



Scope Demo Prop (Vehicle Simulator) Instruction Manual

Safety

For your safety, the safety of others, and to prevent damage to the devices used in this manual, it is important that all instructions and safety messages within this manual, your diagnostic tool user manual and the *Important Safety Instructions* manual (supplied with your diagnostic tool and this simulator) be read and understood before operating or coming into contact with this device.

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- Modifies or alters in any way the standard terms and conditions of the purchase, lease, or rental agreement under the terms of which the equipment to which this manual relates was acquired.
- Increases in any way the liability to the customer or to third parties.

Snap-on[®] reserves the right to make changes at any time without notice.

IMPORTANT:

Before operating or maintaining this unit, please read this manual carefully, paying extra attention to the safety warnings and precautions.

Contact Information (North America)

Websites:

Snap-on Diagnostics and Information

- <http://diagnostics.snapon.com>

Training and Support (by platform) - Find product support information, and watch free instructional product videos.

- <http://diagnostics.snapon.com/FAQ.htm>

Manuals / Technical Documentation - The information in this manual is periodically revised to ensure the latest information is included. Download the latest version of this manual and other related technical documentation at:

- <http://diagnostics.snapon.com/usermanuals>

Forums and Training - Watch free instructional product videos. Connect with and share your Diagnostic Tool questions, ideas and success stories.

- <http://diagnostics.snapon.com/ForumsandTraining.htm>

Phone / E-mail - Technical Assistance

1-800-424-7226 / diagnostics_support@snapon.com

Introduction

This simulator can be used to demonstrate Snap-on diagnostic tool Scope/Multimeter and Guided Component Test capabilities during prospective sales or for basic training.

You can:

- Perform Scope/Multimeter demonstrations using select Snap-on diagnostic tools, without actually connecting to a vehicle. See *Approved Diagnostic Tools* for the complete listing.
- Demonstrate connection and setup procedures.
- Physically show potential and existing customers:
 - Diagnostic tool Scope/Multimeter capabilities
 - The basics of displaying waveforms using the Scope/Multimeter and Guided Component Test functions
 - How to compare waveforms to verify problems

This simulator produces waveforms representative of a 2012 BMW 328i Sedan, and also provides other common automotive waveforms.



NOTE:

This simulator is intended to be used for demonstration purposes only. The display images used throughout this manual were captured using a Verus Pro. Other Snap-on diagnostic tool displays may vary, however the connection and setup procedures are the same.

For clarity throughout this manual the term “simulator” will be used in place of commonly associated terms for this device (e.g. “Demonstration Device”, “(Demo)nstration Board”, Prop etc.).

The diagnostic tool user manual, can be used as an additional reference when using this simulator. For additional information on diagnostic tool operations, refer to the latest version of the diagnostic tool user manual. User manuals are available at:
<http://diagnostics.snapon.com/usermanuals>

Approved Diagnostic Tools

WARNING



Risk of electric shock and equipment or circuit damage.

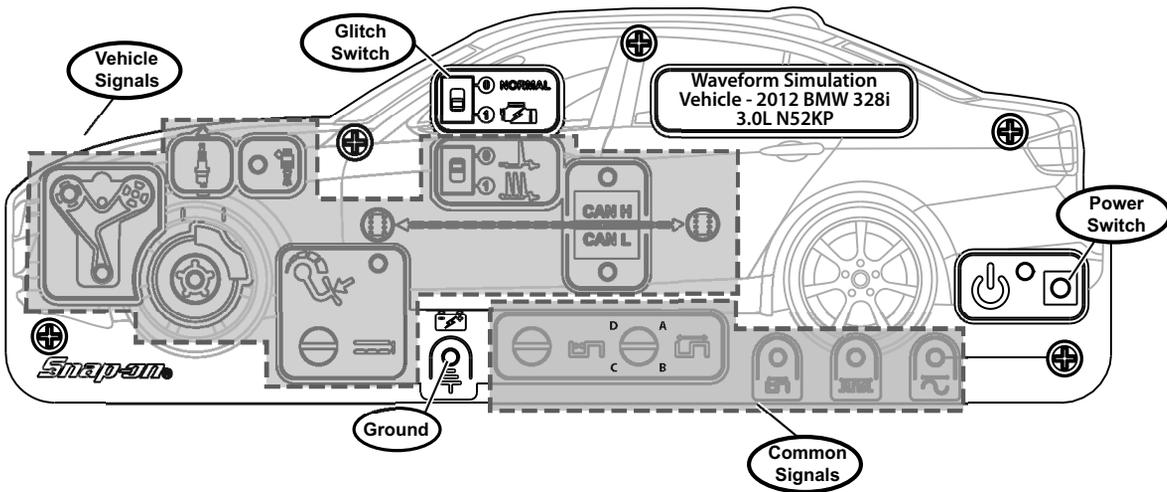
This simulator is intended to only be used with the Snap-on diagnostic tools and power supplies listed below.

Diagnostic Tool / Product	AC Power Supply Part Number	Description / Specification
VERUS	2-02539A	17V max, 60W
VERUS Edge	2-04339A	Switching 19V max, 65W
VERUS PRO	2-02839A	Switching 19V max, 65W
VERDICT		
MODIS Ultra	2-60666A	Switching 15.75V max, 22.5W
Vantage Ultra		
4-way (Quad) AC power supply	EAX0068L20A	17V max, 130W

General Specifications

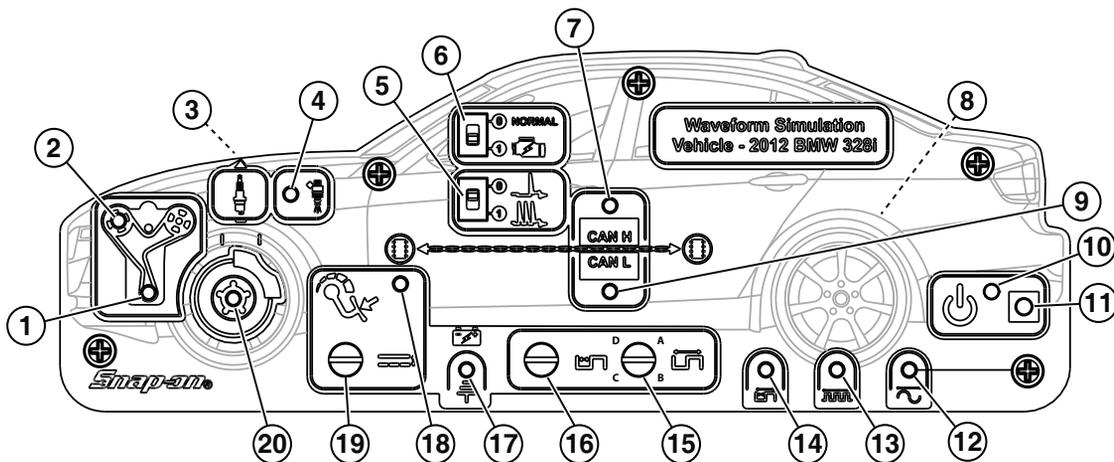
Item	Description / Specification
Operating Voltage	9 VDC (6V Min.)
Continuous Operation Time	48 hours (approximate)
Width	8.0 in. (203 mm)
Height	2.8 in. (71 mm)
Depth	1.6 in. (40 mm)
Weight	0.40 lb (0.18 kg) without battery
Operating Temperature Range (ambient)	At 0 to 90% relative humidity (non-condensing) 32 to 113°F (0 to 45°C)
Storage Temperature (ambient)	At 0 to 70% relative humidity (non-condensing) - 4 to 140°F (- 20 to 60°C)
Environmental Conditions	This product is intended for indoor use only
	This product is rated for Pollution Degree 2 (normal conditions)

Feature Layout



Name	Function / Description
Power Switch	Switches simulator power on/off.
Ground	Ground connector for all applicable demonstration tests.
Glitch Switch	Used to turn signal glitch on/off for all applicable demonstration tests.
Common Signals	The signal connectors and controls in this area are non-vehicle specific and used to demonstrate common automotive waveforms (e.g. sine wave, variable pulse width and variable frequency).
Vehicle Signals	The signal connectors and controls in this area are vehicle specific and used to demonstrate waveforms associated with the specific simulator vehicle (e.g. 2012 BMW 328i 3.0L - crankshaft sensor, camshaft sensor, wheel speed sensor etc.).

Feature Identification



Item	Name	Item	Name
1	Crankshaft Position Sensor (CKP) Signal Connector - See "Crankshaft Position Sensor (CKP) Signal - Demonstration" on page 11.	11	Power Switch - Switches simulator power on/off. Simulates vehicle ignition key switch.
2	Camshaft Position Sensor (CMP) Signal Connector - See "Camshaft Position Sensor (CMP) Signal - Demonstration" on page 15.	12	Sine Wave Signal Connector - See "Sine Wave Signal - Demonstration" on page 25.
3	Secondary Ignition Signal Connector - See "Secondary Ignition Signal - Demonstration" on page 22.	13	Variable Frequency Signal Connector - See "Variable Frequency Signal - Demonstration" on page 27.
4	Fuel Injector Signal Connector - See "Fuel Injector Signal - Demonstration" on page 20.	14	Variable Pulse Width / Duty Signal Connector - See "Variable Pulse Width / Duty Signal - Demonstration" on page 26.
5	Secondary Ignition Multi-strike Switch - Provides two modes (1) multi-strike, (0) single strike during secondary ignition simulation. See "Secondary Ignition Signal - Demonstration" on page 22.	15	Variable Frequency Adjustment Knob - See "Variable Frequency Signal - Demonstration" on page 27.
6	Glitch Switch - Position - (1) = Glitch ON Position - (0) = Glitch OFF	16	Variable Pulse Width / Duty Adjustment Knob - See "Variable Pulse Width / Duty Signal - Demonstration" on page 26.
7	CAN (H)igh Signal Connector - See "CAN (H)igh and (L)ow Signal - Demonstration" on page 21.	17	Ground Connector - Ground connector for all applicable demonstration tests.
8	Battery Compartment (on back-not shown)	18	Accelerator Pedal Sensor (APP) Signal / Variable Voltage Connector - See "Accelerator Pedal Position Sensor (APP) Signal - Demonstration" on page 17.
9	CAN (L)ow Signal Connector - See "CAN (H)igh and (L)ow Signal - Demonstration" on page 21.	19	Variable Voltage Adjustment Knob - See "Accelerator Pedal Position Sensor (APP) Signal - Demonstration" on page 17.
10	Power Switch LED indicator - When lit, the LED indicates that power is being supplied to the simulator.	20	Wheel Speed Sensor (WSS) Signal Connector - See "Wheel Speed Sensor (WSS) Signal - Demonstration" on page 18.

Feature Specifications

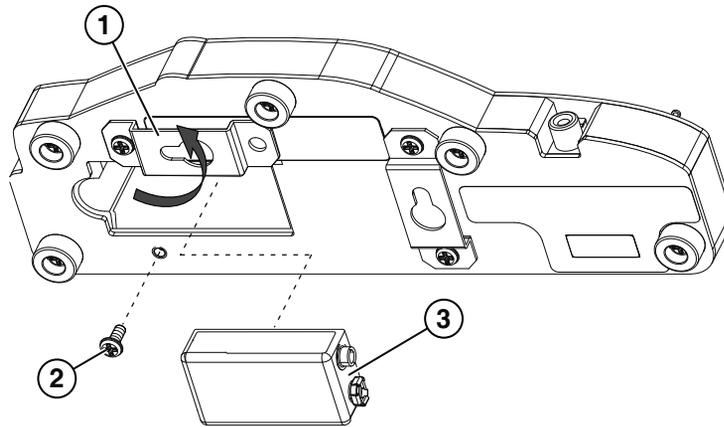
Function	Voltage Range	Glitch Switch	Multi-Strike Switch	Variable Pulse Width Adjustment Knob	Variable Frequency Adjustment Knob	Variable Voltage Adjustment Knob
Crankshaft Position (CKP) Signal	0 to 5	Erratic pulse every rotation of crankshaft	N/A	N/A	N/A	Adjust RPM of signal (500 to 4000)
Camshaft (CMP) Signal (Exhaust)	0 to 5	Additional short pulse	N/A	N/A	N/A	Adjust RPM of signal (500 to 4000)
Variable Voltage Signal (APP)	0 to 5	250 μ s low glitch in the signal every 2 seconds	N/A	N/A	N/A	Adjusts voltage 0 to 5V
Wheel Speed Sensor (WSS)	0.45 to 1	One long pulse every 2 seconds	N/A	N/A	N/A	N/A
Fuel Injector Signal	High Pulse 46V	Missing pulse every 2 seconds	N/A	Adjusts low pulse width 0.5ms to 8.2ms (\pm 5%)	N/A	Adjust RPM of signal (500 to 4000)
CAN-H and CAN-L	H - 3.6 L 1.4	N/A	N/A	N/A	N/A	N/A
Secondary Ignition	- 0.6 to 7	Settings: A-Missing pulse every 2 seconds B-No coil oscillations at end of burn time. C-Low firing D-High firing	Single Strike	Adjusts burn time 1.5ms to 15.2ms	Adjusts glitch type (A, B, C or D)	Adjust frequency of Adjust RPM of signal (500 to 4000)
			Multi-Strike	Adjusts number of strikes 2 to 5		
Sine Wave	0 to 5	Missing pulse every 2 seconds	N/A	N/A	Adjusts frequency 0.23Hz to 60Hz	N/A
Variable Pulse Width Signal	0 to 5	Missing pulse every 2 seconds	N/A	Adjust duty cycle 2% to 98%	Adjusts frequency 0.23Hz to 60Hz	N/A
Variable Frequency Signal	0 to 5	250 μ s inversion of the signal every 2s	N/A	N/A	Adjusts frequency 7.6Hz to 1.95 kHz	N/A
<p>NOTE: All specifications shown are approximate and intended to be used as a guide. Battery voltage directly affects all generated waveforms. As battery voltage decreases the amplitude of the generated waveforms will also proportionately decrease.</p>						

Getting Started



Installing the Battery:

1. Remove the mount bracket screw (*Figure 3 - item 2*) from the back of the simulator.
2. Loosen the other mount bracket screw as needed, to pivot the mount bracket (*Figure 3 - item 1*) out of the way and allow the installation of the battery.
3. Install a 9 volt battery (*Figure 3 - item 3*) using the correct polarity (+/-) as marked.
4. Position the mount bracket into its original position and then install and fasten the mount bracket screw (*Figure 3 - item 2*) removed in step 1.



1— Mount Bracket
2— Mount Bracket Screw

3— 9VDC Battery
(ANSI/NEDA 1604A, IEC 6LR61)

Figure 3 Battery Installation



Turning the Simulator On/Off:

The simulator has 2 modes of operation:

- **Mode 1 (automatic shut-off)** - Pressing the power button for LESS than five seconds activates automatic shut-off mode. In this mode the simulator will remain on for approximately 15 minutes (LED on). After approximately 15 minutes power is turned off automatically.
- **Mode 2 (manual shut-off)** - Pressing the power button for MORE than five seconds activates continuous on operation mode. In this mode the simulator will remain on until the power button is pressed again.



NOTE:

When Mode 2 is selected, the Power LED will flash. This is normal and should not be misinterpreted as a malfunction.

1. Choose an operation mode as described above to turn the simulator on.
The Power LED indicator illuminates.
2. Proceed to *Diagnostic Tool Setup*, next.



NOTE:

The simulator power switch must be on to allow the diagnostic tool to display waveforms. If the simulator does not turn on, see "*Troubleshooting*" on page 30.



Diagnostic Tool Setup:

1. Turn on the diagnostic tool (if not already on).

Most of the following demonstrations require the use of the Channel 1 and/or 2 leads with the alligator clips attached, except where noted.

2. Review the next section *Using the Guided Component Tests (GCT) and Lab Scope Functions*, before performing any demonstrations.

Using the Guided Component Tests (GCT) and Lab Scope Functions

IMPORTANT:

As there are many variations in engine and vehicle control systems, the information within this manual is intended only as basic reference for demonstration purposes using typical examples. Always refer to the OEM diagnostic information provided for the vehicle you are servicing.

Certain tests in this manual can be demonstrated using both the Guided Component Tests (GCT) and Lab Scope functions. For each demonstration, setup guidelines are provided including basic test lead connection, scope voltage, sweep, and other applicable setting information.

Some of the tests can be demonstrated using the Guided Component Tests (GCT) function. One complete example of using a GCT is provided in this manual, see *“Demonstrations” on page 11*. The CKP example is representative of other GCT tests that are available, but not described in this manual.

The Guided Component Test function can provide vehicle specific:

- Diagnostic and troubleshooting tips
- Component location and testing procedures
- Connector terminal pin configuration and wire color codes
- Known good waveforms
- General component and system theory

Using this information can help reduce your overall setup, diagnostic and repair times.



NOTE:

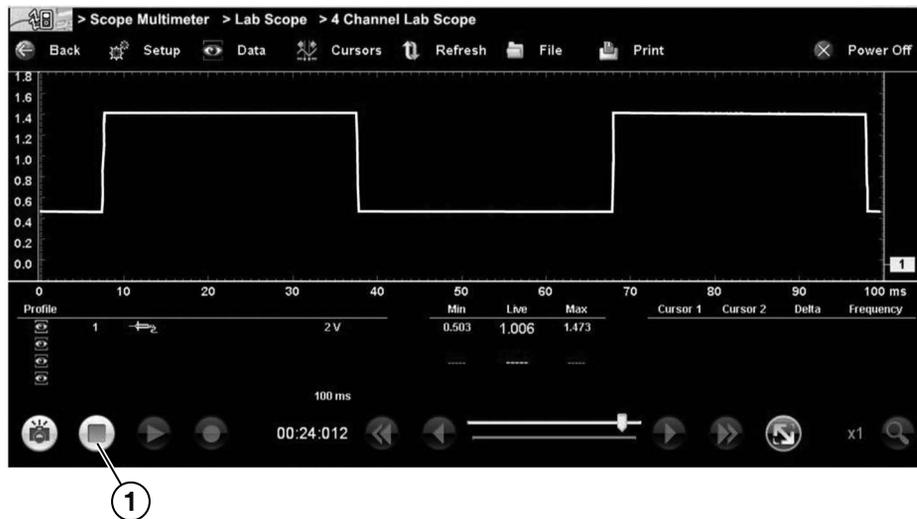
Guided Component Tests automatically configure Lab Scope settings to display waveforms, however the settings can be manually changed.

For additional Guided Component Tests information, refer to the Guided Component Tests section of the latest version of the diagnostic tool user manual. User manuals are available at: <http://diagnostics.snapon.com/usermanuals>

Using the Zoom Function

An important part of using the Scope/Multimeter to analyze waveforms is utilizing the zoom function. The zoom function allows you to change the magnification level of the waveform sweep during review of the data buffer (captured data). Changing magnification levels allows you to compress or expand multiple screens of data to quickly find a loss in the signal or other glitches.

When monitoring waveforms, the default magnification level is 1x. The zoom function is not available until the data buffer is stopped by pressing the **Stop** icon (*Figure 4*).



1— Stop Control Icon

Figure 4 Typical waveform



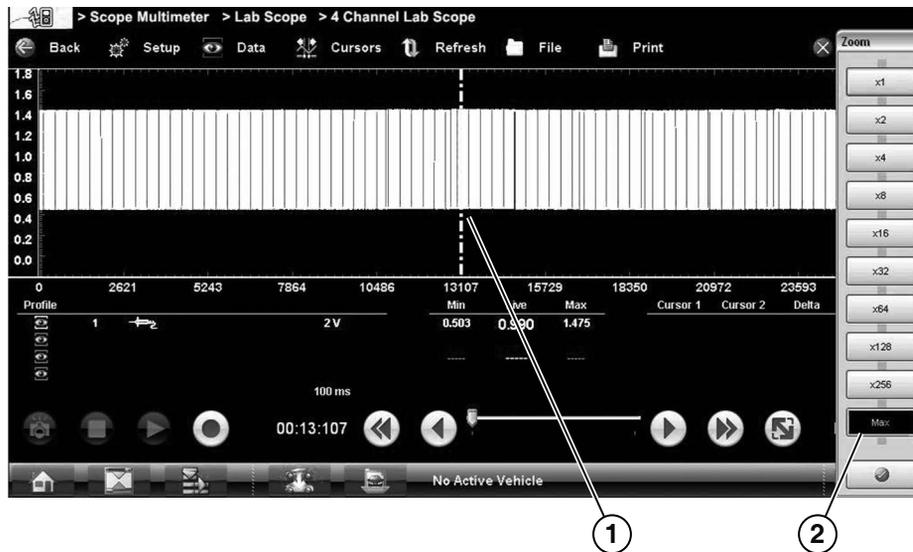
NOTE:

Zoom playback controls are identical to the standard playback controls used when reviewing data files, with the following exception:

Skip Forward / Skip Back control icons - (press once) moves multiple steps relative to set magnification level (e.g. 2X setting, moves 2 steps; 16X setting, moves 16 steps)

Additional information on playback control icons are described in the diagnostic tool user manual.

When the **Zoom** icon is selected the display defaults to the "Max" magnification level and a dropdown scroll menu displays. The dropdown menu allows you to select the display magnification level from a range of 1X to 256X. The "Max" (maximum) option displays all data captured on one screen (*Figure 5*).

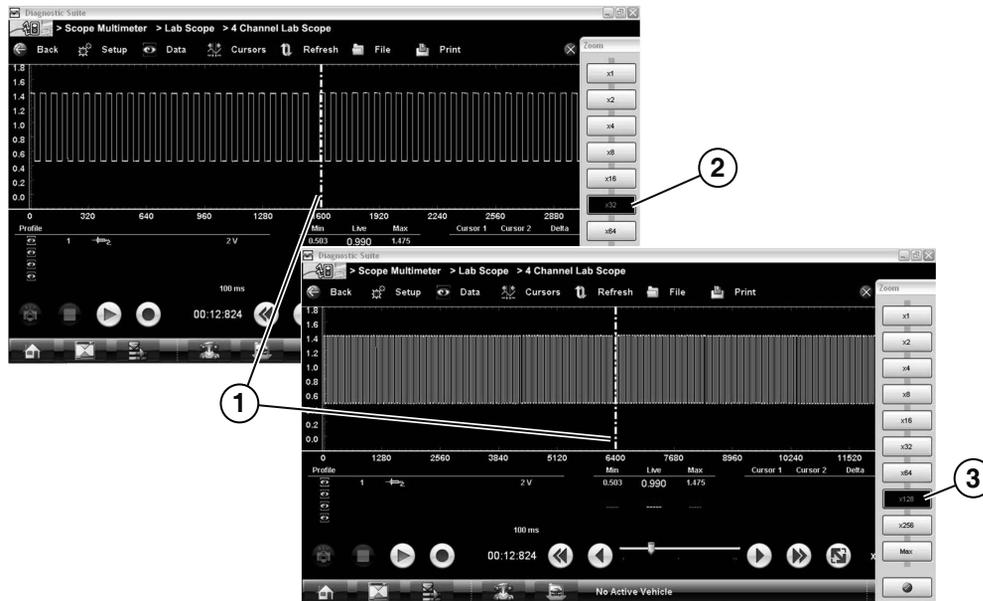


1— Zoom Cursor

2— Zoom Magnification Level (Max shown)

Figure 5 "Max" Magnification Level - All captured data displayed

When zoom levels of 2X and higher are selected, a Zoom cursor (vertical dashed line) (*Figure 5*) displays onscreen. The cursor is used to quickly mark and navigate to points of interest or glitch in a captured waveform.



1— Waveform Glitch

2— Magnification Level at 32X

3— Magnification Level at 128X

Figure 6 Examples of Magnification Level at 32 and 128X

The Zoom cursor can be used to mark the approximate position of a glitch and can be manually dragged onscreen to the desired position. The new cursor position will be centered on the screen when a lower magnification level is selected. *Figure 6* shows examples at 32X and 64X with the Zoom cursor positioned in the area of a signal drop glitch.

**NOTE:**

To quickly identify a glitch (e.g. signal drop), it may be easier to initially view the waveform at a higher magnification level (e.g. 256X or "Max") to display the entire captured waveform, then lower the zoom level to 8X or 2X to review in detail.

Figure 7 shows an example at 8X of the same waveform shown in Figure 6. In the example at 8X the glitch is easily seen as compared to higher magnification levels.

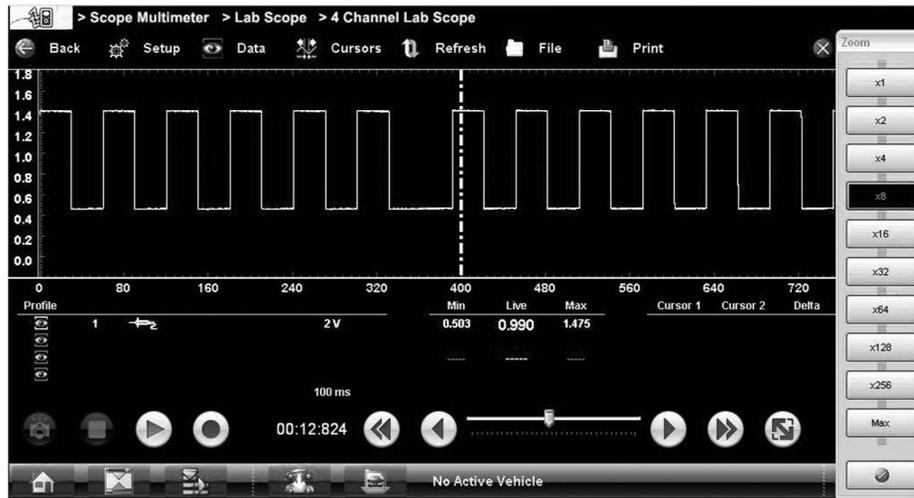


Figure 7 Example of Magnification Level at 8X. (For illustration purposes, the Zoom cursor has been positioned in the area of the glitch.)

Demonstrations

Crankshaft Position Sensor (CKP) Signal - Demonstration

Reference

See "Feature Identification" on page 5 for the location of the CKP connector (**Item 1**).

Signal characteristics and adjustments:

- Simulation of 58 tooth wheel.
- Digital voltage output 0 to 5V - simulated Hall Effect 5V reference type sensor generating a square waveform.
- Adjustable RPM simulation from 500 to 4000. Controlled by the Variable Voltage adjustment knob.
- A glitch is simulated by an erratic pulse once every crankshaft rotation.

Use the following controls to demonstrate variances and glitches in CKP signal patterns:

- Use the **Variable Voltage adjustment knob** to vary the RPM simulation 500 to 4000.
- Toggle the **Glitch switch** on/off to show the difference in patterns. With the switch on notice the change in the pulse pattern.

Lab Scope Setup	
Navigation	Select Scope Multimeter > Lab Scope
Lead Connections	Channel 1 - connect to CKP connector
	Ground - connect to Ground connector
Scale and Trigger Settings	Voltage Scale - set to 10.0V
	Sweep (Time Scale) - set to 20ms
	Trigger Setting - Auto 2.5V, Slope falling (-) edge

CKP Waveform Example (Lab Scope)

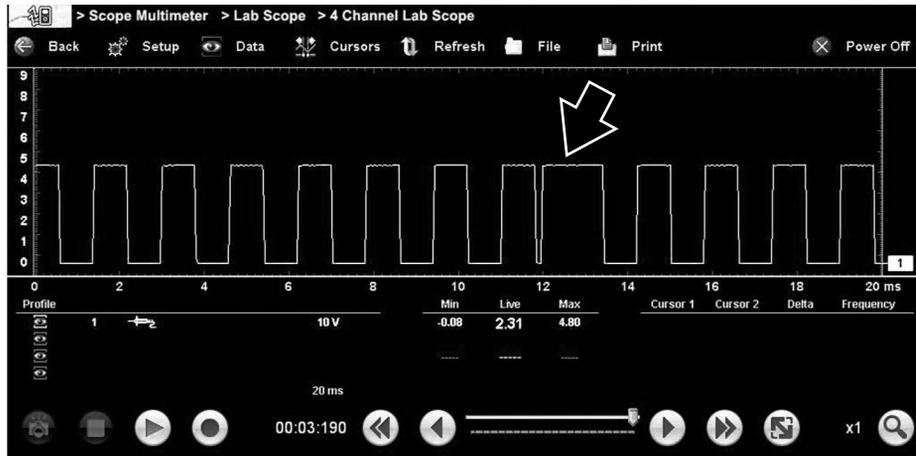


Figure 8 *Glitch On*

Guided Component Test Setup



CKP Guided Component Test:

1. Select the **Guided Component Tests** function from the Home Screen.
2. Select **US Imports**
3. Select the following vehicle: **BMW > 2012 > 328i > 3.0(N52KP)**
4. Select **Fuel Injection**
5. Select **CKP Sensor**
6. Select **Component Information**

As good practice, always review the Component Information details before performing any tests. Once you have reviewed the information, select the **Back** icon, from the toolbar.

7. Select **Signature Test**

The CKP Signature Test screen opens (*Figure 9*).

This CKP Signature Test screen displays information that is typically found in Guided Component Tests (e.g. test lead connection procedures, connector terminal identification, wire color codes, circuit descriptions/illustrations and images of known good waveforms).

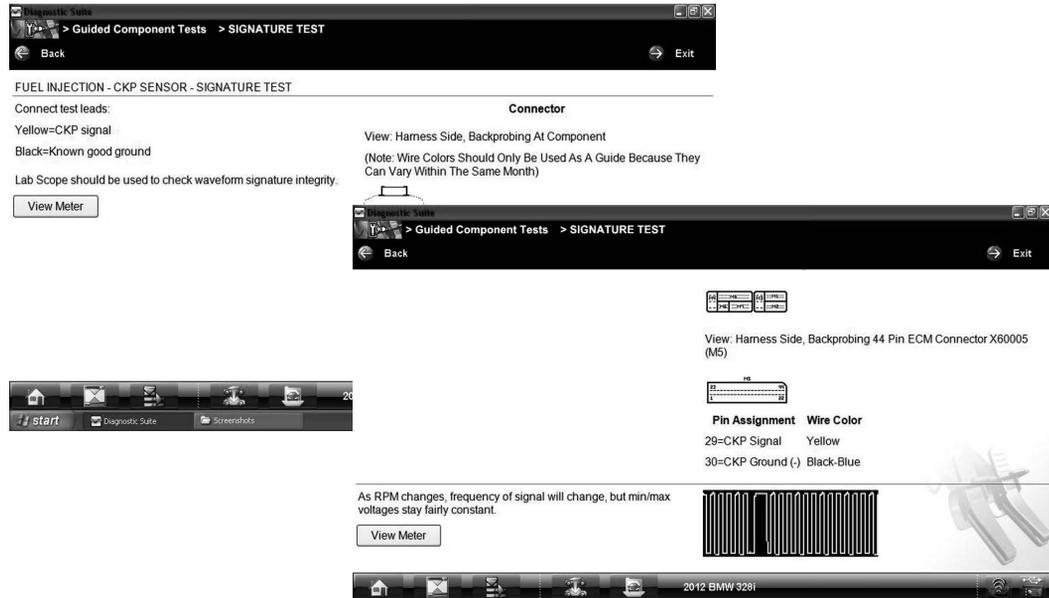


Figure 9 CKP Signature Test

8. For the purposes of this demonstration, review the information provided on the Signature Test screen (to show how it would apply to an actual vehicle), then connect the test leads to the simulator as follows:
 - **Channel 1 lead** - connect to CKP connector
 - **Ground lead** - connect to Ground connector
9. If applicable, select **View Meter** from the Signature Test screen.
10. After the lab scope is displayed (*Figure 10*), select **Meter** from the upper toolbar (if applicable) and then select the **Expand/Collapse** icon to toggle through the different screen views available (*Figure 11*). Where applicable, selecting **Meter** again from the upper toolbar will re-open the CKP signature Test screen and lab scope in different windows.

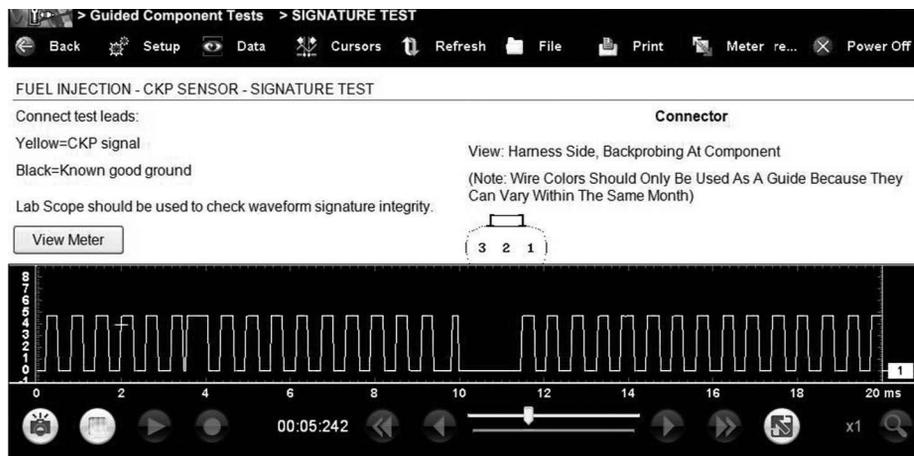


Figure 10 CKP Signature Test Meter Split Screen View (Glitch on)

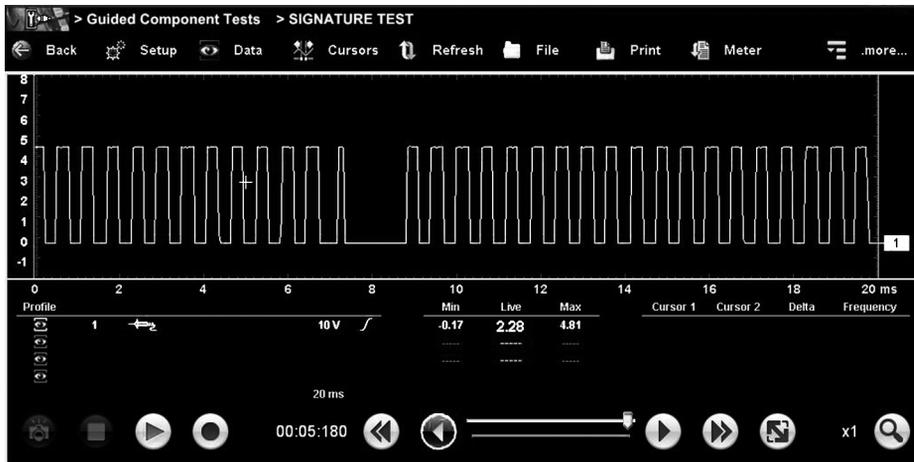


Figure 11 CKP Signature Test Meter View (Glitch off)

11. Set the **Glitch switch** to off and review the waveform (Figure 11).

Compare the waveform to the GCT known good waveform for reference.

12. Set the **Glitch switch** to on and review the waveform. A glitch is simulated by an erratic pulse in the signal once every crankshaft rotation (Figure 12).

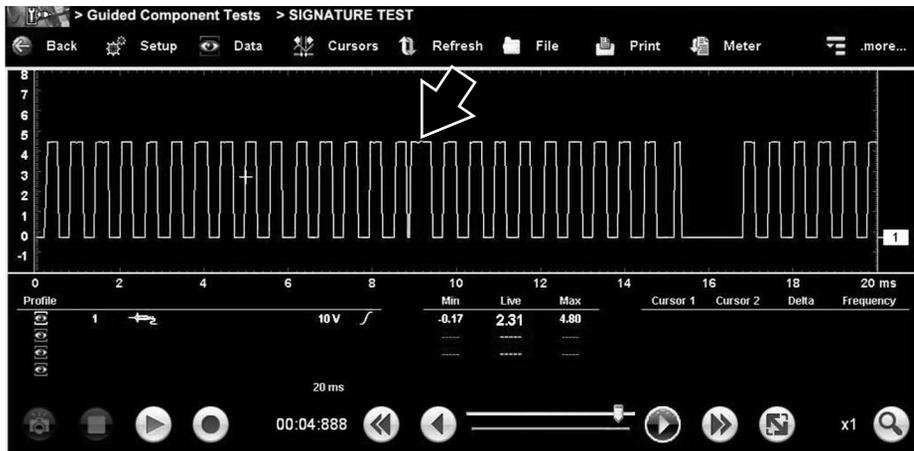


Figure 12 CKP Signature Test - Glitch On

Camshaft Position Sensor (CMP) Signal - Demonstration

Reference

See “Feature Identification” on page 5 for the location of the CMP connector (**Item 7**).

Signal characteristics and adjustments:

- Simulation of an exhaust camshaft sensor signal.
- Signal synchronized with CKP signal.
- Digital voltage output 0 to 5V - simulated Hall Effect 5V reference type sensor generating a square waveform.
- A glitch is simulated by an additional short pulse.

Use the following controls to demonstrate variances and glitches in CMP signal patterns:

- Use the **Variable Voltage adjustment knob** to vary the RPM simulation 500 to 4000.
- Toggle the **Glitch switch** on/off to show the difference in patterns. With the switch on notice the change in the pulse pattern. The glitch(s) display as an additional short pulse (*Figure 13*).

Setup

Both the GCT and Lab Scope can be used for testing.

Guided Component Test	
Navigation	Vehicle identification information: US Imports > BMW > 2012 > 328i > 3.0(N52KP) Select: Fuel Injection > CMP Sensor > Exhaust > Signature Test
Lead Connections	Channel 1 - connect to CMP connector
	Ground - connect to Ground connector
Scale and Trigger Settings (preconfigured)	Voltage Scale - set to 10.0V
	Sweep (Time Scale) - set to 500ms
	Trigger Setting - Auto 2.5V, Slope falling (-) edge

Lab Scope	
Navigation	Select Scope Multimeter > Lab Scope
Lead Connections	Same as Guided Component Test (see above)
Scale and Trigger Settings	Same as Guided Component Test (see above)

CMP Waveform Example (Lab Scope)

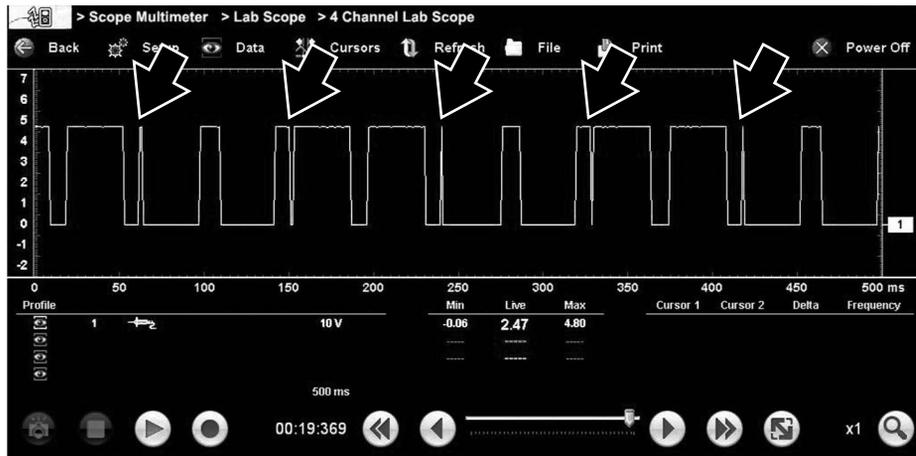


Figure 13 Glitch On

CMP and CKP Waveform Examples

An example of using two channels to monitor different signals, is to compare the CMP and CKP waveforms. Monitoring the relationship between these two waveforms can be used to verify camshaft to crankshaft synchronization. Checking the synchronization of these signals can be a key indicator in determining problems (e.g. no-start or timing problem caused by a stretched or jumped timing belt/chain).

By comparing the test vehicle waveforms to known good waveforms, problems can sometimes be identified quickly without major disassembly. Known good waveform examples may be available from within the Guided Component Tests function, various information services (e.g. SureTrack[®]), or from other sources. See “Where do I find known good waveform examples?” on page 29 for additional information.

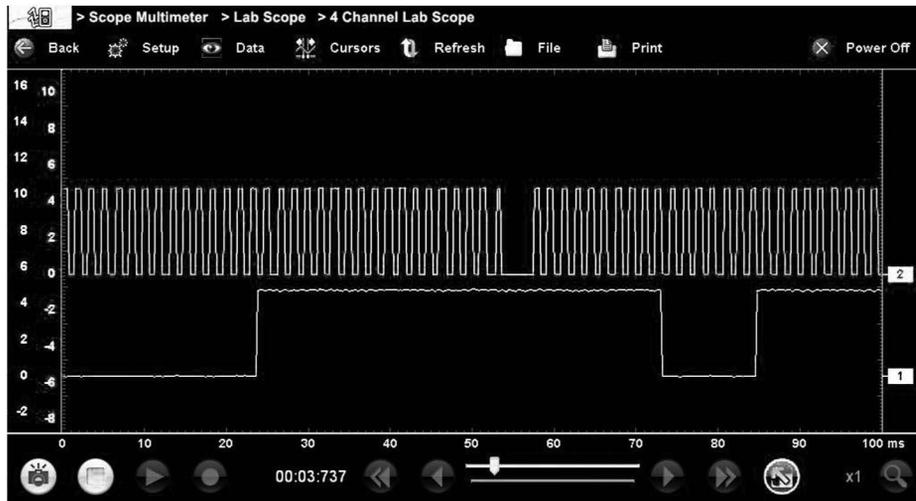


Figure 14 CMP - channel 1, CKP - channel 2 (at 1X magnification)

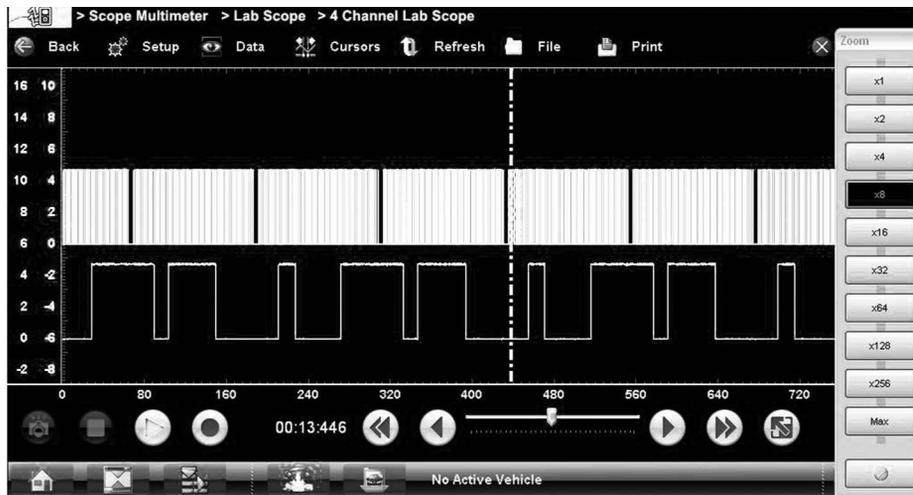


Figure 15 CMP - channel 1, CKP - channel 2 (at 8X magnification)

Accelerator Pedal Position Sensor (APP) Signal - Demonstration

Reference

See “*Feature Identification*” on page 5 for the location of the APP connector (**Item 18**).

Signal characteristics and adjustments:

- The Variable Voltage adjustment knob allows adjustment of voltage between 0V and 5V.
- A glitch is simulated by a 250 μ s low (drop out) glitch in the signal every 2 seconds.

Use the following controls to demonstrate variances and glitches in APP signal patterns:

- Use the **Variable Voltage adjustment knob** to simulate a varying (voltage) accelerator pedal position. As the knob is turned, monitor the output voltage for smooth linear changes from 0 to 5 volts.
- Toggle the **Glitch switch** on/off to show a brief signal drop out approximately every 2 seconds in the waveform.

Setup

Both the GCT and Graphing Multimeter can be used for testing.

Guided Component Test	
Navigation	Vehicle identification information: US Imports > BMW > 2012 > 328i > 3.0(N52KP) Select: Throttle Control System > APP Sensor > DC Voltage Test
Lead Connections	Channel 1 - connect to APP connector Ground - connect to Ground connector
Scale and Trigger Settings (preconfigured)	Voltage Scale - 5V (change to 10V) Peak Detect - off (turn on) Sweep (Time Scale) - 5s

Graphing Multimeter	
Navigation	Select Scope Multimeter > Graphing Multimeter
Lead Connections	Same as Guided Component Test (see above)
Scale and Trigger Settings	Same as Guided Component Test (see above)

APP Waveform Examples (GMM)

The voltage change shown in *Figure 16* is simulated by turning the **Variable Voltage** adjustment knob.

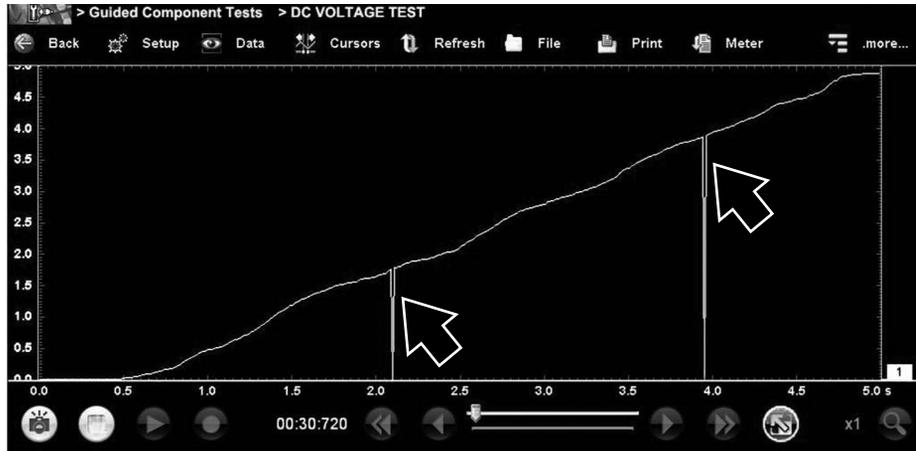


Figure 16 Glitch On

Wheel Speed Sensor (WSS) Signal - Demonstration

Reference

See “*Feature Identification*” on page 5 for the location of WSS connector (**Item 20**).

Signal characteristics and adjustments:

- Fixed frequency of 2.4Hz. Frequency is proportional to wheel speed.
- Amplitude of 1V.
- Two-wire hall effect sensor generating a square waveform.
- Low level between 0.45V and 0.5V.
- A glitch is simulated by a long pulse (every 2 seconds) in the signal as could be the result of a damaged or dirty reluctor/tone wheel.

Use the following controls to demonstrate variances and glitches in WSS signal patterns:

- Toggle the **Glitch switch** on/off to show the difference in patterns. With the switch on notice the change in the pulse pattern.

Setup

Both the GCT and Lab Scope can be used for testing.

Guided Component Test	
Navigation	Vehicle identification information: US Imports > BMW > 2012 > 328i > 3.0(N52KP) Select: ABS > Wheel Speed Sensors > Signature Test
Lead Connections	Channel 1 - connect to WSS connector
	Ground - connect to Ground connector
Scale and Trigger Settings (preconfigured)	Voltage Scale - set to 2.0V
	Sweep (Time Scale) - set to 50ms (alternate setting 500ms)
	Trigger Setting - Auto 1V, Slope falling (-) edge

Lab Scope	
Navigation	Select Scope Multimeter > Lab Scope
Lead Connections	Same as Guided Component Test (see above)
Scale and Trigger Settings	Same as Guided Component Test (see above)

WSS Waveform Example (Lab Scope)

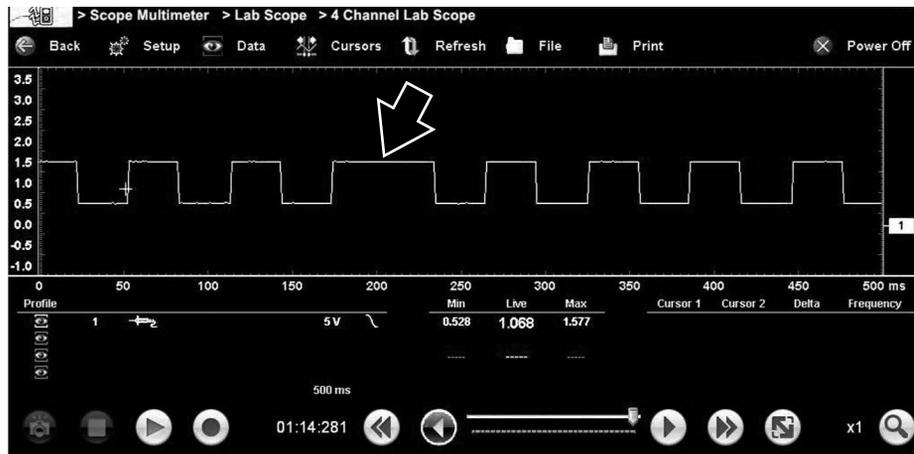


Figure 17 *Glitch On*

Fuel Injector Signal - Demonstration

Reference

See “*Feature Identification*” on page 5 for the location of the Fuel Injector connector (*Item 4*).

Signal characteristics and adjustments:

- Adjustable injector pulse width between 0.5ms and 8.2ms.
- Injector high pulse inductive kick-back voltage 45V and 250µs long.
- Start of pulse triggered by CKP. Trigger once every other rotation.
- Adjustable injector pulse signal frequency.
- A glitch is simulated by a missing injector pulse every 2 seconds.

Use the following controls to demonstrate variances and glitches in Fuel Injector signal patterns:

- Use the **Variable Pulse Width / Duty adjustment knob** to simulate changes in injector pulse width.
- Use the **Variable Voltage adjustment knob** to vary the RPM simulation 500 to 4000.
- Toggle the **Glitch switch** on/off to show the difference in patterns. With the switch on, you may need to stop and review the buffer data in order to see the change in the pulse pattern (missing pulse every 2 seconds).

Setup

Both the GCT and Lab Scope can be used for testing.

Guided Component Test	
Navigation	Vehicle identification information: US Imports > BMW > 2012 > 328i > 3.0(N52KP) Select: Fuel Injection > Fuel System > Injector > Signature Test
Lead Connections	Channel 1 - connect to Fuel Injector connector
	Ground - connect to Ground connector
Scale and Trigger Settings (preconfigured)	Voltage Scale - 50V
	Sweep (Time Scale) - 10ms (alternate setting 200ms)
	Trigger Setting - Auto 5V, Slope falling (-) edge

Lab Scope	
Navigation	Select Scope Multimeter > Lab Scope
Lead Connections	Same as Guided Component Test (see above)
Scale and Trigger Settings	Same as Guided Component Test (see above)

Fuel Injector Waveform Example (Lab Scope)

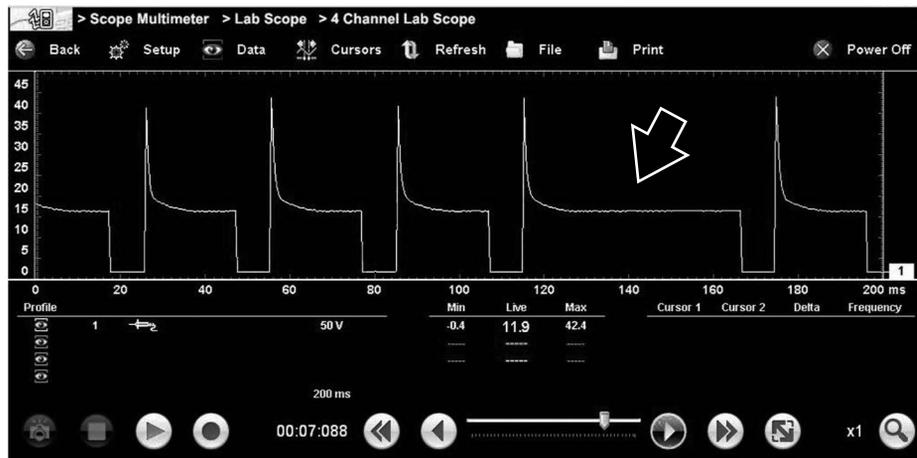


Figure 18 Glitch On

CAN (H)igh and (L)ow Signal - Demonstration

Reference

See “*Feature Identification*” on page 5 for the location of the CAN High and Low signal connectors (*Items 7 and 9*).

Signal characteristics:

- CAN High and Low 2.5V at rest.
- CAN High 2.5V up to 3.5V.
- CAN Low 2.5V down to 1.5V.
- Higher and lower signals levels during ACK (Acknowledge) bit.
- Single frame of data repeated every 10ms.

Setup

Both the GCT and Lab Scope can be used for testing.

Guided Component Test	
Navigation	Vehicle identification information: US Imports > BMW > 2012 > 328i > 3.0(N52KP) Select: Fuel Injection > CAN-BUS > Signature Test
Lead Connections	Channel 1 - connect to CAN H connector
	Channel 2 - connect to CAN L connector
	Ground - connect to Ground connector
Scale and Trigger Settings (preconfigured)	Voltage Scale - 5V
	Sweep (Time Scale) - 500µs
	Trigger Setting - Ch. 1 Auto 3V, Slope rising (+) edge

Lab Scope	
Navigation	Select Scope Multimeter > Lab Scope
Lead Connections	Same as Guided Component Test (see above)
Scale and Trigger Settings	Same as Guided Component Test (see above)

CAN H and L Waveform Example (Lab Scope)

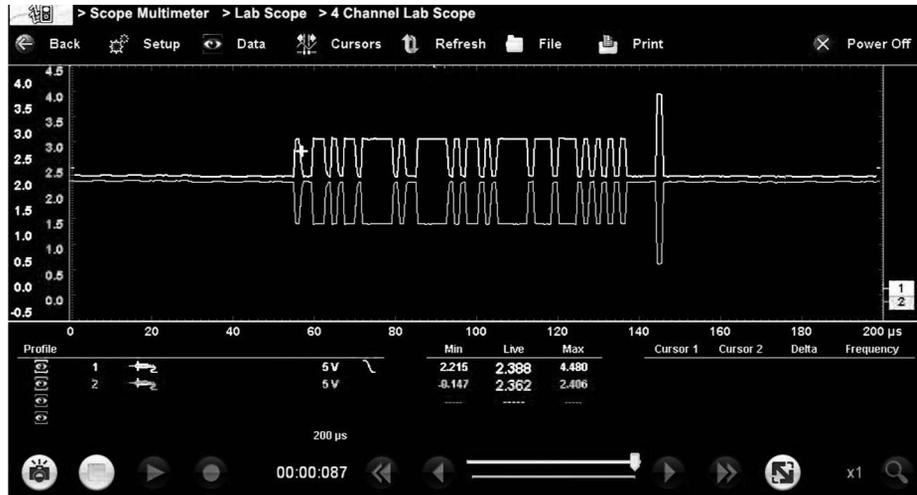


Figure 19

Secondary Ignition Signal - Demonstration

Reference

See “*Feature Identification*” on page 5 for the location of the Secondary Ignition signal connector (**Item 3**).

Signal characteristics and adjustments:

- A dwell period of 2ms.
- Start of pulse triggered by CKP. Trigger once every other rotation.
- Burn time (spark duration) will show ramp down and coil oscillations at the end.

Use the following controls to demonstrate variances and glitches in the Secondary Ignition signal patterns:

Adjustments:

- A multi-strike switch allows single and multi-strike modes of simulation.
 - In multi-strike mode the burn time is fixed and the number of strikes (2-5) is controlled by the **Variable Pulse Width adjustment knob**.
 - In single strike mode the burn time is adjustable from 1.5ms to 15.2ms using the **Variable Pulse Width adjustment knob**.
- Use the **Variable Voltage adjustment knob** to vary the RPM simulation 500 to 4000.

Glitches:

Multiple glitches are available in single strike mode only. Turn the **Variable Frequency adjustment knob** to positions A through D to select:

- **A** - Missing ignition strike every 2 seconds
- **B** - No coil oscillations at the end of the burn time
- **C** - Low firing voltage
- **D** - High firing voltage



NOTE:

This secondary ignition demonstration requires the use of the optional Snap-on secondary coil adapter lead (P/N 6-03422A). Contact your Snap-on representative for additional information.

Setup

Both the GCT and Lab Scope can be used for testing.

The setup and settings shown here are for simulation purposes only. Actual vehicle connection will vary and will require the use of a secondary ignition probe and or coil adapters.

Guided Component Test	
Navigation	Vehicle identification information: US Imports > BMW > 2012 > 328i > 3.0(N52KP) Select: Guided Component Test > Fuel Injection > Ignition Tests > Secondary Tests > Burntime
Lead Connections	Channel 1 - connect the RCA style connector of the test lead to the Secondary Ignition connector
	Ground - connect the black (-) clamp of the test lead to Ground connector
Scale and Trigger Settings (preconfigured)	Voltage Scale - 200mV (change to 10V)
	Sweep (Time Scale) - 10ms
	Peak Detect - On
	Inverted - On
	Trigger Setting - Ch. 1 Auto 1.5V, Slope rising (+) edge
For the purpose of this simulation, the scale and sweep settings for this test need to be changed from the preconfigured settings.	

Lab Scope	
Navigation	Select Scope Multimeter > Lab Scope
Lead Connections	Same as Guided Component Test (see above)
Scale and Trigger Settings	Voltage Scale - 10V
	Sweep (Time Scale) - 50ms
	Peak Detect - On
	Inverted - On
	Trigger Setting - Ch. 1 Auto 1.5V, Slope rising (+) edge

It is important to note, that specific testing instructions may be available for each vehicle. As an example for this simulator the vehicle represented is a 2012 BMW 328i 3.0L. A secondary ignition Burn Time test is provided within the Guided Component Tests function. Within the instructions, it is noted that a special coil adapter is needed (COP-11) and that a low voltage scale is used instead of a Kv scale to measure the secondary ignition burn time. Although Kv scales can be used to measure secondary ignition waveforms, the examples shown here were captured using low voltage scales.

Secondary Ignition Waveform Examples

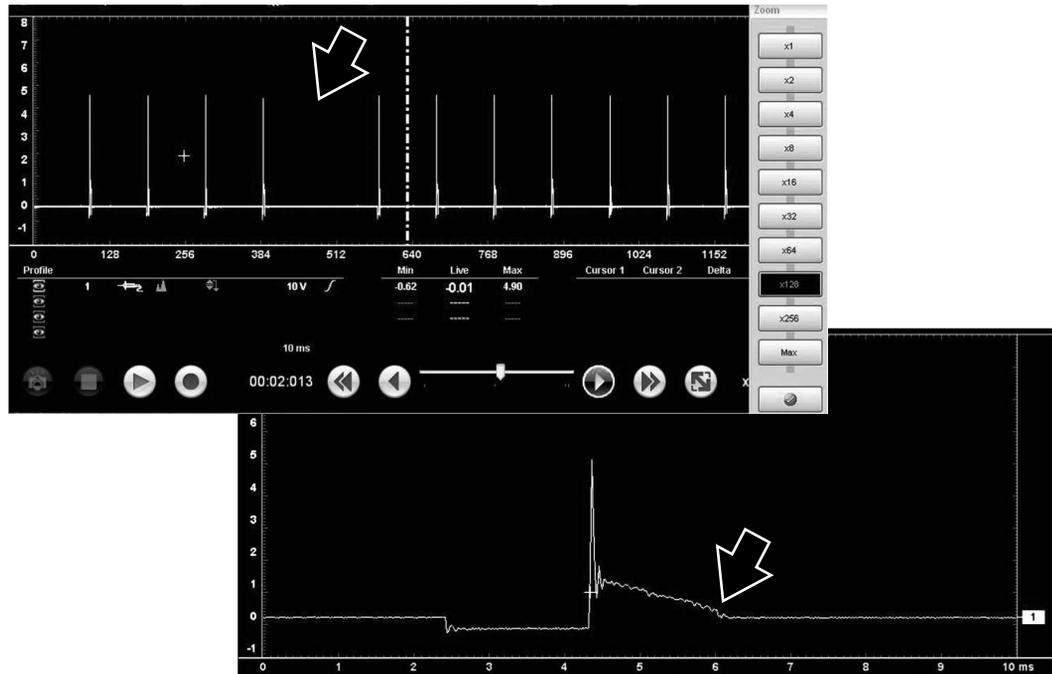


Figure 20 *Glitch on - (Setting A (upper) - Missing ignition strike every 2 seconds, captured waveform reviewed at 128X magnification (Setting B (lower) - No coil oscillations at end of burn time)*

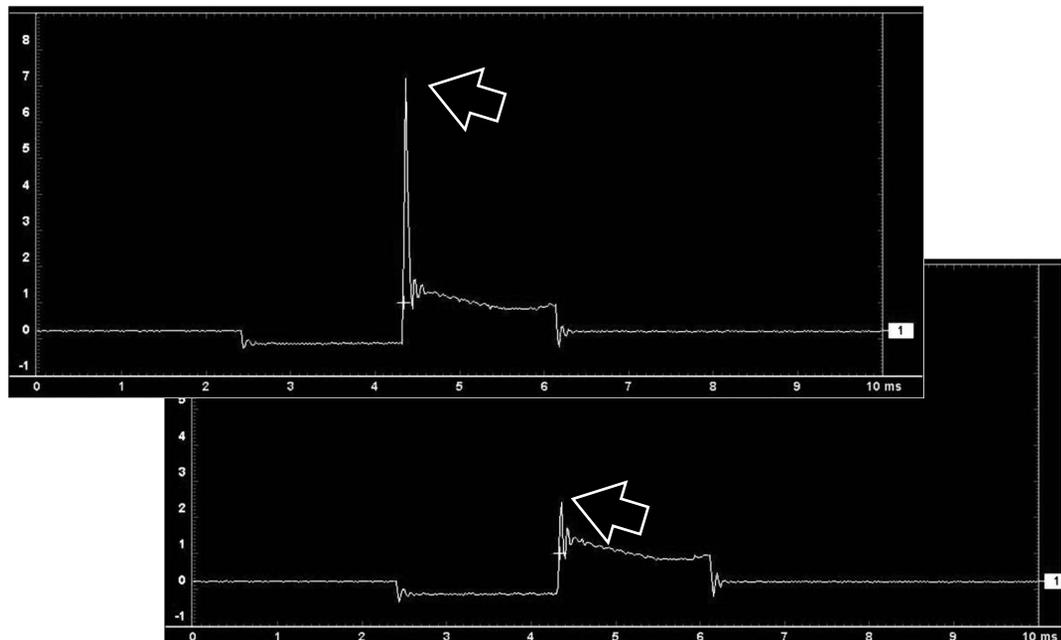


Figure 21 *Glitch on - (Setting D (upper) - High firing voltage), (Setting C (lower) - Low firing voltage)*

Sine Wave Signal - Demonstration

Reference

See "Feature Identification" on page 5 for the location of the Sine Wave signal connector (**Item 12**).

Signal characteristics and adjustments:

- Voltage level (amplitude) 0 to 5V and frequency (0.23Hz up to 60Hz) are controlled by the Variable Frequency adjustment knob.
- A glitch is simulated by a missing pulse every 2 seconds.

Use the following controls to demonstrate variances and glitches in the Sine Wave signal patterns:

- Turn the **Variable Frequency adjustment knob** to show how the waveform changes in frequency and amplitude.
- Toggle the **Glitch switch** on/off to show the signal drop out (missing pulse) approximately every 2 seconds in the waveform.

Setup

The Lab Scope is used for testing.

Lab Scope	
Navigation	Select Scope Multimeter > Lab Scope
Lead Connections	Channel 1 - connect to Sine Wave connector
	Ground - connect to Ground connector
Scale and Trigger Settings	Voltage Scale - set to 10V
	Sweep (Time Scale) - set to 200ms
	Trigger Setting - Auto 0V, Slope falling (-) edge

To see the complete waveform as shown, move the baseline up closer to the center of the display.

Sine Waveform Example (Lab Scope)

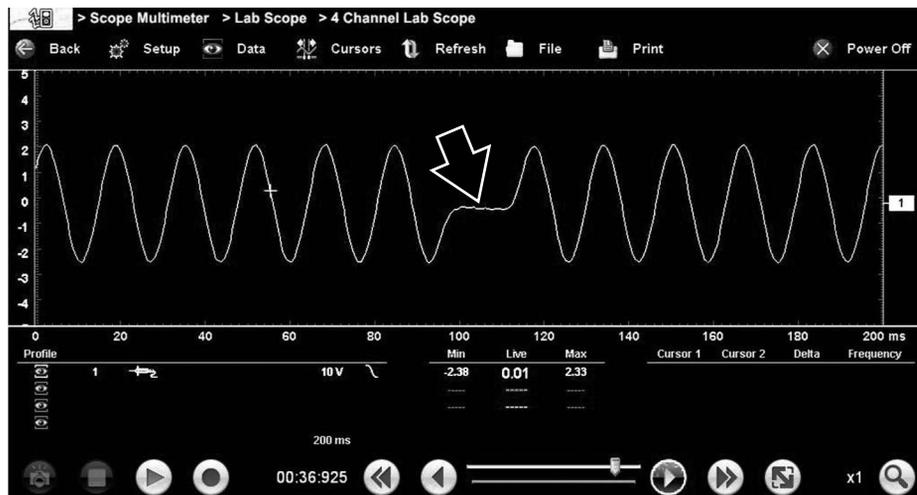


Figure 22 Glitch On

Variable Pulse Width / Duty Signal - Demonstration

Reference

See “*Feature Identification*” on page 5 for the location of the Variable Pulse Width signal connector (**Item 14**).

Signal characteristics and adjustments:

- Frequency (0.23 up to 60Hz) is controlled by the Variable Frequency adjustment knob.
- Pulse / Duty cycle 2 to 98% is controlled by the Variable Pulse Width adjustment knob.
- A glitch is simulated by a missing signal pulse every 2 seconds.

Use the following controls to demonstrate variances and glitches in the Variable Pulse Width signal patterns:

- Turn the **Variable Frequency adjustment knob** to show how the waveform changes in frequency.
- Turn the **Variable Pulse Width adjustment knob** to show how the waveform pulse width changes.
- Toggle the **Glitch switch** on/off to show the signal drop out (missing pulse) approximately every 2 seconds in the waveform.

Setup

The Lab Scope is used for testing.

Lab Scope	
Navigation	Select Scope Multimeter > Lab Scope
Lead Connections	Channel 1 - connect to Variable Pulse Width connector
	Ground - connect to Ground connector
Scale and Trigger Settings	Voltage Scale - set to 10V
	Sweep (Time Scale) - set to 200ms
	Trigger Setting - Auto 2.5V, Slope falling (-) edge
Variable Pulse Width Adjustment Knob	Adjust to mid point of full rotation (left to right) for initial display. If set to full left the waveform will not be displayed.

Variable Pulse Width Waveform Example (Lab Scope)

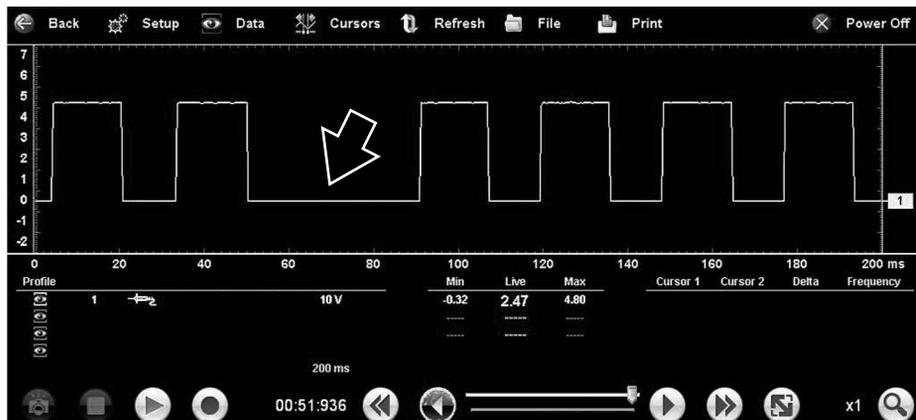


Figure 23 Glitch On

Variable Frequency Signal - Demonstration

Reference

See “*Feature Identification*” on page 5 for the location of the Variable Frequency (Square Wave) signal connector (*Item 13*).

Signal characteristics and adjustments:

- Frequency (7.6Hz up to 1.95 kHz) is controlled by the Variable Frequency adjustment knob.
- A glitch is simulated by a 250 μ s inversion of the signal every 2 seconds.

Use the following controls to demonstrate variances and glitches in the Variable Frequency signal patterns:

- Turn the **Variable Frequency adjustment knob** to show how the waveform changes in frequency.
- Toggle the **Glitch switch** on/off to show the signal invert approximately every 2 seconds in the waveform.

Setup

Both the Lab Scope and Graphing Multimeter can be used for testing.

Lab Scope	
Navigation	Select Scope Multimeter > Lab Scope
Lead Connections	Channel 1 - connect to Variable Frequency connector
	Ground - connect to Ground connector
Scale and Trigger Settings	Voltage Scale - set to 10V
	Sweep (Time Scale) - set to 50ms
	Trigger Setting - Auto 2.5V, Slope falling (-) edge

Variable Frequency Waveform Example (Lab Scope)

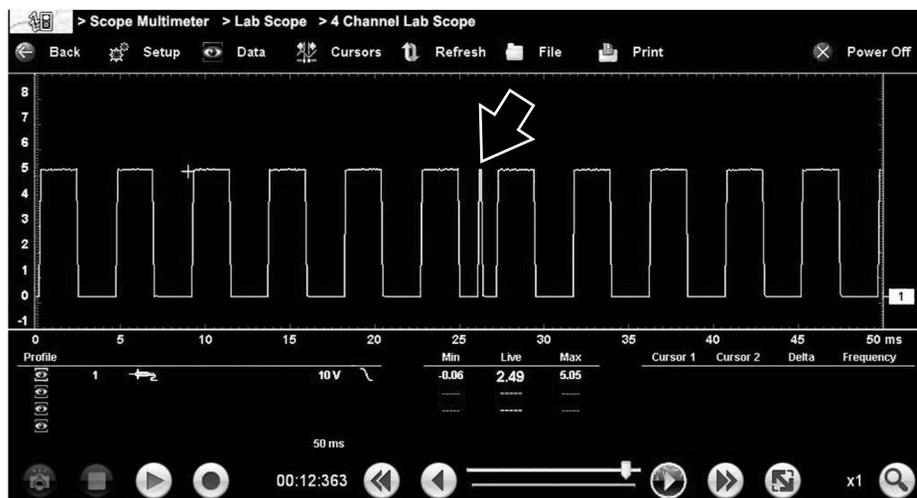


Figure 24 Glitch On

Graphing Multimeter	
Navigation	Select Scope Multimeter > Graphing Multimeter
Lead Connections	Channel 1 - connect to Variable Frequency Signal connector
	Ground - connect to Ground connector
Scale and Trigger Settings	Probe - set to Hz
	Scale - set to 2 MHz
	Sweep (Time Scale) - set to 10 s

The Graphing Multimeter provides an alternate way to check for erratic glitches. A primary advantage of the GMM is that it graphs the history of the signal over longer periods of time than the typical lab scope setup. The GMM can help you quickly find erratic glitches that may be overlooked when using the lab scope.

The following example (*Figure 25*) uses the same signal as shown above, displayed using the **Graphing Multimeter (GMM) > Frequency** function. In this example the GMM measures the frequency (number of cycles per second) of the signal and plots the frequency measurement over the time period of 10 seconds.

The following example is created by slightly turning the variable frequency adjustment knob (back and forth) to get the varying frequency effect. In this case the glitch is easily noticed as a sharp upward spike about every 2 seconds, this indicates that the frequency of the signal briefly increases possibly indicating a problem.

Variable Frequency Waveform Example (GMM)

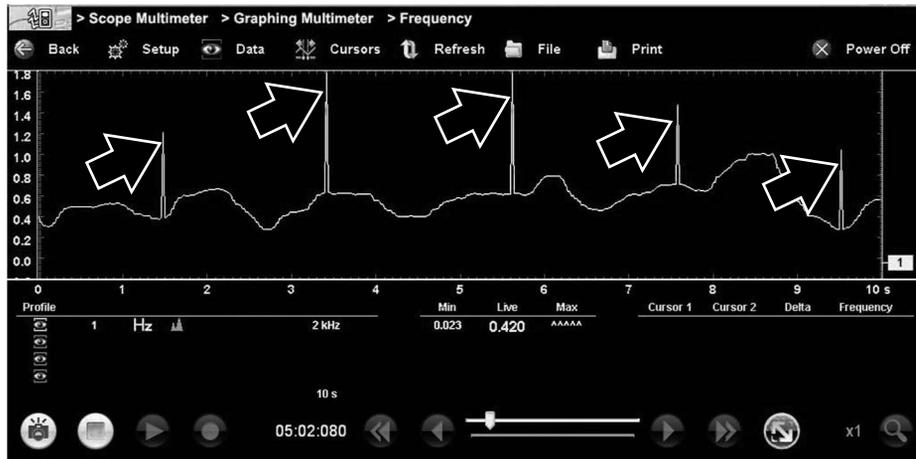


Figure 25 GMM Frequency example - Glitch On

Where do I find known good waveform examples?

In some cases captured waveforms may not provide enough information to determine if a suspected sensor or circuit is at fault. Comparing the test vehicle waveforms to known good waveforms, can help to provide supporting evidence when trying to determine a fault.

Known good waveform examples may be available from different sources including the Guided Component Tests function (on select diagnostic tools), information services (e.g. SureTrack) or from other sources.

One of the many resources available within the online version of SureTrack (askatech.com) is the comprehensive collection of known good component waveform examples gathered through actual vehicle tests. Waveform and PID graph screenshot examples are provided by fellow member technicians and shared with all members in a searchable (vehicle/component specific) database.

As good practice, capturing waveforms before and after the repair will help you to build your own library of waveforms for future troubleshooting.



To find waveform examples within SureTrack:

1. Visit askatech.com and join SureTrack (if not already a member).
2. Sign in to SureTrack.
3. Enter (identify) the test vehicle details in the search field at the top of the screen (Figure 26).
4. Select the **Dashboard** tab (left side) (Figure 26).

If waveform and or PID graph examples are available, the **Library** tab will be displayed at the top (Figure 26).

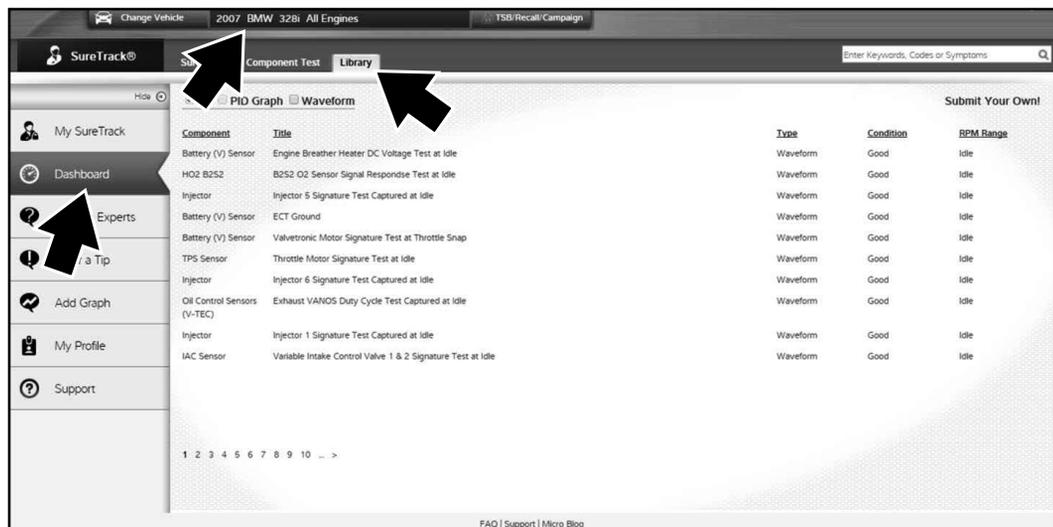


Figure 26 SureTrack - Library tab showing list of waveform examples

5. Select the **Library** tab (Figure 26). A list of examples is displayed and sortable by selecting the PID Graph and or Waveform check boxes at the top.
6. Search through the list and select the desired example.

Typical examples are displayed in Figure 27.



NOTE:

Examples may not be available for all vehicles or components and are supplied from various diagnostic tools. All examples are provided as reference only.

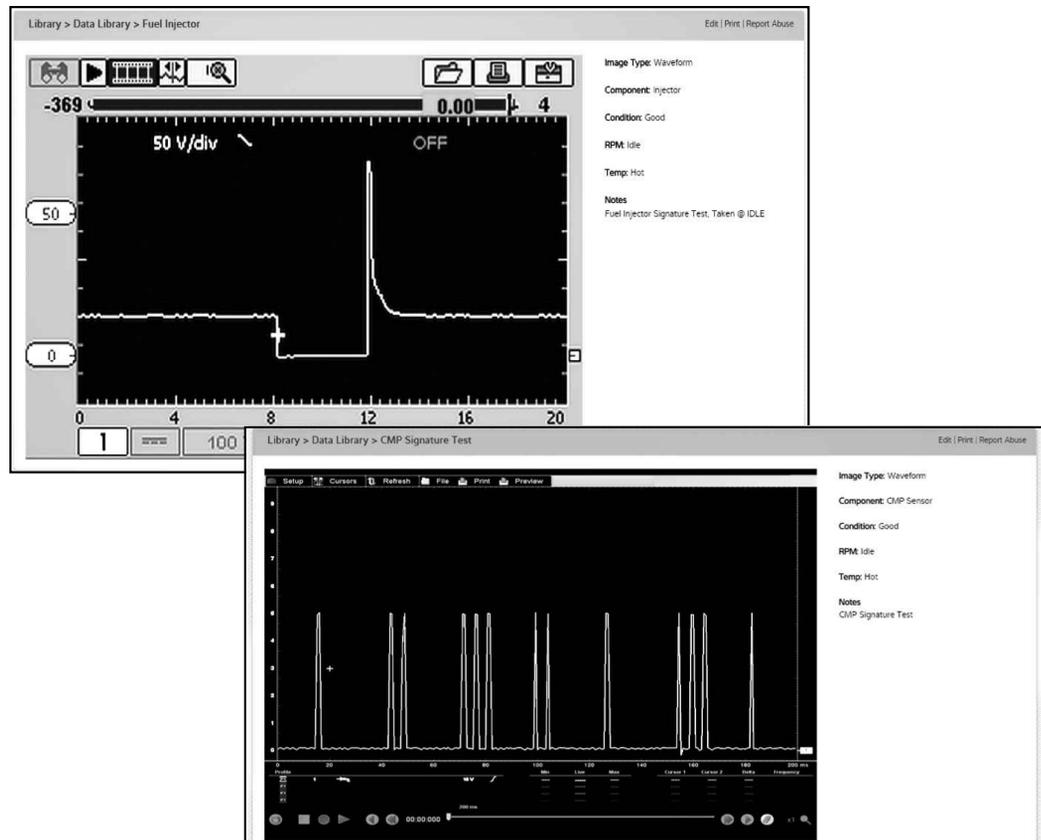


Figure 27 SureTrack - Waveform examples

For additional waveform reference information, visit the Snap-on Diagnostics forums to ask questions, and share information at: <http://diagnostics.snapon.com/ForumsandTraining.htm>.

Troubleshooting



In case of a malfunction with the simulator:

1. Disconnect all test leads from the simulator.
2. Press the **Power** switch to turn the simulator off.
3. Check the battery level, if the battery is discharged (below 6 VDC) the simulator may not operate. Replace the battery as necessary.



NOTE:

Battery voltage directly affects generated waveforms. As battery voltage decreases the amplitude of the generated waveforms will also proportionately decrease.

4. Press the **Power** switch to turn the simulator on.
5. Reconnect the tests leads and test the simulator, by performing a demonstration.
If the problem persists:
6. Check the test leads and connections for proper operation.
7. Turn the diagnostic tool off and then restart it.
If the problem persists after multiple attempts to reset, contact Snap-on Diagnostics Customer Service.