Oscilloscope Diagnostics
A PicoScope Guide

Where to start
What to do
How to succeed
Foreword
By Alan Tong, Founder and Managing Director, Pico Technology

When I started designing and building Pico oscilloscopes over 25 years ago, I could not have imagined how technology within the automotive industry would develop. Today I am proud that Pico is at the forefront of diagnostics in this industry.

We work closely with our ever-growing customer base of vehicle manufacturers. Whether we are continuously developing the product at our headquarters near Cambridge, UK, or in our USA office in Texas, we are committed to meeting VMs needs through advancements in technology. As such, PicoScope is no longer limited to just electrical systems, but can also test and diagnose pressure, noise, vibration and harshness issues like never before.

It’s this heritage that allows us to create products for the aftermarket that continually grow and have become the benchmark for scope-based diagnostics. We hope that this guide will show how the power of PicoScope can help benefit businesses, as we show you the ease and simplicity of our PicoScope 6 Automotive software.
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The Diagnostic Journey
To understand how you ultimately get the very best out of oscilloscope diagnostics with your PicoScope, we must first understand where PicoScope fits into the diagnostic process. Our aim is for PicoScope to help your workshop give your customers the very best diagnostic service.

Let us start with an example: A customer arrives with an engine running issue. Just like all forms of mechanical diagnostics, the first step is to ask the customer about the problem. This is often (but not always) accompanied by a dashboard warning light.

Your general first port of call will be to attach a serial diagnostic tool to the vehicle. In our example this gave the fault codes ‘P1345 Cam/Crank Synchro fault’ and ‘Camshaft Sensor Open Circuit’. With a degree of knowledge we might assume that the most likely cause of these codes would be a faulty camshaft sensor.

The camshaft sensor was replaced, the engine code erased, and the vehicle returned to the owner. In this example, the customer returned the next day with the same fault.

Finding and testing the root cause with PicoScope
The above is a simplistic view, but let us consider a workshop that has invested in PicoScope and is using it as an everyday tool for diagnostics. In this case, following the fault code readout from the serial diagnostic tool, it would be common practice to connect the PicoScope to the camshaft sensor to test it before it is removed.

When the test was completed, the PicoScope results initially gave the view that the camshaft sensor was working correctly.

When you capture data with PicoScope, it stores data in the Waveform Buffer. This allows you to scroll through frames of data post-test and to review your waveform captures. Zooming in on the camshaft waveform, it soon became clear there was an intermittent fault.

Running the test again, while gently wiggling the wiring loom, it quickly became apparent that there was a wiring issue.

Further inspection of the wiring revealed chafing between the camshaft sensor wires. This fix was quick and simple to resolve without replacing any components.
Following the wiring repair, the test was repeated with PicoScope which showed a clear fix. The fault codes were erased and the vehicle was returned to the customer. The workshop was confident that the root cause had been found and fixed.

The customer left the workshop, happy with a successful diagnosis. With no fault recurrence, this professional diagnostic workshop ensured future business with their customer.

This is of course just one example of where PicoScope fits in the diagnostic journey. As technicians you will understand there are many tools at your disposal, including: technical information, training, knowledge, serial diagnostic tools, gas analyzers, and of course PicoScope.

It’s your ability to use these together that will ensure you remain a successful workshop in the future. Armed with PicoScope and the knowledge that you are able to see, analyze and understand the electrical signals that vehicle components produce, you will be confident that you can discover the root cause of a problem. This in turn will enhance the image of your business as professional diagnostic providers.

Don’t just take our word for it. More than twenty of the world’s leading vehicle manufacturers already use PicoScope in their dealer diagnostics, and it’s our heritage and commitment that makes PicoScope the scope of choice.
What can PicoScope do?

With ever more complex diagnostic problems facing the diagnostic workshop, a tool to get to the real cause of the problem has never been more valuable. Only with PicoScope do you have such a high level of help available as a first-time user, as well as lightning-fast capture rates to cope with the most advanced modern-day vehicle signals.

Pico Technology is unique within the automotive industry, in the way we specialize in the manufacture of PC-based scopes for automotive use, and work with an ever increasing number of the world’s leading vehicle manufacturers for dealer-level oscilloscope diagnostics. This experience makes sure that PicoScope is ahead of its competition, and constantly advancing to tackle the fast-paced developments within the automotive industry.

Over the following pages you will find a short summary of PicoScope and what it can do. We hope this will help show you that, by investing in PicoScope, your business can become proficient in vehicle diagnostics, staying ahead of the competition.

Remember, PicoScope can be used on a wide range of vehicles and equipment, including cars, trucks, bikes, agricultural vehicles, boats, and more. When used with our range of accessories, PicoScope can also detect signals relating to: vacuum, fuel and hydraulic pressures, noise, vibration and harshness. It is also safe to use with no risk to the vehicles or equipment, thanks to our non-intrusive testing methods.
Oscilloscope Diagnostics Using PicoScope 6 Software

Pico Technology’s advanced diagnostics software is always on hand to help you, no matter what your experience of capturing component waveforms is. At this point it is worth reminding ourselves what a waveform is. Simply put, it shows how voltage levels change over a period of time:

What makes the PicoScope so powerful, is the ability to capture these waveforms. It turns the vehicle’s electrical signals into a picture that you can see, measure, manipulate, and compare, to understand exactly what is going on within a vehicle’s systems in real-time.

PicoDiagnostics

Arguably PicoScope’s best-kept secret is our PicoDiagnostics software. This ever-evolving software is downloaded for free alongside our PicoScope Automotive software. It not only gives you an accurate, powerful battery and alternator tester, but also includes a test for relative compression and cylinder balance. Note that performance of these tests is limited by some modern vehicle’s smart charging systems.

As your journey into more advanced vehicle diagnostics continues, the purchase of our NVH (noise, vibration and harshness) kit opens up the possibility of detecting and analyzing issues with noise, vibration and harshness.

Remember

Both PicoScope 6 Automotive and PicoDiagnostics are available to download for free from our website: www.picoauto.com. There are no charges or annual fees for updates, as our software constantly evolves, improving your tool long after the initial purchase.
This perception could not be further from the truth. While PicoScope may be used by some of our industry’s foremost experts (thanks to its outstanding performance and resolution), it is surprisingly intuitive and easy to use for a novice. Let us start at the beginning.

You are probably already familiar with using a multimeter as a basic check, to make sure that a component is receiving a signal voltage. You will also know that the multimeter is relatively easy to connect to the component. While a more secure connection is required, there is virtually no difference between the connections for the multimeter and the scope.

For our scope connection we use back-pinning probes or breakout leads to give a better connection, but in truth these are no more difficult to use. Let us look at an example of connecting to a camshaft sensor.

Locate the sensor you wish to test by using a combination of experience and technical data.

For a camshaft sensor we recommend that you use a back-pinning probe. When this connection is made it is simple to attach your diagnostic tool.

The simplicity of the connection is where the similarity stops. Only with a PicoScope can you see high levels of detail in your test results. More importantly, the waveform is much more valuable to you as a technician than a simple multimeter reading.

For example, a multimeter measurement of 7.46 V is displayed. However, with the same connection, PicoScope displays a clear and concise waveform, showing a 12 V camshaft sensor switching off and on with a regular pattern.

Granted, this example is one of the easiest components to both connect to and analyze, but with PicoScope there really are an unlimited number of tests you can undertake. We even include an ever-increasing selection of Guided Tests (currently over 150) in the PicoScope 6 Automotive software, to help you test the most common components.
Guided Tests

The Guided Tests cover a variety of component tests, including:

- Starting and Charging circuits
- Sensors
- Actuators
- Ignition
- Communication networks
- Advanced tests
- Pressure sensors
- Motorcycle-specific

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When you select any of these tests a Guided Test sheet is opened containing:

How we recommend you connect to the component:

An example waveform:

Notes about the waveform to help with your analysis:

Technical information: How the component works and of course how it relates to other components:
In addition, when you select the Guided Test, the PicoScope software also opens a data file which sets up the PicoScope to run the given test. This means that in your first days of using PicoScope you don’t have to worry about setting up the software manually – you are simply ready to start running your test.

Understanding and Analyzing Waveforms

The first thing to consider when viewing and analyzing waveforms, is the timebase and voltage scale. While our Guided Tests will set these up for you, it is a good idea to take the time to learn the basics. This will help you analyze waveforms and hone your PicoScope skills. Let us go back to the beginning and simply see the waveform as voltage shown over time, and apply this to what we see on the screen.

Voltage

This can be set on the drop-down menu adjacent to each channel option button. It is set by default to ±5 V, but can easily be changed. Your chosen voltage scale is divided equally between the 10 vertical divisions shown on screen. In our example each division represents 1 V, from -5 V to +5 V.

Timebase

By default, the timebase is set to 5 milliseconds per division (5 ms/div) of which there are ten. A setting of 5 ms/div gives you 50 ms of time across the entire capture. The timebase setting is controlled by a drop-down menu located on the toolbar. To view more detail of a single event, simply reduce the timebase. To view more events with less detail, simply increase the timebase. The zoom functions give you the best of both worlds, capturing with a fast timebase for every piece of information, but being able to view the waveform at any level of detail.

It is worth taking the time to become familiar with these settings, as they will let you make small changes to how the waveform is displayed on the screen. This can prove invaluable to you, as it enables you to see it in the detail you require. Do not forget that the Auto Setup button is there to help, and will adjust your capture settings to show you sensible waveforms.

When you are connected to the component, and your settings are complete, you just press the start button (or alternatively the spacebar on your keyboard). PicoScope will start to record the data. Stop the test at any time and scroll back through your waveforms with the waveform buffer: This is particularly useful for spotting intermittent faults.
We have now covered a little about the screen and some basics about setting up and understanding the parameters. Next, let us take a look at how we best analyze and understand waveforms. Of course there is no magic wand here, but PicoScope allows you to easily view waveforms in the very best way possible. Combine this with our Guided Tests and the Waveform Library (see below) and we provide you with some great tools to help understand and analyze what you see. The ability to interpret waveforms is still where the skill lies.

We supply many reference waveforms, both within our Guided Tests and on the Waveform Library. It is, however, worth remembering that you are usually not looking for an exact match, but a way to compare and evaluate (as in our example) whether a component is working correctly.

The Reference Waveform in the example above has been captured at a slightly different voltage scale to our test component. At first glance it appears difficult to use as a comparison, but it is still valuable.

We know that the green waveform signal has come from a good coil pack, and despite the blue waveform from our coil pack having been recorded at a different voltage scale, it is easy to see that there is no coil oscillation taking place; so we indeed have a faulty coil pack. We could also adjust the scaling and offset of our signal to make visual comparison easier.

As you can see from the example above, interpretation is key when viewing and analyzing waveforms. This once again emphasizes the importance of the data in the Guided Tests and of course in the Waveform Library.
The Waveform Library lets you search for a valuable reference waveform as a comparison for your test. When you have found a waveform, you can import the full captured waveform or individual channels. This makes it easy to compare with your own captured signal. Often rulers become very powerful when comparing, and again our previous example highlights this well.

It is worth remembering that this powerful feature will allow you to save and share your own waveforms with the PicoScope community, and if you get stuck you can always email or call our support team for further advice.

You can find more help and advice at www.picoauto.com. Our online forum is a great source of help and information, as well as the many case studies and online training articles we have published. You will also find a list of our recommended trainers and links to their various training courses, so that you can increase your understanding and knowledge about using PicoScope even further.

Over the next few pages we will look at the specifics of some of the most valuable tests you can run with PicoScope, and look in more detail at how these can help you. We hope that you feel inspired to start working with PicoScope.
PicoScope Top 10 Tests

If you are new to PicoScope you may be wondering exactly how you can use it, and the benefits it will have for your workshop. With this question in mind (and because we have spent years working with scope diagnostics) we have created what we feel are the top ten uses for PicoScope. We have included a brief overview of each test, the benefits the test offers your, and most importantly, how to:

- **Connect** Connect to the vehicle
- **Run** Capture the waveform
- **Read** Analyze the captured waveform

Remember: Many of the following tests are supported with a full Guided Test and settings file built into the PicoScope Automotive software. We are proud to have over 150 of these Guided Tests, but these are by no means the limit of what PicoScope can be used to test for.
**TEST 1: Relative Compression / Cranking**

<table>
<thead>
<tr>
<th>Software</th>
<th>PicoScope 6 Automotive – Guided Test AT004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checking</td>
<td>Suspected compression issues</td>
</tr>
<tr>
<td>Skill level</td>
<td>🔧 🔧 🔧 🔧 🔧</td>
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**Connect** 2000 A Current Clamp – fitted around the battery+ cable, make sure that the orientation of the clamp is correct, with respect to the current flow away from the battery.

**Run** Timebase should be set to 200 ms per division. Start PicoScope.

**Read** The waveform shows the amperage to crank the engine, usually between 80 and 200 amps. Once the engine has overcome the initial friction and inertia, the waveform should settle down to a consistent ‘sawtooth’ pattern – zoom and rulers can help evaluate here, although a drop in cylinder compression is often quite obvious.

If the waveform confirms a cylinder is losing compression, further testing with a low amp current clamp, connected to an injector or ignition coil, will help to identify the offending cylinder.

Using our WPS500X pressure transducer will highlight any mechanical issues requiring further attention.

Each peak of the sawtooth pattern should be equal and level (once settled).
**TEST 2: Battery, Alternator and Starting Test**

<table>
<thead>
<tr>
<th>Software</th>
<th>PicoDiagnostics (remember that this is a separate software package to PicoScope 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checking</td>
<td>Vehicle starting and charging circuits</td>
</tr>
<tr>
<td>Skill level</td>
<td>⚛ ⚛ ⚛ ⚛ ⚛</td>
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**Connect** a BNC cable from Channel A on the PicoScope to the battery +, and a ground point on the vehicle. Then connect our 2000 A current clamp to PicoScope and position it around the starter motor feed cable.

**Run** Follow the setup wizard in our PicoDiagnostics software to run the test.

**Read** The test result is displayed in a simple traffic light system, and covers all the starting and charging components.

This result can be printed out as a report for your customer. This report can be customized with your workshop details and logo, as well as your customer’s information.

Remember to put the correct data in the drop down boxes (temperature, type of battery and the battery specifications: CCA, EN, DIN).
**TEST 3: Diesel injector current**

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<thead>
<tr>
<th>Software</th>
<th>PicoScope 6 Automotive – Guided Test AT039</th>
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</thead>
<tbody>
<tr>
<td>Checking</td>
<td>Diesel injectors</td>
</tr>
<tr>
<td>Skill level</td>
<td>🔧 🔧 🔧 🔧 🔧</td>
</tr>
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</table>

**Connect** using a 20 A / 60 A current clamp, connect to Channel A on your PicoScope and place the clamp around the fuel injector supply wire. You might need to connect to each wire in turn to identify the correct one. It may also be necessary to pull back some of the loom’s outer shielding to fit the current clamp.

**Run** by pressing the start button or the space bar to capture the waveform (the engine must be running).

**Read** Each injection event will be visible and will include: pilot, pre-, main and post injection to confirm the fueling strategy under all test conditions. You can create a reference waveform to quickly compare multiple injectors on the screen. The comparison is made easy with the rulers integrated in the software. PicoScope software contains Guided Tests for all common injector makes.

Make sure that the current clamp has enough battery power.

**Note:** This is a Piezo injector. Solenoid injectors have very different waveforms.
**TEST 4: Ignition Coil-On-Plug**

| Skill level | ⚒ ⚒ ⚒ ⚒ ⚒ |

**Software**
PicoScope 6 Automotive – Guided Test AT077

**Checking**
Vehicle Single Coil Packs

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**Connect**
Locate the top of your coil packs. Connect the Coil-On-Plug and Signal Probe to the PicoScope and earth to the vehicle.

**Run**
The engine must be idling for this test. Start PicoScope and place the end of the COP probe on the top of the coil pack to capture the signal. You should see a clear signal.

**Read**
The waveform will look something like the example below. Now you can see every detail. **In our example** you can clearly see the ‘burn time’ from the spark plug. It also shows the coil oscillation period. Remember how easy it is to use rulers to measure the different parts of the waveform, and our reference waveforms, to compare with different coil packs.

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**Move the probe around to pick up the best signal.**
TEST 5: Cam and Crank sync

<table>
<thead>
<tr>
<th>Software</th>
<th>PicoScope 6 Automotive – Guided Test AT151</th>
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</thead>
<tbody>
<tr>
<td>Checking</td>
<td>Valve Timing Evaluation</td>
</tr>
<tr>
<td>Skill level</td>
<td>🔧 🔧 🔧 🔧 🔧</td>
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**Connect** Locate sensors using your vehicle’s technical data. We recommend you use either back-pinning probes or breakout leads to make the connection. Use technical data to identify the signal wire. You may need to check multiple connections to get a signal.

**Run** The engine must be idling to complete this test. Start PicoScope when you are ready to capture the signal.

**Read** There should be a consistent pattern that develops as you capture data throughout 720 degrees of crankshaft rotation. With cam and crank signals, this consistent pattern can provide invaluable data for waveform comparisons.

Remember to extend the timebase to allow you to see multiple revolutions together. If each 360° camshaft revolution is consistent, it is likely that the synchronization between the camshaft and the crankshaft is correct, and that both sensors are working correctly. Inconsistencies will highlight probable valve timing issues, sensor faults or short circuits within the associated wiring looms.

Use the rotation rulers to ensure the relationship between crankshaft and camshaft sensors.
**TEST 6: Wiggle Test**

<table>
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<tr>
<th>Software</th>
<th>PicoScope 6 Automotive</th>
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<tbody>
<tr>
<td>Checking</td>
<td>Wiring loom or connection faults</td>
</tr>
<tr>
<td>Skill level</td>
<td>🔧 🔧 🔧 🔧 🔧</td>
</tr>
</tbody>
</table>

PicoScope captures data so fast it is easy to identify wiring or connection issues quickly. Simply wiggling a wire (arguably an easy test that can often be overlooked) can reveal a wiring fault.

**Connect** This test is used when you have spotted an intermittent fault with a signal (so a connection is already made).

**Run** Start PicoScope when you are ready to capture the signal, and gently wiggle the wiring loom attached to the component. We recommend reducing the capture rate to make it easier to spot problems within a single screen capture. Masks and alerts can be used to automate detection when signals go outside normal limits.

**Read** Stop PicoScope and scroll back through the data with the buffer controls. Often wiring or connection faults will create an inconsistent pattern as illustrated in the example. When we scrolled back through our captured data, it was easy to spot the signal faults from the ignition coil. In this example, it turned out that a fault in the wiring loom was causing an ignition misfire.

Remember to retest after the repair, to make sure that you have a reliable fix.

Use a slow timebase across the screen while you do a wiggle test.
**TEST 7: Lambda (Oxygen) Sensor Testing**

<table>
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<tr>
<th>Software</th>
<th>PicoScope 6 Automotive – Guided Test AT022 &amp; AT023</th>
</tr>
</thead>
<tbody>
<tr>
<td>Checking</td>
<td>Lambda (Oxygen) Sensor</td>
</tr>
<tr>
<td>Skill level</td>
<td>⚒ ⚒ ⚒ ⚒ ⚒</td>
</tr>
</tbody>
</table>

**Connect** Locate the sensors with the help of your vehicle’s technical data. We recommend you use either back-pinning probes or breakout leads to make the connection.

Use the technical data to identify the output signal wire from the lambda sensor harness connector.

**Run** Note: The engine is required to be at normal operating temperature in order to produce a valid signal. Start PicoScope when you are ready to capture the signal.

**Read** Depending on the type of lambda sensor, the signal will be seen to cycle high and low in a consistent manner with curved edges. These sensors generally switch high and low once per second. We have included Guided Tests for measuring different types of lambda sensors, so please read these for further information.

Remember to have a good earth point for this sensor.

![Diagram of sensor connections](image)
TEST 8: Air Flow Meter (AFM) also known as MAF (Mass Airflow Sensor)

<table>
<thead>
<tr>
<th>Software</th>
<th>PicoScope 6 Automotive – Guided Test AT008 &amp; AT095</th>
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</thead>
<tbody>
<tr>
<td>Checking</td>
<td>Air Flow Meter testing</td>
</tr>
<tr>
<td>Skill level</td>
<td>🔧 🔧 🔧 🔧 🔧</td>
</tr>
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</table>

**Connect** Locate sensors with the help of your vehicle’s technical data. We recommend you use either back-pinning probes or breakout leads to make the connection. Use the technical data to identify the signal wire. You can choose to check multiple terminals to obtain a signal.

**Run** Start PicoScope, and snap the throttle quickly from idle to full throttle to capture the waveform. We suggest a timebase of 1 s/div to capture 10 seconds of data in one frame.

**Read** The voltage output from the Air Flow Meter (AFM) should be proportional to airflow. The waveform should show approximately 0.5 volt when the engine is at idle, but this voltage will rise as the engine is accelerated, to around 4.0 to 4.5 volts. This voltage will, however, depend on how hard the engine is accelerated, and a lower voltage is not necessarily a fault within the AFM.

On deceleration the voltage will initially fall as the throttle is closed, reducing the airflow as the engine returns to idle speed. Further details are covered in our Guided Tests.

The example waveform is from a gasoline mass airflow sensor. A diesel sensor waveform will look different.
Connect We recommend using our CAN Test Breakout box to make a secure connection to the vehicle’s communication signals. When it is connected to the vehicle’s EOBD socket, the LEDs on the breakout box will light up to indicate that communication is established. Connect the YELLOW lead to Channel A of the scope and to pin 6, then the black pin to pin 4 (Chassis GND). Connect the RED lead to Channel B of the scope and to pin 14.

Note: Some vehicles can have multiple CAN connections on the 16-pin connector, and some vehicles may use pin 5 (Signal GND) instead of pin 4.

Run Start PicoScope and turn on the vehicle ignition. You should now see a waveform.

Read The waveform should reveal to you that data is being exchanged continuously along the CAN bus. The signals should be mirror images of each other and there should always be two signals present. It is also possible, of course, to check that the peak voltages are correct. The workshop manual should be referred to for precise waveform values.

The CAN signal may not be present at the OBD socket until a scan tool is connected.
**Test 10: WPS500X Compression Testing**

<table>
<thead>
<tr>
<th>Software</th>
<th>PicoScope 6 Automotive – Guided Test AT157</th>
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<tbody>
<tr>
<td>Checking</td>
<td>Petrol engine compression (advanced)</td>
</tr>
<tr>
<td>Skill level</td>
<td>🔧 🔧 🔧 🔧 🔧</td>
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**Connect** the WPS500X Pressure Transducer to PicoScope with the BNC to BNC cables provided. Attach the transducer, as you would any compression gauge, by removing a spark plug and properly disabling the fuel system (if possible) and ignition for that cylinder.

**Run** Start PicoScope and the engine. You may need to adjust the timebase and voltage scales to achieve the best signal display.

**Read** When you have captured the waveform, you will be able to see everything that is taking place in every 720° cycle of the engine. Use rotation markers (found in the bottom right-hand section of your PicoScope screen), to better understand the details. You can adjust these markers to show 4 partitions and divide the waveform into 180° partitions revealing the 4 stroke cycle. Now you can reveal exactly how the cylinder is operating under test during each engine stroke: TDC > Ex Valve Opening > Exhaust Valve Closing > Inlet Valve Opening > Inlet Valve Closing > BDC

Switching the pressure transducer from one cylinder to the next is an easy way to have a direct and valuable comparison. Remember, it is not any more difficult to attach than a standard compression gauge, but it will give you so much more information. You can also save the first cylinder as a reference against the remaining cylinders. Viewing all this lets you to make a complete and accurate engine diagnostic. You can do this before you undertake a time-consuming and expensive engine dismantle. In addition, should a dismantle be required, it lets the technician identify where a fault is most likely to be found when work begins.

The Expansion pocket should be equal to the Intake pocket. Any anomalies here would indicate valve timing or valve seat errors.
Top Tip for more Guided Tests

As you now realize, the many Guided Tests contained in the PicoScope Automotive software are invaluable when you first start using your PicoScope. Inevitably there will come a point where you want to test a component that is not covered by a Guided Test.

This does not have to be as difficult or daunting as you may think, as it is highly likely that the test you want to undertake already has been done by one of our team, or other customers. First, search the Waveform Library for the component you wish to test. When you find the waveform, you simply open it.

When you open up a PicoScope waveform, the software automatically adjusts the timebase and voltage scale to the parameters set when the test was undertaken. At this point, you will have to use the technical data, and of course your own knowledge base, to find the component and connect to it.

Remember you can also load a reference waveform to see on screen while you capture your own data. That way, you can make a post-capture comparison.
Choosing the Right Kit for You
After establishing your need for a PicoScope, how do you choose the right kit? Below is a summary of our kits, ranging from starter kits (giving you a basic set of adaptors to get going with PicoScope), right up to our 4-Channel advanced kit (offering a comprehensive range of accessories within the kit).

The kits are available in a carry case, foam trolley trays, or both.

2-Ch Starter kit  Order Code: Box PP920, Foam PQ000
2-Channel PicoScope 4225
2 x Small crocodile clip (black & red)
2 x BNC to 4 mm test leads: blue and red
1 x 1.8 m Pico USB3 Cable
2 x Battery Clip (black & red)
2 x Flexible back pinning Probe (black & red)
1 x High bandwidth 10:1 attenuator
1 x PicoScope Software CD
1 x Pico Advanced Vehicle Diagnostics DVD

4-Ch Starter kit  Order Code: Box PP921, Foam PQ001
4-Channel PicoScope 4425
2 x Small crocodile clip (black & red)
4 x BNC to 4 mm test leads: blue, red, green, yellow
1 x 1.8 m Pico USB3 Cable
1 x Battery Clip red
2 x Battery Clip black
2 x Flexible back pinning Probe (black & red)
1 x High bandwidth 10:1 attenuator
1 x PicoScope Software CD
1 x Pico Advanced Vehicle Diagnostics DVD

2-Ch Standard kit  Order Code: Case PP922, Foam PQ002
2-Channel PicoScope 4225
Contains all the items in the 2-channel starter kit plus:
1 x S-hook
2 x Multimeter style test probe (black & red)
1 x Back-pinning probes set
2 x Shrouded to unshrouded 4 mm adaptor (black & red)
1 x 20 A/ 60 A DC current clamp
1 x 2000 A / 200 A Current clamp with BNC
1 x BNC to BNC lead with earth clamp
1 x COP and signal probe
1 x ATC Fuse extension lead
1 x Mini Fuse extension lead
4-Ch Standard kit Order Code: Case PP923, Foam PQ003
4-Channel PicoScope 4425
Contains all the items in the 4-channel starter kit plus:

1 x S-hook
2 x Multimeter style test probe (black & red)
1 x Back-pinning probes set
2 x Shrouded to unshrouded 4 mm adaptor (black & red)
2 x additional small crocodile clips (black and red)
2 x Secondary ignition pickup leads
1 x 20 A / 60 A DC current clamp
1 x 2000 A / 200 A current clamp with BNC
1 x BNC to BNC lead with earth clamp
1 x High bandwidth 10:1 attenuator
1 x COP & signal probe
1 x ATC Fuse extension lead
1 x Mini Fuse extension lead

4-Ch Diesel kit Order Code: Case PP924, Foam PQ004
4-Channel PicoScope 4425
Contains all the items in the 4-channel starter kit plus:

1 x Back-pinning probes set
1 x Fuse extension leads kit (ATC, Mini-ATC, JCASE, Maxi style fuses)
2 x Small crocodile clips (black and red)
1 x 2-pin breakout lead
1 x 60 MHz oscilloscope probe x1/x10
1 x 20 A / 60 A DC current clamp
1 x 2000 A / 200 A current clamp with BNC
1 x Premium 5 m Test Lead BNC to 4 mm (black)
1 x 60 MHz Scope Probe

4-Ch Advanced kit Order Code: Case PP925, Foam PQ005
4-Channel PicoScope 4425
Contains all the items in the 4-channel standard kit plus:

1 x additional S-hook
1 x additional 20 A/60 A DC current clamp
1 x 60 MHz Scope Probe
1 x 2-pin breakout lead
1 x 6–way universal breakout lead, micro
1 x 6–way universal breakout lead, small
1 x 6–way universal breakout lead, medium
1 x 6–way universal breakout lead, large
2 x additional Secondary ignition pickup leads
4 x HT Extension leads
2 x Large dolphin/gator clips (black & red)
Essential Accessories
Here is an overview of our essential accessories, covering what they are, what they do, and how they can enhance your diagnostic capabilities. For our full range of PicoScope kits, accessories, and current pricing, please visit our website: www.picoauto.com

Current clamps
60 A / 20 A
2000 A / 200 A
30 A

A Pico current clamp is an essential addition to our starter kits to open up current measurements and waveform captures. From fuel pumps and injectors to ignition coils, never again will you have to disconnect or strip the component wiring. Add extra clamps to your Standard kit to capture multiple injectors at the same time.

Order Code: TA018
Order Code: TA167
Order Code: TA234

Breakout leads / boxes
German breakout lead kit
6-way Universal breakout leads
CAN Test box

This range of four common breakout leads makes component connections easy. They are the preferred method of connection for vehicle manufacturers and professional diagnostic experts, as their design allows for access to individual wires.

Our universal breakout lead kit contains four leads, each with different sized connectors. This allows you to connect to a multitude of sensors in the engine compartment of any vehicle.

Our CAN Test Box allows connection between your PicoScope and a vehicle’s 16-pin OBD port. We recommend this method for obtaining your vehicle’s CAN High and Low signals (see Guided Test AT126). The CAN Test Box terminals accept standard 4 mm plugs.

Order Code: PQ030
Order Code: PP943
Order Code: TA069
**Ignition Accessories**

Coil-On-Plug and Signal probe

Add to Starter kits to pick up secondary ignition waveforms from most coil-on-plug or coil-per-cylinder systems.

Order Code: PP357

**Essential additions**

Back-pinning probes

The back-pinning probes slip down the side of the insulation on the back of multi-plug terminals, allowing you to pick up signals without stripping wires or disconnecting plugs. With spare pins and screws included, these are a must have for any diagnostic technician.

Order Code: TA008

Secondary ignition pickup (capacitive with BNC)

The MI074 is a capacitive pickup that connects around the insulation of an ignition circuit component (such as a plug wire), avoiding the need for direct connection. Use our MI074 in conjunction with our HT extension leads to read Multi COP signals.

Order Code: MI074

Fuse extension leads kit

Do you find it hard to break into particular vehicle circuits? With Pico’s fuse extension leads, you can easily extend the fuse connection to allow space for a current clamp and measure the current draw for the circuit. Set includes ATC, mini-ATC, JCASE, and Maxi style fuse extensions.

Order Code: PP967

HT Extension lead (set of 4 leads)

This set of breakout leads is ideal for Multi COP packs. Simply fit one lead between each coil pack and plug, place an MI074 secondary ignition pickup on each lead, and your scope will show accurate ignition waveforms with correct kV measurements.

Order Code: PP400

1400 V Differential probe

Add our 1400 V differential probe to any kit and it allows the measurement of much higher voltages, which is ideal for hybrid and electric vehicles. This probe has a bandwidth of 25 MHz, with differential voltage ranges of 1400 V, and is CAT III rated.

Order Code: TA057
PicoScope Storage Solutions
Introducing PicoScope’s range of storage solutions for your PicoScope kits and accessories. Available individually to store your existing kit, or packaged with your newly purchased kit to create your own PicoScope diagnostic workstation.

PicoScope’s range of foam trays let you store your valuable PicoScope and accessories in a toolbox of your choosing.

We also offer a cable storage boom, allowing you have your PicoScope kit ready for use as soon as you need it.

You can also buy empty trays to store your existing Pico Technology products, or buy a range of pre-filled trays to extend your own kit’s testing capabilities.

The foam trays come in two sizes: 185 mm(W) x 390 mm(D), and 370 mm(W) x 390 mm(D) depending on function. Both sizes include a removable 20 mm strip so they will fit in 370 mm deep trays. Available either pre-packed with various kit options, or empty if you already have your kit.

To view our entire range of accessories, kits and storage solutions, please visit our website:  www.picoauto.com

Low amps current clamps

Our two low amps current clamps pre-loaded in a Pico foam tray. This option combines the TA018 20A / 60 A and TA234 30 A clamps in one bundle.

Order Code: PQ019

High & low amps current clamps

Our two most popular current clamps pre-loaded in a Pico foam tray. This option combines the TA018 20A / 60 A and TA167 2000 A clamps in one bundle.

Order Code: PQ020

Complete 6-way universal breakout lead kit

This kit contains all four breakout leads, with connector sizes of:
- Micro: 0.6 mm
- Small: 1.5 mm
- Medium: 2.3 mm
- Large: 2.8 mm

Order Code: PQ021
The CAN test box connects to a vehicle’s OBDII / EOBD connector and makes it easy to diagnose electrical faults.

Instantly check power and ground circuits. Identify communication link protocols.

Order Code: PQ024

HT extension leads (set of 4)

This kit includes four TA037 HT extension leads for measuring secondary ignition. This allows the user to test all four coils on a 4-coil cartridge pack. In addition, the kit includes a TA205 maxi fuse extension for measuring current in high current circuits.

Order Code: PQ023

WPS500X Pressure Transducer kit

The WPS500X kit includes the WPS500X Automotive Pressure Transducer, as well as a large selection of hoses and adapters – everything you might need.

Order Code: PQ006
WPS500X Pressure Transducer

The ultimate accessory to all of our PicoScope kits. View your vehicle’s engine and vital components, alongside the electrical signals, for a truly unrivalled diagnostic view.

The kit comes supplied with a standard compression hose, and adaptors to fit the most common spark plug apertures. You can further enhance your WPS500X kit with our range of accessories that will substantially increase the possible uses and available tests for your pressure transducer.

We can also supply adaptors from two of the UK’s leading suppliers of vehicle service tools (www.sykes-pickavant.com and www.asttools.co.uk), enabling you to fit our transducer to other vehicle components.

ATS adaptor set
Order Code: PP970

Sykes-Pickavant adaptor set
Order Code: TA250

Pico range of pressure taps
Order Code: PP972
Vacuum tap

Order Code: PP973
Fuel hose pressure tap (small)

Order Code: PP974 Fuel hose pressure tap (medium)

Compression testing configuration examples using Sykes Pickavant adaptor
Pressure testing
Our WPS500X pressure transducer is the essential add-on to your PicoScope kit, allowing you to accurately view vacuum and pressure levels up to 500 psi (34.5 bar). The ability to display pressure, alongside electrical component signals in real time, gives you an unparalleled view into engine and vehicle diagnostics.

Nothing shows engine compression like our pressure transducer – see it all with the WPS500X.

Expansion pocket. Intake and exhaust valves closed.
Exhaust stroke. Intake valve closed, exhaust valve open.
Intake stroke. Intake valve open, exhaust valve closed.
Compression stroke. Intake and exhaust valves closed.

The example above is just one example of our WPS500X in use. With three different pressure ranges, the WPS500X is optimized for measuring a vast array of vehicle pressures.

Connecting with PicoScope
When you first start your diagnostic journey with PicoScope, the idea of connecting to vehicle components and reading their signals can feel daunting. At Pico we have spent over 20 years breaking down the myths about scope diagnostics and helping our customers become some of our industry’s leading diagnostic experts. Taking the time to read this guide will give you the foundation for a much wider knowledge and understanding of vehicle systems and analysis, leading to a more reliable and professional diagnosis of your customers’ vehicles.
Noise, Vibration, Harshness and Balancing

The PicoDiagnostic NVH kit enables the identification and diagnosis of unwanted vehicle vibration and noise sources.

The PicoDiagnostics NVH Kit is the cost-effective answer to the many NVH problems technicians are facing today. Providing real-time diagnostics in the form of either: a bar graph, a frequency chart, a 3D frequency chart, RPM order, or road speed view. The ability to start the recording before a road test, and play back the recording for analysis upon return to the workshop, lets the driver focus on the driving during the road test.

Our NVH kit works with the PicoScope 4000 Series Automotive oscilloscopes, and it is available in a number of configurations to suit your needs (J2534 Scan Tool or VCI not supplied).

| 20 Hz Vibration only | 200 Hz Vibration and noise | 20 kHz Noise only |

The root of all NVH problems is vibration. In some cases these are abnormal vibrations, and in other cases they are always present (e.g. engine combustion). They should, however, never reach the driver or the passengers.

Noise is vibration transmitted through the air and is heard when it reaches a person’s ear. The ‘perfect hearing’ range is 20 Hz to 20 kHz, and vibrations are usually felt at frequencies below 200 Hz; in the overlapping frequency range, vibrations can both be felt and heard. In order to deal with this frequency range effectively, the PicoDiagnostics NVH kits contain microphones (for sound), and accelerometers (for vibration).

Traditionally, NVH problems have been viewed as being both difficult to solve and subjective, as people have different levels of NVH sensitivity. For technicians to tackle these issues effectively, they require the right tools and procedures to diagnose objectively and simply - PicoDiagnostics NVH.

Add our Optical Sensor kit, so that you can use the tool for balancing propshaft (drive shafts) to also use the tool for the balancing of propshafts (drive shafts). The simple user interface lets you easily identify and correct imbalance in a quick, and consistent manner.

- 3-axis NVH Diagnostics Kit
  - Order Code: PP986

- 4-axis NVH Diagnostics Kit
  - Order Code: PP987

- Optical sensor kit
  - Order Code: PP991
So is that all PicoScope can do?
Simply put, no. This guide is written to help new users get started with PicoScope. As you become more proficient with using PicoScope you can start working with more of our advanced features, including:

**Math channels**
Math channels allow you to create virtual channels (such as duty cycle or frequency), and view them as a waveform.

**Masks**
Create a mask around your waveform to automatically highlight intermittent faults.

**Serial data decoding**
Decode the serial data hidden within CAN waveforms and other serial protocols.

Remember: PicoScope is not only easy to use out of the box, but contains industry leading performance and functionality, which is improving all the time.