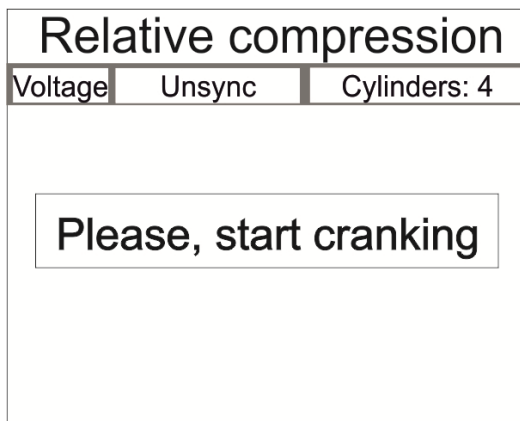
Advantages

- Non-invasive test;
- Test completes within seconds;
- You do not need a pressure transducer to run the relative compression test;

- No mechanical work needed. No removal of spark plugs, glow plugs, or injectors, thus preventing accidental damage to the customer's engine components. All you have to do is to disable the fuel system to prevent the engine from starting;
- Disabling fuel system is always better because you are not flooding your cylinders;
- No oscilloscope needed;
- Reduced skill level required and thus achieve rapid testing;
- No waveform analysis skills needed;
- Test based on scientifically grounded theory;
- Test proven in the practice for many years;
- Useful tool in the parking lot type situation instead of dragging a scope/laptop around;
- No current clamp needed, in case the DC voltage method is used.

When you select and press the Start button, you will be prompted to start cranking:

Keep cranking the engine until the following appear:



The above is valid for all tests below!

4.2. Application

Reasons to perform a relative compression test using i-Tester.

Compression test has to be performed when the engine symptoms are as follows:

- Engine misfiring;
- Rough idle;
- Loss of power over time;
- Unexplained loss of power;
- Smoke from the exhaust;
- Puffing noise in induction or exhaust.

Checking the engine health in cases as follows:

- In case of buying a used car;
- Before ECU remapping to evaluate engine status;
- Periodic prevention check;
- In cases where it is very hard to gain access to the spark plugs in order to perform a traditional compression test.

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4.3. "DC Voltage Unsync"

DC Voltage method – No synchronization (Unsync)

This method is used to verify that all cylinders have equal compression. Results from this test does not allow exact cylinder number identification, because there is no cylinder synchronization signal.

The principle of this test is based on tracking the battery voltage changes during cranking to determine the compression values of all cylinders.

Important note:

Before performing this test, you must disable the fuel system to prevent the engine from starting. This can be done by removing the fuel pump fuse, relay or unplugging the fuel pump itself.

Test steps:

1. Connect the CarScope iTester power cable black crocodile clip to the battery negative (-) terminal and the red crocodile clip to the battery positive (+) terminal.
2. Select the number of cylinders of the engine you are testing, using the ▲ and ▼ keypad buttons.
3. Select the Start button using ◀ and ▶ keypad buttons.
4. Press the OK keypad button to start the test.
5. Follow the instructions shown on the CarScope iTester display.
Note: You may cancel the test process at any time by pressing the Back or Home button.
6. After the test process completed the results will be shown on the CarScope iTester display.

Relative Compression			
Voltage	Unsync		Cylinders: 4
A	B	C	D
89%	64%	100%	94%
Save to file		RPM:216	

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4.4. "DC Current Unsync"

DC Current method - No synchronization (Unsync)

This is the most commonly used method for relative compression measurement. No additional cables and accessories are needed!

It is used to verify that all cylinders have equal compression. Results from this test does not allow exact cylinder number identification, because there is no cylinder synchronization signal. The principle of this test is based on tracking the starter motor current changes during cranking to determine the compression values of all cylinders.

Important note:

Before performing this test, you must disable the fuel system to prevent the engine from starting. This can be done by removing the fuel pump fuse, relay or unplugging the fuel pump itself.

Test steps:

1. Connect the CarScope iTester power cable black crocodile clip to the battery negative (-) terminal and the red crocodile clip to the battery positive (+) terminal.
2. Connect the CA-600 AC/DC current clamp to the iTester "in2" BNC connector.

Be careful, the clamp arrow (points to the battery positive +) matches the current direction! In case of wrong current clamp connection, you will not able to perform this test at all! The current probe must be clamped on the wire that connects the battery to the starter.

Note: CA-600A probe is supplied with a 4 mm banana plug type connectors so it cannot be plugged directly to a CarScope iTester. A banana plug to BNC adapter must be used for this purpose.

3. Select the number of cylinders of the engine you are testing, using the ▲ and ▼ keypad buttons.
4. Select the Start button using ◀ and ▶ keypad buttons.
5. Press the OK keypad button to start the test.
6. Follow the instructions shown on the CarScope iTester display.

Note: You can cancel the test process at any time by pressing the Back or Home keypad buttons.

7. After the test process completed the results will be shown on the CarScope i-Tester display.

Relative Compression			
Current	Unsync		Cylinders: 4
A	B	C	D
89%	64%	100%	94%
Save to file			RPM:216

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4.5. Cylinder synchronization and accessories needed for synchronization

Cylinder synchronization

By hooking up a second probe to either the ignition or an injector, you can follow the firing order/injection sequence and know which one it is. This is not the only way to do this type of cylinder identification but it does work as a way to start with.

Additional accessories needed to capture an external synchronization signal (trigger pickup)

- Main signal cable with a BNC connector to a 4mm red banana plug (included in the basic set)
- Inductive pick-up (optional, it is not in the basic set)
- High sensitive, high frequency current clamp. We recommend current clamps which transformation ratio is at least 1-2V at 10A and frequency response 500Hz minimum. Current clamps designed for the 50-60Hz mains supply will not do the work! (optional, not in the basic set)

Accessories needed for synchronization

- A main signal cable with a BNC connector to a 4mm red banana plug (included in the basic set).



With the main cable, you can get synchronization from:

- Primary ignition;
 - Gasoline injectors;
 - Diesel injectors.
- An Inductive pick-up (optional, it is not in the basic set)

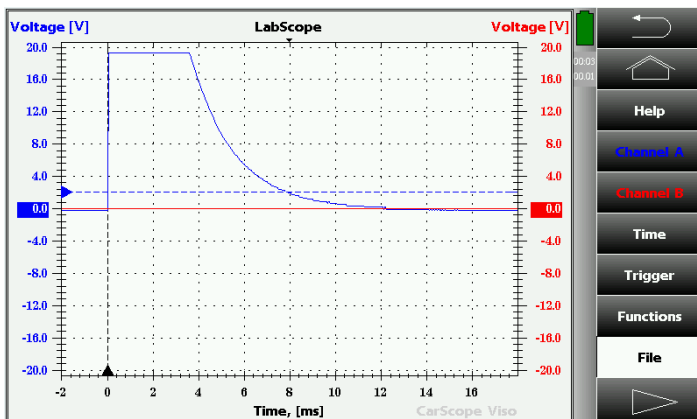


There are various inductive probes for sale, but to achieve a stable synchronization with the i-Tester, we will clarify here the minimum parameter values:

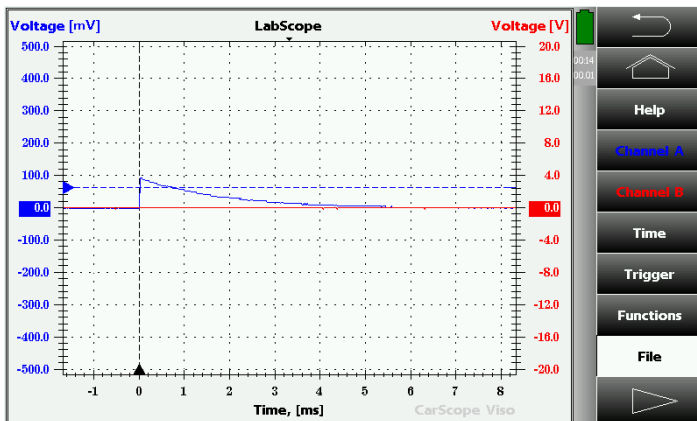
- The output signal of the Inductive pick-up should have an amplitude of at least 120mV (0.12V) when connected to the "in2" input;
- The output signal of the Inductive pick-up should have an amplitude of at least 1.5V when connected to the "in15" input;
- Pulse width (pulse duration) of the Inductive pick-up signal should be at least 1mS.

With this probe, you can get synchronization from:

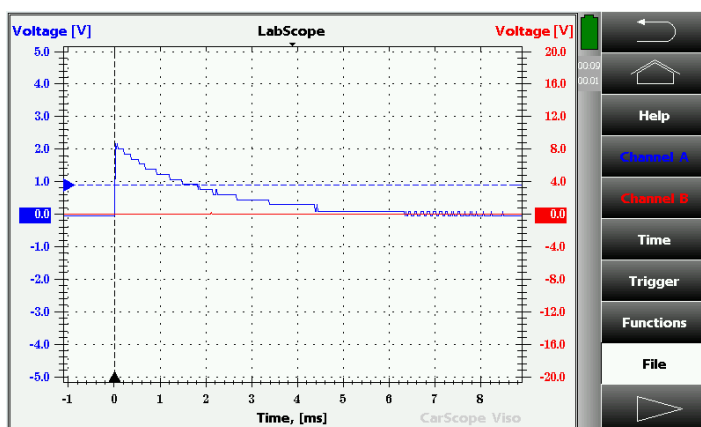
- Primary ignition - signal from primary ignition "coil-on-plug"



- Secondary ignition;
- Gasoline high impedance injector (saturated) - signal from a high impedance (saturated) gasoline injector.



- Diesel injectors - signal from a diesel Common Rail electromagnetic injector



- A high sensitive, high frequency current clamp. We recommend current clamps which transformation ratio is at least 1-2V at 10A and frequency response 500Hz minimum. Current clamps designed for the 50-60Hz mains supply will not do the work! (optional, not in the basic set).



With current clamps, you can get synchronization from:

- Primary ignition;
- Gasoline injectors;
- Diesel injectors.

- 10:1 attenuator when capturing signal from the Primary ignition



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4.6. Synchronization methods – gasoline and diesel engines

Gasoline engines			
Test method	Sync input	Sync probes	Synchronization from
DC Voltage	In15	Inductive pick-up and Coil-on-Plug Extension Lead	Secondary ignition “coil-on-plug”
	In15	Inductive pick-up	Classic secondary ignition system
	In15, In2	Inductive pick-up	Primary ignition (current)
	In2	10/20A High sensitive, high frequency current clamp	Primary ignition (current)
	In15	Main signal cable and a voltage attenuator 20:1 ***	Primary ignition (voltage)
	In15	Main signal cable	Solenoid injector (voltage)
	In15	Main signal cable and a voltage attenuator 10:1 **	Piezo injector (voltage)
	In2	10/20A High sensitive, high frequency current clamp	Injector (current) - solenoid or piezo
	In2	Inductive pick-up *	Injector (current) - solenoid or piezo
DC Current	In15	Inductive pick-up and Coil-on-Plug Extension Lead	Secondary ignition “coil-on-plug”
	In15	Inductive pick-up	Classic secondary ignition system
	In15	Inductive pick-up	Primary ignition (current)
	In15	Main signal cable and a voltage attenuator 20:1 ***	Primary ignition (voltage)
	In15	Main signal cable	Solenoid injector (voltage)
	In15	Main signal cable and a voltage attenuator 10:1 **	Piezo injector (voltage)
Diesel engines			
Test method	Sync input	Sync probes	Synchronization from
DC Voltage	In15	Inductive pick-up	Injector (current) - solenoid or piezo
	In2	10/20A High sensitive, high frequency current clamp	Injector (current) - solenoid or piezo
	In15	Main signal cable	Solenoid injector (voltage)
	In15	Main signal cable and a voltage attenuator 10:1 **	Piezo injector (voltage)
DC Current	In15	Inductive pick-up	Injector (current) - solenoid or piezo
	In15	Main signal cable	Solenoid injector (voltage)
	In15	Main signal cable and a voltage attenuator 10:1 **	Piezo injector (voltage)

* If the induced voltage is greater than 120mV

** **Warning: High voltage up to 140V!!!**

*** **Warning: High voltage up to 400V!!!**

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4.7. "DC Voltage Sync in2"

DC Voltage method - Sync from "in2"

This method is used to verify that all cylinders have equal compression. Results from this test allow exact cylinder identification.

The principle of this test is based on tracking the battery voltage changes during cranking to determine the compression values of all cylinders.

Important note:

Before performing this test, you must disable the fuel system to prevent the engine from starting. This can be done by removing the fuel pump fuse, relay or unplugging the fuel pump itself.

Test steps:

1. Connect the CarScope i-Tester power cable black crocodile clip to the battery negative (-) terminal and the red crocodile clip to the battery positive (+) terminal.

2. Getting a synchronization signal

GASOLINE engines:

- Use a high sensitive, high frequency current clamp:

Injector sync: Connect the current clamp to the "In2" input! Clamp one of the injector's wires with a 10-20A current clamp to get a synchronization signal. Injector current is usually about 1-2A. If you use the CA-60 current clamp, set it to 20A!

Primary ignition sync: Connect the current clamp to the "In2" input! Clamp one of the wires of the primary ignition coil with a 10-20A current clamp to get a synchronization signal.

Primary current is usually about 7-9A.

Be careful, the clamp arrow matches the current direction! Incorrect connection will cause a lack of synchronization signal!

- Use an Inductive pick-up

Injector sync: Connect the Inductive pick-up to the "In2" input! Clamp one of the injector's wires to get a synchronization signal. Inductive pick-up output signal will be about 100mV.

Primary ignition sync: Connect the inductive pick-up to the "In2" input! Clamp one of the wires of the primary ignition coil to get a synchronization signal.

Be careful, the inductive pick-up arrow matches the current direction! Incorrect connection will cause a lack of synchronization signal!

DIESEL engines:

- Use a high sensitive, high frequency current clamp:

Injector sync: Connect the current clamp to the "In2" input! Clamp one of the injector's wires with a 10-20A current clamp to get a synchronization signal. Injector current is usually about 20A. If you use the CA-60 current clamp, set it to 20A!

3. Select the number of cylinders of the engine you are testing, using the ▲ and ▼ keypad buttons.

4. Select the Start button using ◀ and ▶ keypad buttons.

5. Press the OK keypad button to start the test.

6. Follow the instructions shown on the CarScope i-Tester display.

Note: You can cancel the test process at any time by pressing the Back or Home button.

7. After the test process completed the results will be shown on the CarScope i-Tester display.

Relative Compression			
Voltage	Ext.Voltage	Cylinders: 4	
A*	B	C	D
89%	64%	100%	94%
Save to file		RPM:216	

Note: Cylinder recognized as a synchronization cylinder is always A and it's marked with "*". By knowing the injection sequence / firing order of the engine and the cylinder number used for synchronization, you can identify the cylinder numbers and their percentages.

Example: (please see the picture above for reference)

Cylinders: 4

Firing order: 1-3-4-2

Sync. Cylinder: 3

A* - 3: 89%

B - 4: 64%

C - 2: 100%

D - 1: 94%

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4.8. "DC Voltage Sync in15"

DC Voltage method – Sync from "in15"

This method is used to verify that all cylinders have equal compression. Results from this test allow cylinder identification.

The principle of this test is based on tracking the battery voltage changes during cranking to determine the compression values of all cylinders.

Important note:

Before performing this test, you must disable the fuel system to prevent the engine from starting. This can be done by removing the fuel pump fuse, relay or unplugging the fuel pump itself.

Test steps:

1. Connect the CarScope i-Tester power cable black crocodile clip to the battery negative (-) terminal and the red crocodile clip to the battery positive (+) terminal.

2. Getting a synchronization signal

GASOLINE engines - we recommend 2 main triggering methods:

- Use an inductive pick-up:

Connect the inductive pick-up to the "In15" input and clamp it on any cylinder's high-tension wire. If the vehicle uses the "coil-on-plug" ignition system, use a "Coil on Plug Extension Lead" and clamp the Inductive pick-up on it.

Be careful, the inductive pick-up arrow matches the current direction. Incorrect connection will cause a lack of synchronization signal!

- Use the main signal cable with a BNC connector to a 4mm red banana plug to get an injector voltage signal:

Capture voltage signal from one of the injector's wires and supply it to the "In15" input.

- Use the main signal cable with a BNC connector to a 4mm red banana plug and 10:1 attenuator to get a Primary ignition voltage signal:

Capture voltage signal from one of the primary ignition coil wires and supply it to the "In15" input.

DIESEL Common Rail engines:

- Use an inductive pick-up:

Connect the inductive pick-up to the "In15" input and clamp it to one of the injector's wires to get a synchronization signal. Fuel system must be disabled by disconnecting the rail pressure valve and connecting another valve to the vehicle's electrics to simulate its presence! If you don't do this, you will not get an injector signal!

- Use the main signal cable with a BNC connector to a 4mm red banana plug to get an injector voltage signal:

Capture voltage signal from one of the injector's wires and supply it to the "In15" input.

3. Select the number of cylinders of the engine you are testing, using the ▲ and ▼ keypad buttons.

4. Select the Start button using ◀ and ▶ keypad buttons.

5. Press the OK keypad button to start the test.

6. Follow the instructions shown on the CarScope i-Tester display.

Note: You may cancel the test process at any time by pressing the Back or Home keypad buttons.

7. After the test process completed the results will be shown on the CarScope i-Tester display.

Relative Compression			
Current	Low Amp. Clamp	Cylinders: 4	
A*	B	C	D
89%	64%	100%	94%
Save to file		RPM:216	

Note: Cylinder recognized as a synchronization cylinder is always A and it's marked with "*". By knowing the injection sequence / firing order of the engine and the cylinder number used for synchronization, you can identify the cylinder numbers and their percentages.

Example:

(see the picture above for a reference)

Cylinders: 4

Firing order: 1-3-4-2

Sync. cylinder: 3

A* - 3 : 89%

B - 4 : 64%

C - 2 : 100%

D - 1 : 94%

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4.9. "DC Current Sync in15"

DC Current method with sync from "in15"

This method is used to verify that all cylinders have equal compression. Results from this test allow exact cylinder identification.

Test is based on tracking the starter motor current changes during cranking to determine the compression values of all cylinders.

Important note:

Before performing this test, you must disable the fuel system to prevent the engine from starting. This can be done by removing the fuel pump fuse, relay or disconnecting the fuel pump itself.

Test steps:

1. Connect the CarScope i-Tester power cable black crocodile clip to the battery negative (-) terminal and the red crocodile clip, to the battery positive (+) terminal.

2. Connect the CA-600 AC/DC current clamp to the i-Tester "In 2" BNC connector and clamp it on the wire that connects the battery to the starter motor.

Be careful, the clamp arrow (points to the battery positive +) matches the current direction! In case of wrong current clamp connection, you will not be able to perform this test at all!

Note: CA-600A probe is supplied with a 4 mm banana plug type connectors so it cannot be plugged directly to the CarScope i-Tester. A banana plug to BNC adapter must be used for this purpose.

3. Getting a synchronization signal

GASOLINE engines:

- Use an inductive pick-up for Secondary ignition signal:

Connect the inductive pick-up to the "In15" input and clamp it on any cylinder's high-tension wire. If the vehicle uses the "coil-on-plug" ignition system, use a "Coil on Plug Extension Lead" and clamp the Inductive pick-up on it.

Be careful, the inductive pick-up arrow matches the current direction. Incorrect connection will cause a lack of synchronization signal!

- Use an inductive pick-up for Primary ignition signal:

Connect the inductive pick-up to the "In15" input and clamp it on one of the primary ignition coil wires.

Be careful, the inductive pick-up arrow matches the current direction. Incorrect connection will cause a lack of synchronization signal!

- Use the main signal cable with a BNC connector to a 4mm red banana plug to get an injector voltage signal:

Capture voltage signal from one of the injector's wires and supply it to the "In15" input.

- Use the main signal cable with a BNC connector to a 4mm red banana plug and 10:1 attenuator to get signal from the Primary ignition:

Capture voltage signal from one of the primary ignition coil wires and supply it to the "In15" input.

DIESEL Common Rail engines:

- Use an inductive pick-up:

Connect the inductive pick-up to the "In15" input and clamp it to one of the injector's wires to get a synchronization signal. Fuel system must be disabled by disconnecting the rail pressure valve and connecting another valve to the vehicle's electrics to simulate its presence! If you do not do this, you will not get an injector signal!

- Use the main signal cable with a BNC connector to a 4mm red banana plug to get an injector voltage signal:

Capture voltage signal from one of the injector's wires and supply it to the "In15" input.

4. Select the number of cylinders of the engine you are testing, using the ▲ and ▼ keypad buttons.

5. Select the Start button using ◀ and ▶ keypad buttons.

6. Press the OK keypad button to start the test.

7. Follow the instructions shown on the CarScope i-Tester display.

Note: You can cancel the test process at any time by pressing the Back or Home keypad buttons.

8. After the test process is completed, results will be shown on the CarScope i-Tester display.

Relative Compression			
Current	Ext. Voltage	Cylinders: 4	
A*	B	C	D
89%	64%	100%	94%
Save to file		RPM:216	

Note: Cylinder recognized as a synchronization cylinder is always A and it is marked with "*" .

By knowing the injection sequence (firing order) of the engine being tested and the cylinder number that you are using for synchronization, you will be able to identify exact cylinder numbers and their percentages.

Example:

(Please see the picture above for reference)

Cylinders: 4

Firing order: 1-3-4-2

Sync. cylinder: 3

A* - 3: 89%

B - 4: 64%

C - 2: 100%

D - 1: 94%

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4.10. Errors during measurement

Waveform Analysis Error code 001

This error is displayed in case the captured waveform has a very low average amplitude, and the analysis cannot be performed.

This error is most likely due to:

1. Bad (unstable) cables connections.

1.1. In case you are using the DC Voltage method for this test:

CarScope i-Tester power cable is not properly connected.

Please ensure the CarScope i-Tester power cable is connected properly (stable) to the vehicle battery.

1.2. In case you are using the DC Current method for this test:

CarScope i-Tester "in2" input is not connected properly.

Please ensure the CarScope i-Tester "in2" input is connected properly to the current clamp / inductive pick-up and ensure the clamp arrow matches the current direction.

2. Too short engine cranking time.

Please repeat the test with cranking time according to instructions on the CarScope i-Tester display during the test.

3. Bad electrical connection or damaged starter motor.

Please check the electrical connections and the starter motor status.

4. Damaged or discharged battery.

Please check the battery status.

Waveform Analysis Error code 002

This error is displayed in case there are not enough stable cylinder cycles captured.

This error is most likely due to:

1. Too short engine cranking time.

Please repeat the test with cranking time according to instructions on CarScope i-Tester display during the test.

2. Bad electrical connection or damaged starter motor.

Please check the electrical connections and the starter motor status.

3. Damaged or discharged battery.

Please check the battery status.

4. Entered number of cylinders, does not correspond to the tested engine.

Please check the correct number of cylinders.

5. Cranking RPM's too low or too high.

Please ensure the cranking RPM's are in the range from 150 to 400 RPM.

Waveform Analysis Error code 003

This error is displayed if cranking RPM's are too low.

This error is most likely due to:

1. Bad electrical connection or damaged starter motor.

Please check the electrical connections and the starter motor status.

2. Damaged or discharged battery.

Please check the battery status.

3. Entered number of cylinders, does not correspond to the tested engine.

Please check the correct number of cylinders.

4. In case of a missing compression in every even or every odd cylinder, for example:

4.1) 1st Cyl no compression, 2nd Cyl is with compression, 3rd Cyl no compression,
4th Cyl is with compression...

4.2) 1st Cyl is with compression, 2nd Cyl no compression, 3rd Cyl is with compression,
4th Cyl no compression...

In this special case the analysis cannot be performed.

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4.11. Warnings during measurement

Waveform Analysis Warning code 01

This warning message is displayed in case the cylinders with relative low pressure are more than those with relative high pressure.

This warning is most likely due to:

1. Exhaust valves on one or more cylinders are permanently closed.

Please use another cylinder compression test method to confirm or ignore this doubt.

2. Bad electrical connection or damaged starter motor.

Please check the electrical connections and the starter motor status.

3. Damaged or discharged battery.

Please check the battery status.

4. Entered number of cylinders, does not correspond to the tested engine.

Please check the correct number of cylinders.

Waveform Analysis Warning code 02

This warning message is displayed in case the synchronization signal used for cylinder identification is missing or not correct.

This warning is most likely due to:

1. Improper cylinder synchronization signal polarity.
 - In case you are using the main signal cable with a BNC connector to a 4mm red banana plug, please ensure the signal is with positive polarity towards ground;
 - In case you are using a Low amperage current clamp for cylinder synchronization signal, please ensure the Current clamp is connected with right direction to the "in2" input and ensure the clamp arrow matches the current direction;
 - In case you are using an Inductive pick-up for cylinder synchronization signal, please ensure the Inductive pick-up is connected with right direction to the "in15" input and ensure the arrow matches the current direction.
2. Low amplitude of the cylinder synchronization signal.
 - In case you are using the "in15" input, please ensure the signal has an amplitude of at least 1.5V;
 - In case you are using the "in2" input, please ensure the signal has an amplitude of at least 0.12V (120mV).
3. Entered number of cylinders, does not correspond to the tested engine.
Please check the correct number of cylinders.
4. Too short cylinder synchronization signal.
Please ensure the pulse time of cylinder synchronization signal is more than 1mSec (0.001 sec).

Waveform Analysis Warning code 03

This warning message is displayed in case the synchronization signal used for cylinder identification is not stable.

This warning is most likely due to:

1. Unstable amplitude of the cylinder synchronization signal.
 - In case you are using the "in15" input, please ensure the signal has an amplitude of at least 1.5V;
 - In case you are using the "in2" input, please ensure the signal has an amplitude of at least 0.12V (120mV).
2. Entered number of cylinders, does not correspond to the tested engine.
Please check the correct number of cylinders.
3. Some pulses of the cylinder synchronization signal are too short.
Please ensure the pulses of cylinder synchronization signal are longer than 1mS (0.001 sec).

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5. Mode “Rail Pressure”



Note: This function is available since firmware version TT0106B!

5.1. Description, advantages and application

This mode is used for fast verification of the condition of the diesel Common Rail high-pressure system. Results allow direct/indirect identification of common problems in this system – lack of pressure due to leaks, high-pressure pump failure, bad high-pressure sensor, no sensor power supply etc.

The principle of this test is based on checking the high-pressure sensor readings while the car is in various operation states: ignition on, cranking, idling and accelerating.

Checking the high-pressure sensor readings is the fastest, simplest way to find a problem in the Common Rail system.

Great advantage of this test is that it is very easy to perform – only one wire hooked to the high-pressure sensor output.

Test steps:

1. Connect the CarScope i-Tester power cable black crocodile clip to the battery negative (-) terminal and the red crocodile clip to the battery positive (+) terminal.
2. Connect a “BNC to 4mm red banana” cable to the “in15” input and insert a needle probe in the 4mm banana.
3. Back probe the output of the high-pressure sensor which usually is the center pin.
Note: On some Delphi and Siemens high-pressure sensors, output pin is not the center pin! To find it, use a multimeter, back probe each sensor pin to find the ground, +5V and signal output pins! Do not disconnect the high-pressure sensor connector during back probing sensor pins!
4. Choose “Rail Pressure” from the home screen and select your preferable pressure measurement unit. MPa is default but you can change it by entering the Unit submenu and pick “bar” or “PSI”.
5. Select “P threshold” if you need to change the pressure threshold when the engine starts. According to our research during development, the most versatile default value is 185MPa. If you are experiencing problems with your particular system, you can choose between 180 and 200MPa. Pressing \rightarrow returns the default value - 185MPa.

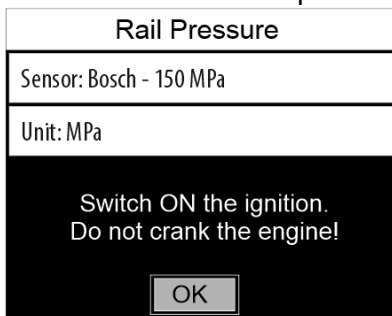
6. Select the vehicle's fuel system type: Bosch, Delphi, Siemens, Denso using the ▲ and ▼ keypad buttons.

Note: To find fuel system type, see the technical documentation of your car or labels on the high-pressure pump, high-pressure sensor, injectors etc.

7. Select the high-pressure sensor pressure range, using the ▲ and ▼ keypad buttons. See the technical documentation of your car for the correct pressure range!

Note: If you select wrong pressure range, displayed pressure will not be the actual rail pressure! For most engines, when the engine is idling pressure is about 25-30MPa!

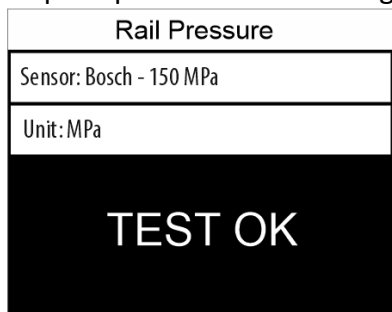
8. Switch the ignition ON and wait for sensor test to complete. You do not need to press the "OK" button in this step!



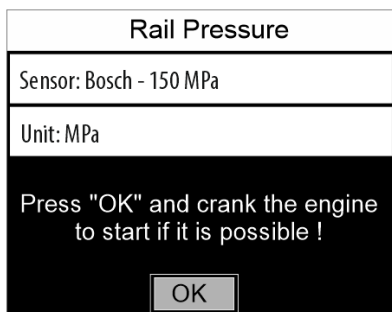
Note: If nothing happens within 5-10 seconds, please check the electrical contact between the high-pressure sensor and the needle probe!

Note: If you receive an error or warning message, see the list of warnings/errors below for more details.

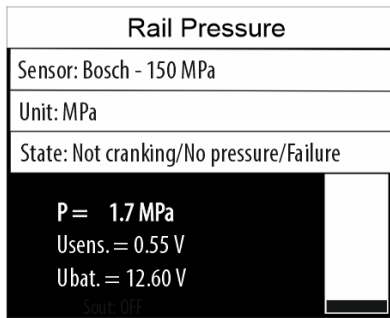
9. You will see the "TEST OK" message for just a second if everything is ok and then you will be prompted to start cranking the engine. See point 10.



10. Press the "OK" button and start cranking the engine.



11. You will get this screen with warning "Not cranking/No pressure/Failure" which is normal. Warning should disappear when the pressure rises.

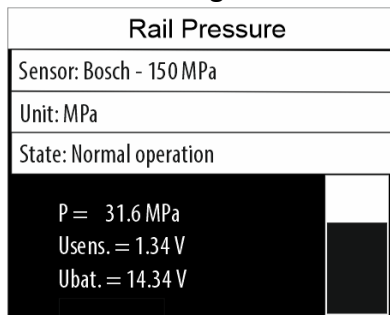


You can see the actual pressure as well as sensor and battery voltages during cranking. If the engine cannot start, you could directly/indirectly find the reason for that.

Note: You may receive errors/warnings in this step, which will guide you to find the problem with the car. See the list of warnings/errors below for more details.

Note: You may cancel the test process at any time by pressing the "BACK" or "HOME" buttons.

12. After the engine start and if everything is ok, the screen will change:



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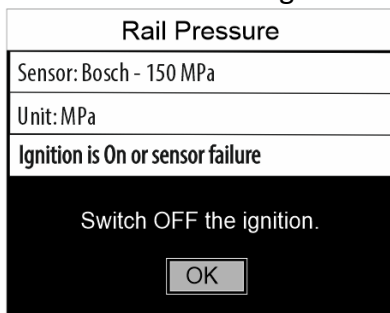
5.2. Warnings during test

List of the possible warning messages during the Common Rail pressure test.


5.2.1. If Ignition is ON and you start a sensor test this warning will appear.

Note: On some cars when you switch OFF the ignition it takes up to 1 minute for the sensor voltage to drop down to zero! You may have to wait until that happens and repeat the test!



Solution: Switch the ignition OFF, (wait) and repeat the test.



5.5.2. This warning is normal and will appear every time after pressing "OK" and before cranking the engine. Other possible reason could be if you are cranking the engine but there is no fuel pressure in the system due to a failure - fuel leaks, bad high-pressure pump and etc.

Rail Pressure	
Sensor: Bosch - 150 MPa	
Unit: MPa	
State: Not cranking/No pressure/Failure	
P = 1.7 MPa Usens. = 0.55 V Ubat. = 12.60 V	

5.3.3. This warning message appears if the engine is cranking but cannot exceed the selected “P threshold” value. You could lower this value and repeat the test again. Default is 185 MPa but you can vary between 180MPa and 200MPa. Note: Pressing \triangleright returns the default value - 185MPa.

Rail Pressure	
Sensor: Bosch - 150 MPa	
Unit: MPa	
State: Insufficient pressure for start	
P = 14.8 MPa Usens. = 0.9 V Ubat. = 11.1 V	

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5.3. Errors during test

List of all possible error messages during the Common Rail pressure test.

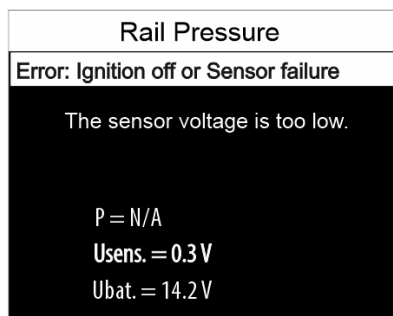
5.3.1. If the car battery voltage is below 10.5V when you start the test, this error message will appear:

Rail Pressure	
Error: Weak battery	
The battery voltage is too low. Replace the battery or recharge It !	
P = N/A Usens. = 0.4 V Ubat. = 9.4 V	

Solution: Recharge or replace the battery!

5.3.2. If Ignition is OFF but the sensor voltage is over 0.1V, this error will appear. It means that something is wrong with the sensor itself because in this state sensor voltage should be 0V.

Note: On some cars it may take up to 1 minute after the last ignition on/engine start for this voltage to drop down to zero!

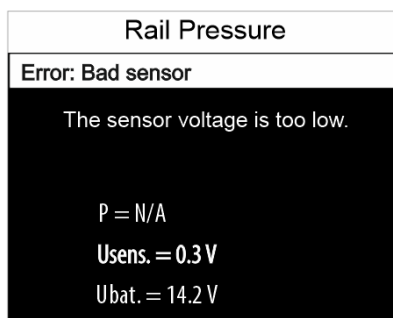


Solution:

- Wait some time and try again;
- If the same error appears, check the vehicle electrical wiring;
- Replace the high-pressure sensor.

5.3.3. If Ignition is ON but the sensor voltage is too low, this error message will appear.

Note: Bosch, Delphi and Siemens sensors have around 0.5V at their output at zero pressure!
Denso sensors have about 1V at zero pressure!

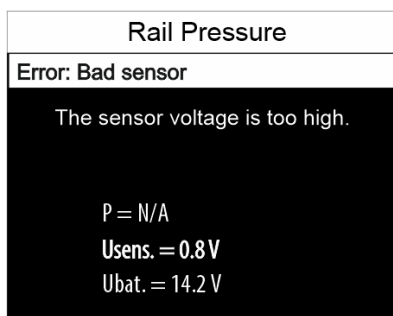


Solution:

- Check the sensor supply voltage – it should be around 5V.
- Check the sensor connection to ground and the vehicle electrical wiring!
- If none of the above-mentioned helps, replace the high-pressure sensor!

5.3.4. If Ignition is ON but the sensor voltage is too high, this error message will appear.

Note: Bosch, Delphi and Siemens sensors have around 0.5V at their output at zero pressure!
Denso sensors have about 1V at zero pressure!



Solution:

- Wait for a while if there is some pressure left in the system to drop down;
- Check the sensor supply voltage – it should be around 5V;
- Check the sensor connection to ground and the vehicle electrical wiring!
- If none of the above mentioned helps, replace the high-pressure sensor!

5.3.5. If during cranking the battery voltage drops below 9.5V, this error message will appear.

Note: It is possible that you have a bad starter motor, which consumes too much current when cranking the engine!

Rail Pressure
Error: Weak battery
The battery voltage is too low. Replace the battery or recharge it !
P = N/A
Usens. = 0.4 V
Ubat. = 9.8 V

Solution: Recharge or replace the battery!

5.3.6. If during cranking, sensor output voltage drops below a predefined value, this error will appear.

Note: Bosch, Delphi and Siemens sensors have around 0.5V at their output at zero pressure! Denso sensors have about 1V at zero pressure!

Rail Pressure
Error: Ignition off or Sensor failure
The sensor voltage is too low.
P = N/A
Usens. = 0.3 V
Ubat. = 14.2 V

Solution:

- Check the ignition status - you should be in ignition ON state at this time;
- Check for sensor failure;
- Check the sensor supply and ground connections;
- Check vehicle electrical wiring.

5.3.7. If during cranking or engine running, sensor output voltage exceeds a predefined value, this error will appear.

Note: Bosch, Delphi and Siemens sensors have around 4.5V at their output at maximum pressure! Denso sensors have about 4V at maximum pressure!

Rail Pressure
Error: Sensor failure
The sensor voltage is too high.
P = N/A
Usens. = 4.8 V
Ubat. = 14.2 V

Solution:

- Check for sensor failure;
- Check the sensor supply and ground connections;
- Check vehicle electrical wiring.

5.3.8. If cranking lasts too long (more than 6 seconds) and the engine cannot start, this error message will appear.

Note: On some cars even if the engine is running, battery-charging circuit still does not operate. If this time exceeds those 6 seconds, this error will appear!

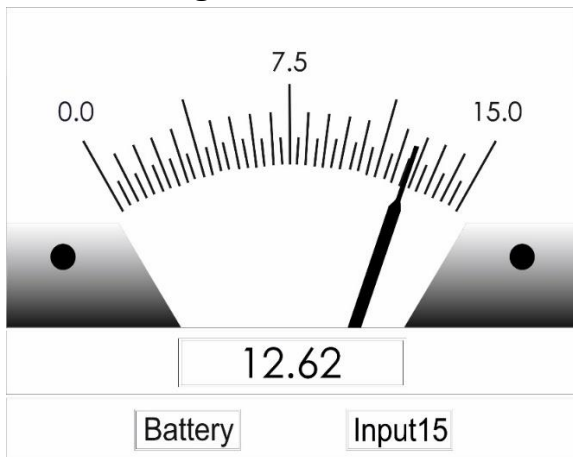
Rail Pressure	
Sensor: Bosch - 150 MPa	
Unit: MPa	
Error: Engine starting problem	
P = 24 MPa	
Usens. = 1.0 V	
Ubat. = 10.7 V	

Solution:

- Check what is preventing the engine from starting;
- Check for fuel leaks that does not allow the engine to start;
- Check the battery charging circuit operation.

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6. Mode "Digital Voltmeter"



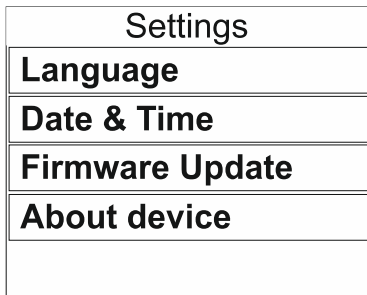
There are 2 possible configurations in this mode:

- Measure the car battery voltage with the power supply cable via the dual purpose input;
- If you use the in15 input, you can use the i-Tester as a standard voltmeter with a ground respective to the power supply ground (at the Dual purpose input).

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7. Settings

In this menu you can change the device language, set date & time, update the device firmware and see details about the device.

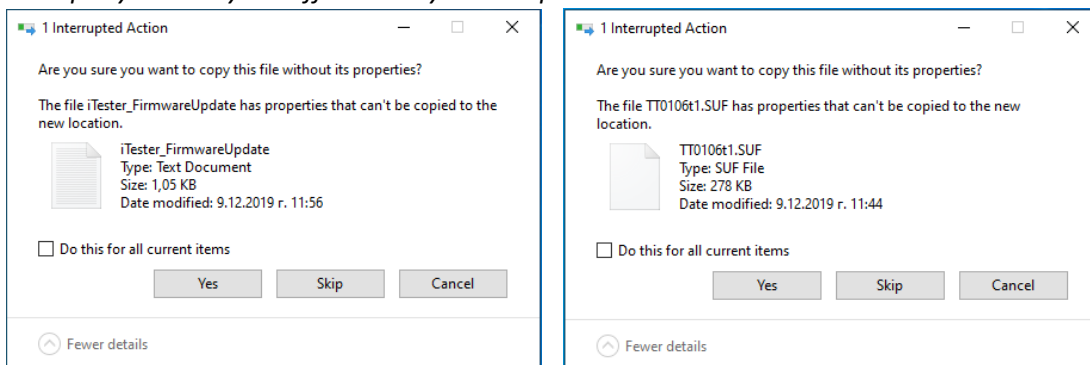


7.1. Firmware update procedure

1. Download the firmware package to your computer.
2. Unzip the archive to your computer.
3. Turn i-Tester power off and unplug the micro SD card from the device.
4. Plug i-Tester SD card to your computer (or USB card reader).
5. Copy the **TTxxxxx.SUF** file from your computer to i-Tester SD card in folder as follows:

SD card:/ITESTER/FWUPDATE/TTxxxxx.SUF

A warning message "Are you sure you want to copy this file without its properties" could appear once or several times. Just click "Yes" on each message and copying will continue. Texts on images below are exemplary and may be different on your computer!



6. Copy the **HELP** folder from the archive to the SD card, replacing the folder with the same name in the following path:

SD card:/ITESTER/

Confirm replacement of all existing files in the micro SD card HELP folder

7. Unplug i-Tester SD card from your computer and put it in i-Tester.
8. Turn i-Tester Power On
9. From the home screen choose "Settings" and select "Firmware update"
10. Select and confirm "TTxxxxx.SUF" file name.
11. Warning message will appear Do you want to continue? Select and confirm "YES".
12. A series of messages will appear on the screen that will inform you about firmware update process status. The whole process will take few seconds.

13. Finally a message will inform you that the firmware is successfully updated to version Vx.x. Press the "OK" button.

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8. Technical specifications

8.1. General Specifications

Functional on the following Engine Types:

Number of Cylinders	3, 4, 5, 6, 8, 10, 12
Engine Stroke	4 stroke
Fuel Types	Gasoline, Diesel
Ignition Systems	Conventional, DIS, Coil-on-Plug
Electrical System Voltage	12V
Power Supply	10V to 18V, 4 W typical
Relative Compression	0 to -100% contribution

Display

Type	TFT LCD Module
Size	2.4" diagonal
Resolution	320 x 240 pixels
Backlight	4chip white LED in Parallel
High Brightness	150 cd/m ²

Real time clock battery	CR2032, 210 mA/h save time for up three years without external supply
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Important note: Because of lithium-ion battery shipping restrictions, we do not include CR2032 lithium-ion battery inside in the post packages. When you receive the tester, you have to buy a Li-Ion battery type CR2032 yourself and put it into battery holder socket inside the CarScope i-Tester. To do so, you should unscrew and remove four screws to open the bottom cover. We apologize for the inconvenience!

Included Memory Card	4 GB micro SDHC
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8.2. Inputs

Dual purpose input

//Power supply connector with an additional function//

Main purpose	Power Supply
Additional purpose	Supply voltage measurement
Frequency Response, -3 dB	DC to > 200 KHz
Coupling	DC

Input range	0 mV to 15 V
Input Overload Protection	± 200V DC+AC peak
Input Impedance	50 kOhm 20 pF
Vertical Resolution	12 bit (4096 levels)
DC Voltage Measurement Accuracy	± 5 mV Max Error

IN15

Frequency Response, -3 dB	DC to > 200 KHz
Coupling	DC
Input range	0 mV to 15 V
Input Overload Protection	±200V DC+AC peak
Input Impedance	50 kOhm 20 pF
Vertical Resolution	12 bit (4096 levels)
DC Voltage Measurement Accuracy	± 5 mV Max Error

IN2

Frequency Response, -3 dB	DC to > 200 KHz
Coupling	DC
Input range	0 mV to 2 V
Input Overload Protection	± 100V DC+AC peak
Input Impedance	100 kOhm 18 pF
Vertical Resolution	12 bit (4096 levels)
DC Voltage Measurement Accuracy	± 3 mV Max Error

[TOP](#)**8.3. Accessory Information**

Standard Accessories (included with your i-Tester)

Shielded Test Lead

Length	1.8 meters
Connector at i-Tester	BNC
Bandwidth	0 to 1.0 MHz
Test lead capacitance	170 pF
Voltage to ground	200V
Maximum input voltage	200V
Maximum current	2A
Maximum cable resistance	100 mohm
Operating temperature range	0 - 40 °C

Power supply cable

Description	Red/Black car battery crocodile clips to 2 pin terminal block plug
Total length	1.0 meter
Connector at i-Tester	Pluggable Terminal Block 5.0mm, 2 POS
Red/Black cables	Silicone jacketed highly flexible 0.75 mm ² (18 AWG)

Operating temperature range -20 °C to +120 °C

Optional Accessories (abbreviated specifications)

Inductive Pickup

The inductive pick-up probe is used for synchronization from primary/secondary ignition or injectors (gasoline or diesel).

Maximum RPM	12,000 RPM @ 4 stroke / 4 cylinder
Accuracy	10% of reading
Current range	0 to 10 amperes
Connector at i-Tester	BNC
Cable	RG58, shielded
Cable length	1.5 meters (5 feet)
Suitable spark plug lead diameter	9 mm. maximum

10:1 Attenuator adapter

The 10:1 voltage attenuator is used for synchronization from injectors (gasoline or diesel) or primary ignition.

Attenuation	10:1
Bandwidth	0 to 1.0 MHz
Input impedance	10 M
Input capacitance	27 pF
Maximum input	200V

AC/DC Current Probe CA-600A

The 600-ampere current clamp is ideal for use with CarScope i-Tester for performing relative compression tests.

The current clamp can measure up to 600 A (AC or DC). In use there is no need to break into the circuit or disturb the isolation as the opening jaws simply clamp around the current carrying conductor. No electrical contact is required.

Current ranges	2 to 600 A dc or ac peak
Rate Output	0 to 600mV (AC and DC) for 0 to 600A
Output	Coil cable with 4 mm banana plug
Captured Conductor Size:	30 mm maximum
Accuracy	0 to 400A, $\pm(2\% \text{ reading} + 2A)$ 400A to 500A, $\pm(3\% \text{ reading} + 2A)$
Low battery indicator	Red LED lightning
Operating environment	0°C to +50°C, at <70 % R.H.
Storage environment	-20°C to +60°C, 0...80 % R.H.
Battery type	9V DC, 6F22
Battery life	100 hors typical
Dimensions	178mm (H) × 70mm (W) × 33mm (D)
Weight	300g

AC/DC Current Probe CA-60A

Current ranges	0.01 to 20 A dc or ac peak 0.2 to 60 A dc or ac peak
Output	Coil cable with 4 mm banana plug
Jaws Opening Capability	Max 9mm conductor
Accuracy	2% to 3.5% (range dependent)
Low battery indicator	Red LED lightning
Operating environment	0°C to +50°C, at <70 % R.H.
Storage environment	-20°C to +60°C, 0...80 % R.H.
Battery type	9V DC, 6F22
Battery life	100 hors typical
Size	195mm X 70mm X 33mm
Weight	250g

Car Cigarette Lighter cable

You can use this cable to power the device from the cigarette lighter. This allows you to sit inside the car while performing the relative compression test.

WARNING:

ALL INPUTS HAVE A COMMON GROUND RESPECTIVE TO THE POWER SUPPLY GROUND AT THE DUAL PURPOSE INPUT! WHEN USING A POWER SUPPLY THAT IS NOT DOUBLE INSULATED, CONNECT COMMON TO PROTECTIVE GROUNDING!

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