

Automotive Labscope



Operator's Manual

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Specifications

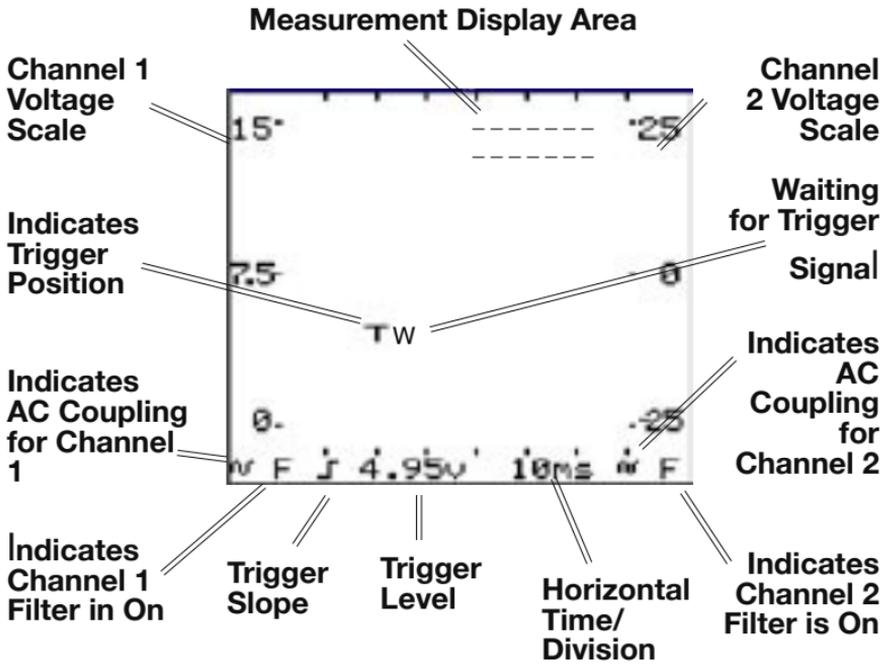
Bandwidth	100 kHz
Channels	2
Voltage Ranges	0.5 V full scale to 100 V full scale
Vertical Position	Fixed with Offset (ground moved to center screen)
Input Coupling	AC, DC
Sample Rate	140 kS/s
Sweep Rate	60 s/Div to 100 μ s/Div
Trigger	Auto, Wait
Display	128 x 128 pixel LCD, Backlit
Memory	2 test setups (waveforms, setups, and related information)
Presets	At least 50 preset measurements with reference waveforms and Help menu for each
Update Rate	At least 3 times / Second RS-232C Talk/Listen capability
Battery	NiMH rechargeable battery pack
External Power	AC adapter

Front Panel Controls

ON/OFF	Press to turn the unit on or off. If no buttons are pushed for approximately five minutes (20 minutes at 60 sec/division), the scope will turn off the power.
SELECT	Press the SELECT button to access the main menu and make a selection
UP/DOWN	Scroll to a desired setup or measurement by moving the highlighted line up or down.
CH1	Changes the voltage range of Channel 1. Pressing both the upper and lower portions of the button simultaneously causes the ground reference move to the center of the screen. Press both upper and lower portions again and the ground reference will move to the bottom of the screen.
CH2	Same as CH1
TRIG	Changes the voltage level of the trigger. Pressing both the upper and lower portions of the button simultaneously causes the trigger slope to alternate between positive and negative slope. The actual position of the trigger start point is indicated by a "T" on the display.
TIME/DIV	Pressing the TIME/DIV button sets the horizontal sweep speed for both channels.
HELP	Pressing the HELP button causes information relating to that selected measurement item or menu feature to be displayed on-screen. There may be multiple pages of information, which can be scrolled through using the UP or DOWN arrow buttons. To exit the HELP menu, press the HELP button again.
HOLD	Pressing the HOLD button freezes the current on-screen waveform, and brings up the waveform storage selection menu.
REF	Pressing the REFERENCE button displays a representative waveform for the menu item currently selected. This waveform is only visible on-screen while the REFERENCE button is being pressed. When in the Standard scope mode, pressing the REFERENCE button will cause the current scope parameters to be displayed.

Please Note: The reference waveforms are representative only, and may not exactly match the measurement the labscope is currently acquiring. Please use caution when comparing the signal actively being acquired to the reference waveform.

Understanding the Display



External Connections

COM	Signal ground connection. Common for CH1 and CH2.
CH1	Input for CH1 signal. AC coupled (DC Component of the signal is blocked). Bandwidth using this input is 10Hz to 100kHz. With the input DC coupled (direct coupled), the bandwidth is DC to 100kHz. Maximum input voltage is 300 VAC or 300 VDC. Please note the trigger source is always CH1.
CH2	Input for second signal in a dual-channel display mode. Maximum input voltage is 300 VAC or 300 VDC.
RS-232	RS-232 interface for computer communication.
EXT	Input to recharge the internal batteries

Manual Setup

Use the up/down arrow buttons to move the arrow to the desired menu selection. The current selection for each command is indicated by the reversed video. Press SELECT to highlight the other function. Select OK to begin operation.



CH1POS: BOTT CENT

Positions the ground reference on the bottom or center of the screen. Pressing both the up and down segments of the CH1 key will perform the same operation.

CH2: OFF ON

Turns Channel 2 Off for single-channel operation or On for dual-channel operation.

CH2POS: BOTT CENT

Functions same as for Channel 1. Positions the ground reference at either the bottom or center of the screen. Note: Setting both channels to the same position may cause visual confusion if the signals are similar. Whenever possible, use bottom and center for different channels.

TRIG: AUTO WAIT

Selects either Automatic trigger (trace runs continuously even without signal present) or Wait (sometimes called Normal trigger). In WAIT, the scope waits for a signal before starting the trace. (It is normal for the display to be blank until a signal is present at the input.)

TRIG SLOPE:

Determines whether the scope triggers on the rising edge () or the falling edge () of the input signal. This is indicated on the display by the symbol at the bottom left of the screen, to the left of the trigger level readout.

COUPLING1: AC DC

Select between AC coupling or DC coupling for Channel 1. When in AC-coupled mode, a small sinewave appears in the lower left corner of the display. NOTE: AC coupling filters out the DC part of the incoming signal, and displays only the AC signal changes. DC coupling displays the DC component of the signal along with the AC signal changes.

FILTER1: OFF ON

When ON, a low-pass filter is connected in series with the input for Channel 1. This limits the bandwidth and reduces background noise and interference. When FILTER1 is ON, an "F" appears in the lower left corner of the display. NOTE: For faster signals, such as optical distributors, the decreased bandwidth with the filter installed may alter the displayed signal. If unsure, always check the signal with and without the filter applied.

COUPLING2: AC DC

Provides same functions for Channel 2 as described for Channel 1 COUPLING. When in AC-coupled mode, a small sinewave appears in the lower right corner of the display.

FILTER2: OFF ON

Provides same function for Channel 2 as described for Channel 1 FILTER. When FILTER2 is ON, and "F" appears in the lower right corner of the display.

BACKLIGHT: OFF ON

Turns backlight on or off.

SHUTDOWN: AUTO MAN

During power up, the default shutdown is set to Auto. Auto will turn the unit off after about 20 minutes. Selecting Man(ual) will force the labscope to stay on until you turn it off.

CONTRAST:

Allows the display contrast to be adjusted through a range of 0 (least contrast) through 10 (highest contrast).

UNDO

Cancels the current choices and returns the scope to the previous setup.

OK

Accept current Manual Setup choices and begin operation.

SET Measurements

Allows selection of up to two automated measurements for display along with the acquired signal. NOTE: Menu scrolls through measurements. Select up to two measurements from the Measurements submenu using the UP or DOWN arrow buttons and the SELECT button. Accept your choices by selecting OK. The scope returns to the Manual Setup menu where you can make further setup changes or accept your previous choices.

Standard Setups

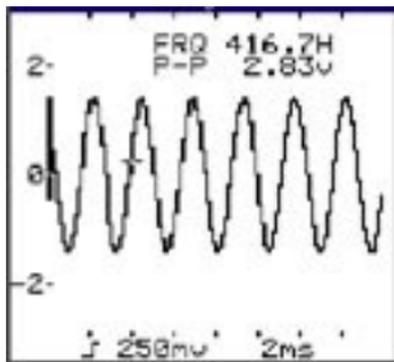
Standard Setup sets the LabScope to the following conditions.

CH1 = 15 V, DC Coupled, Trigger = 3.3 V, positive Slope, Time/Div = 10 ms

Sensor Tests

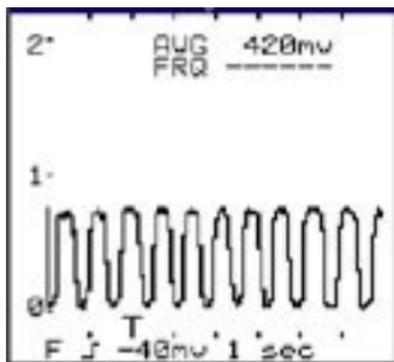
ABS Wheel Speed

Connect COM probe to the sensor “low”, “-”, or ground circuit. Connect CH1 probe to the sensor “high”, “+” or signal output to the ABS control unit. Spin the wheel and look for symmetrical oscillations that increase in amplitude as wheel speed increases.



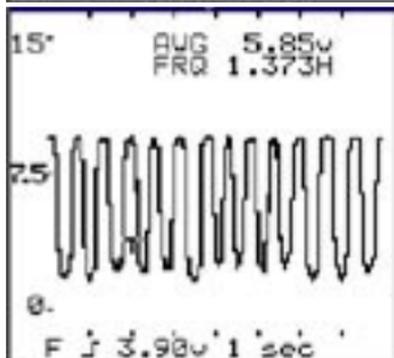
Oxygen Sensor 1V

Connect COM probe to the O2 sensor ground circuit or sensor body (NOT the negative battery terminal). Connect the CH1 probe to the O2 sensor signal wire to the PCM. Warm the engine for 2-3 minutes at 2500 RPM. Test the sensor using propane enrichment or “snap-throttle” method. Check for proper max/min voltage and response time.



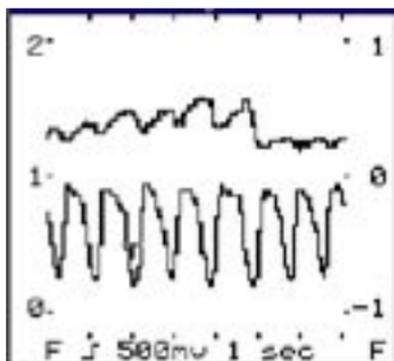
Oxygen Sensor 5V

Connect COM probe to the O2 sensor ground circuit or sensor body (NOT the negative battery terminal). Connect the CH1 probe to the O2 sensor signal wire to the PCM. Warm the engine for 2-3 minutes at 2500 RPM. Test the sensor using propane enrichment or “snap-throttle” method. Check for proper max/min voltage and response time.



O2 Sensor Dual 1V

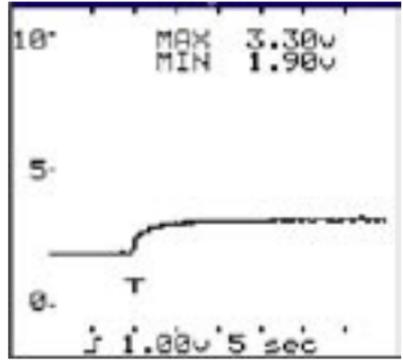
Connect COM probe to the O2 sensors' ground circuit or sensor body (NOT the neg. battery terminal). Connect the CH1 probe to the #1 (Pre-Cat) O2 sensor signal to the PCM. Connect the CH2 probe to the #2 (Post-Cat) O2 sensor signal to the PCM. Warm the engine for 2-3 minutes at 2500 RPM. Test the sensors using propane enrichment or “snap-throttle” method. Check for proper max/min voltage and response time.



Sensor Tests

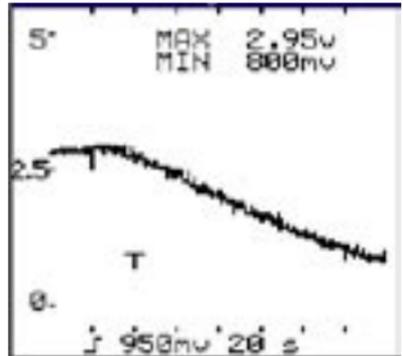
Intake Air Temp IAT

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect the CH1 probe to the sensor's signal to the PCM. Spray the sensor tip with cooling spray or begin the test at the suspected temperature range and verify the signal's amplitude is within its limits for the given temperature. Opens will appear as upward spikes to VRef. Shorts will appear as downward spikes to ground.



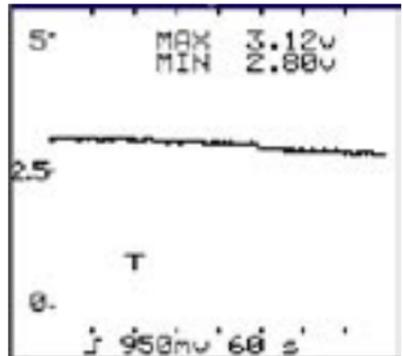
Engine Coolant ECI

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect the CH1 probe to the sensor's signal to the PCM. Begin the test at the suspected temperature range, and verify the signal's amplitude is within its limits for the given temperature. Opens will appear as upward spikes to VRef. Shorts will appear as downward spikes to ground.



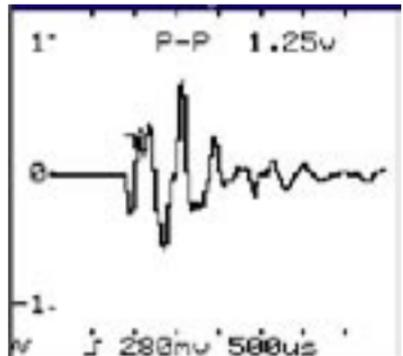
Fuel Temp. Sensor

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect the CH1 probe to the sensor's signal to the PCM. Begin the test at the suspected temperature range, and verify the signal's amplitude is within its limits for the given temperature. Opens will appear as upward spikes to VRef. Shorts will appear as downward spikes to ground.



Knock Sensor

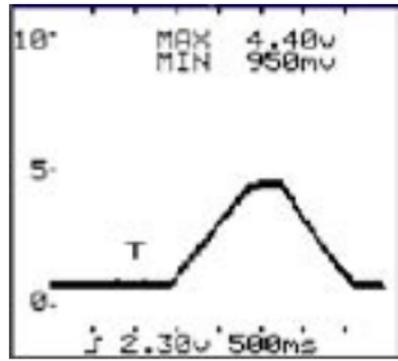
Connect COM probe to the negative battery post or engine block. Connect CH1 probe to the sensor output signal circuit to the PCM (or spark control unit). With the key off, lightly tap the engine (in the general vicinity of the sensor) with something metallic. The amplitude of the oscillations in the waveform should increase with harder taps.



Sensor Tests

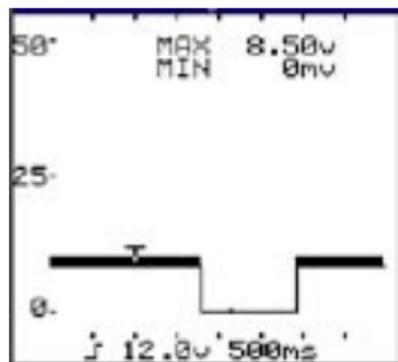
Throttle Position

Connect COM probe to the sensor's ground circuit, engine block or negative battery post. Connect the CH1 probe to the sensor's signal to the PCM. With the key on, engine off, slowly work the throttle from closed position to wide open throttle and back again. There shouldn't be any breaks, spikes to ground, or dropouts in the waveform's amplitude.



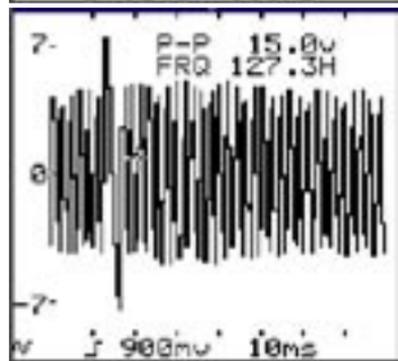
Throttle Position SW

Connect COM probe to the Sensor's ground circuit, engine block, or negative battery post. Connect the CH1 probe to the sensor's signal to the PCM. With the key on, engine off, slowly work the throttle from closed position to wide open throttle and back again. There shouldn't be any breaks, spikes to ground, or dropouts in the waveform's amplitude.



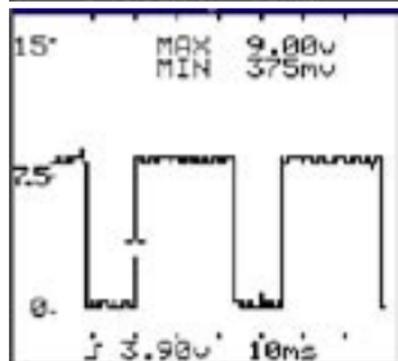
Magnetic (CKP/CMP)

Connect COM probe to the sensor "low", "-", or ground circuit. Connect CH1 probe to the sensor "high", "+", or signal output to the PCM or ignition control unit. Crank or start the engine. Let the engine idle, rev the engine, or drive the vehicle to make the drivability or emissions problem occur. Check the waveform for proper shape, frequency and amplitude.



Hall Effect (CKP/CMP)

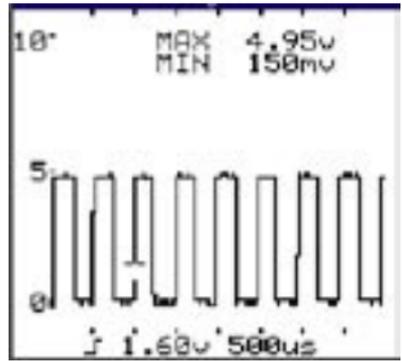
Connect COM probe to the sensor "low", "-", or ground circuit. Connect CH1 probe to the sensor "high", "+", or signal output to the PCM or ignition control unit. Crank or start the engine. Let the engine idle, rev the engine, or drive the vehicle to make the drivability or emissions problem occur. Check the waveform for proper shape, frequency and amplitude.



Sensor Tests

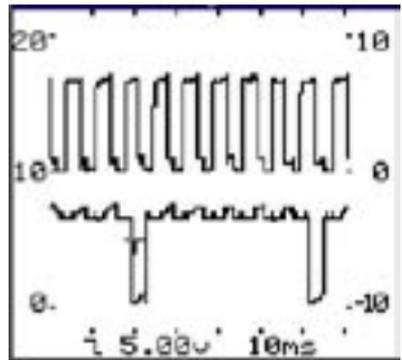
Optical (CKP/CMP)

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect CH1 probe to the sensor's signal circuit to the PCM. Crank or start the engine. Let the engine idle, rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper shape, frequency, and amplitude.



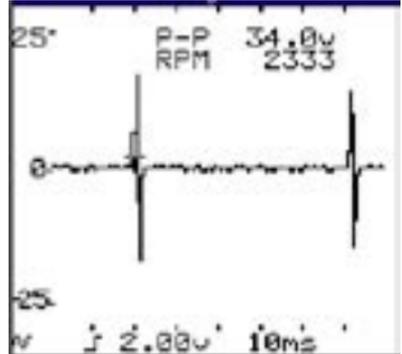
Dual Trace Hall Eff

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect CH1 probe to the crankshaft sensor's signal circuit to the PCM. Connect CH2 probe to the camshaft sensor's signal circuit to the PCM. Crank or start the engine. Let the engine idle, rev engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveforms for proper shape, frequency, and amplitude.



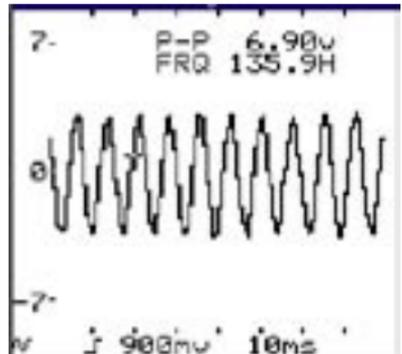
Magnetic CMP

Connect COM probe to the sensors' "low", "-", or ground circuit. Connect the CH1 probe to the camshaft sensors' "high", "+", or signal output to the PCM or ignition control unit. Crank or start the engine. Let the engine idle, rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper shape, frequency, and amplitude.



Magnetic VSS

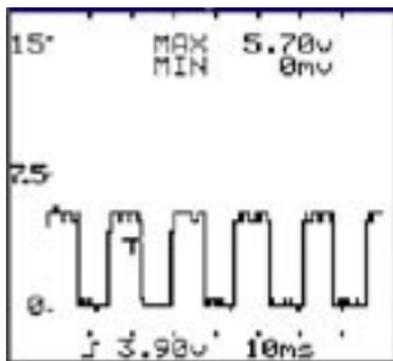
Connect COM probe to the sensor "low", "-", or ground circuit. Connect CH1 probe to the sensor "high", "+", or signal output to the PCM. As the wheels begin to spin, symmetrical oscillations should increase in amplitude as wheel speed increases.



Sensor Tests

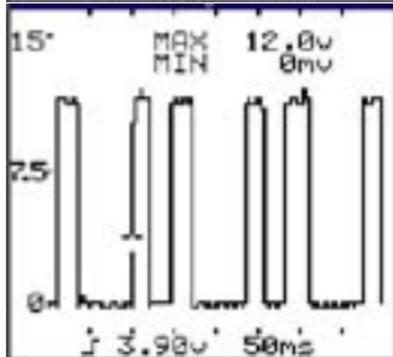
Hall Effect VSS

Connect COM probe to the sensor's ground circuit, engine block, or negative battery. Connect CH1 probe to the crankshaft sensor's signal circuit to the PCM. Connect CH1 to the sensor signal circuit to the PCM. As wheels begin to spin, pulses should increase in frequency as wheel speed increases. Check waveform for proper shape, frequency, and amplitude.



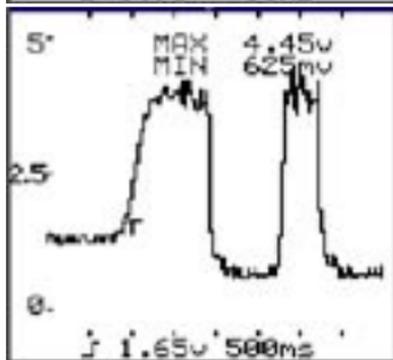
Optical VSS

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect CH1 probe to the crankshaft sensor's signal circuit to the PCM. Connect CH1 probe to the sensor's signal circuit to the PCM. Crank or start the engine, let the engine idle, rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper amplitude at any given engine vacuum.



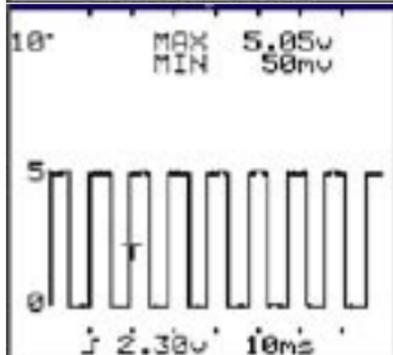
Analog MAP Sensor

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect the CH1 probe to the camshaft sensors' "high", "+", or signal output to the PCM or ignition control unit. Crank or start the engine. Let the engine idle, rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper shape, frequency, and amplitude.



Digital (Ford) MAP

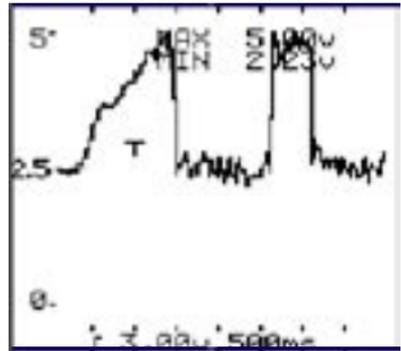
Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect the CH1 probe to the camshaft sensors' "high", "+", or signal output to the PCM or ignition control unit. Crank or start the engine. Let the engine idle, rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper shape, frequency, and amplitude.



Sensor Tests

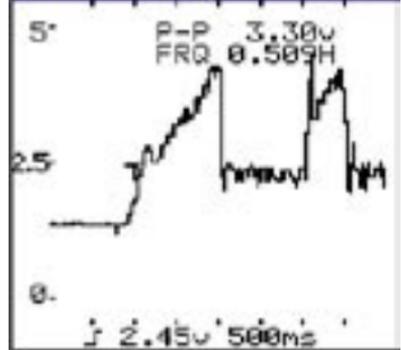
Analog MAF Hot Wire

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect CH1 probe to the sensor's signal circuit to the PCM. Crank or start the engine, let the engine idle, rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper amplitude at any given air flow rate.



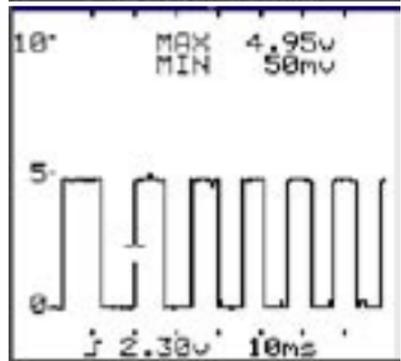
Analog MAF Vane Type

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect CH1 probe to the sensor's signal circuit to the PCM. Crank or start the engine, let the engine idle, rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper frequency, shape, and amplitude at any given air flow rate.



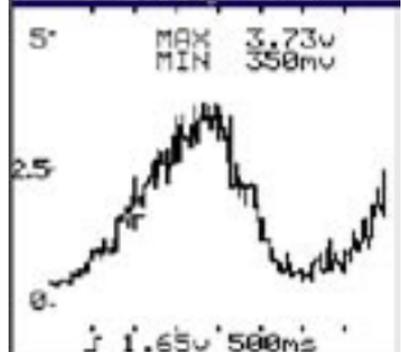
Digital MAF

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect CH1 probe to the sensor's signal circuit to the PCM. Crank or start the engine, let the engine idle, rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper amplitude at any given air flow rate.



EGR Valve Pos EVP

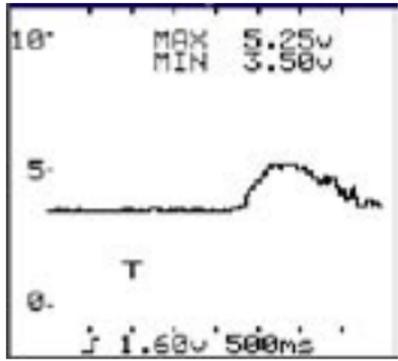
Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect CH1 probe to the sensor's signal circuit to the PCM. Crank or start the engine, let the engine idle, rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper amplitude at any given EGR flow rate.



Sensor Tests

EGR Pressure/Flow

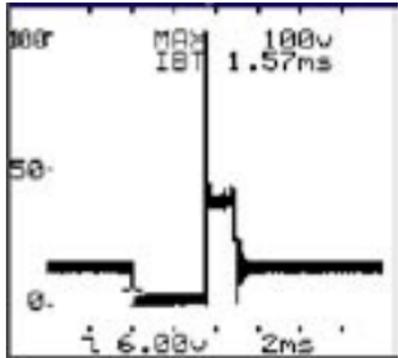
Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect CH1 probe to the sensor's signal circuit to the PCM. Crank or start the engine, let the engine idle, rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper amplitude at any given air flow rate.



Actuator Tests

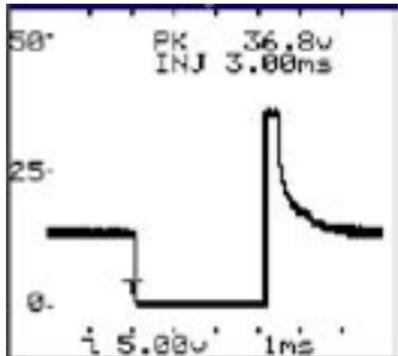
Ignition Primary

Connect the COM probe to a good ground source, such as the negative battery post or engine block. Connect the CH1 probe to the negative (pulsing) side of the ignition coil. With the key on, engine running, use the throttle, or drive the car to cause the misfire or driveability problem to occur. Check the waveform for proper shape and amplitude.



Multi Fuel Inj MFI

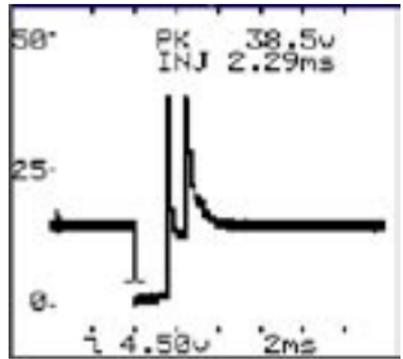
Connect the COM probe to the engine block, or negative battery post. Connect the CH1 probe to the injector control signal from the PCM (the pulsing side of the fuel injector). Operate the engine as needed to make the driveability or emissions problem occur. Make sure the critical dimensions of amplitude, frequency, shape, and pulse width are correct, repeatable, and consistent for the type of fuel injector driver being tested and for the engine condition present (RPM, load, O2 voltage, etc.)



Actuator Tests

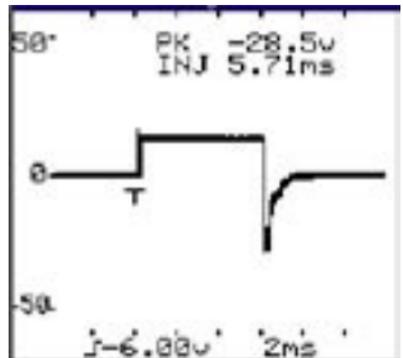
Throt. Body Inj TBI

Connect the COM probe to the engine block, or negative battery post. Connect the CH1 probe to the injector control signal from the PCM (the pulsing side of the fuel injector). Operate the engine as needed to make the driveability or emissions problem occur. Make sure the critical dimensions of amplitude, frequency, shape, and pulse width are correct, repeatable, and consistent for the type of fuel injector driver being tested and for the engine condition present (RPM, load, O2 voltage, etc.)



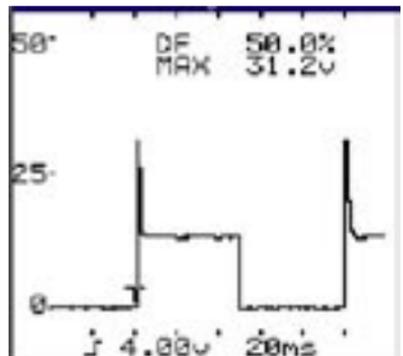
PNP Fuel Injectors

Connect the COM probe to the engine block, or negative battery post. Connect the CH1 probe to the injector control signal from the PCM (the pulsing side of the fuel injector). Operate the engine as needed to make the driveability or emissions problem occur. Make sure the critical dimensions of amplitude, frequency, shape, and pulse width are correct, repeatable, and consistent for the type of fuel injector driver being tested and for the engine condition present (RPM, load, O2 voltage, etc.)



Carb Mix Sol. MC

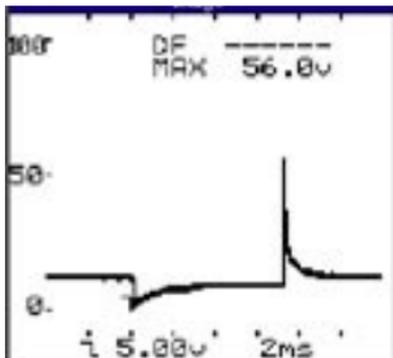
Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect CH1 probe to the mixture control signal from the PCM (pulsing side of the mixture control solenoid/valve). Operate the engine as needed to make the driveability or emissions problem occur. Make sure the critical dimensions of amplitude, frequency, shape, and pulse width are correct, repeatable, and consistent for the type of fuel injector driver being tested and for the engine condition present (RPM, load, O2 voltage, etc.)



Actuator Tests

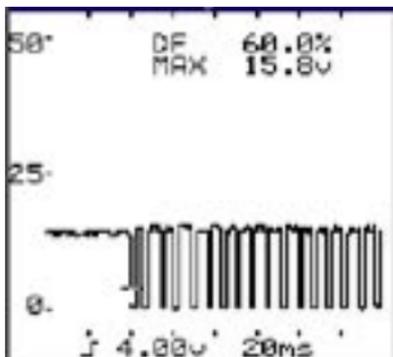
Bosch CIS Freq Valv

Connect COM probe to the sensor's ground circuit, engine block, or negative battery post. Connect CH1 probe to the mixture control signal from the PCM (pulsing side of the mixture control solenoid/valve). Operate the engine as needed to make the driveability or emissions problem occur. Make sure the critical dimensions of amplitude, frequency, shape, and pulse width are correct, repeatable, and consistent for the type of fuel injector driver being tested and for the engine condition present (RPM, load, O2 voltage, etc.)



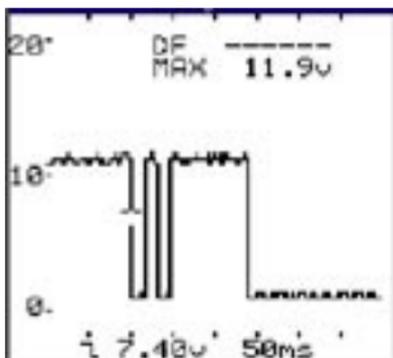
EGR Ctrl Solenoid

Connect the COM probe to the engine block, or negative battery post. Connect the CH1 probe to the solenoid/valve's control signal from the PCM (the pulsing side of the solenoid/valve). Start the engine, Rev the engine, or drive the vehicle to make the the driveability or emissions problem occur. Check the waveform for proper duty cycle, shape, frequency, and amplitude at any desired EGR flow rate.



Idle Air Ctrl IAC

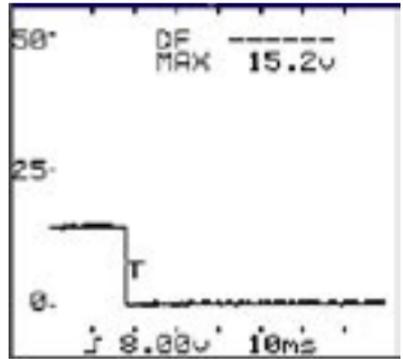
Connect the COM probe to the engine block, or negative battery post. Connect the CH1 probe to the solenoid/valve's control signal from the PCM (the pulsing side of the solenoid/valve). Start the engine, Rev the engine, or drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper duty cycle, shape, frequency, and amplitude at any desired idle speed.



Actuator Tests

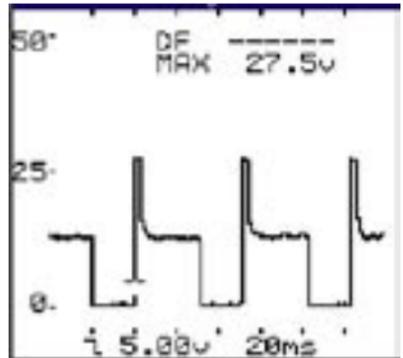
Transmission Shift

Connect COM probe to the engine block, or negative battery post. Connect CH1 probe to the solenoid/valve's control signal from the PCM (the pulsing side of the solenoid/valve). Start the engine. Drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper duty cycle, shape, frequency, and amplitude at the critical shift point.



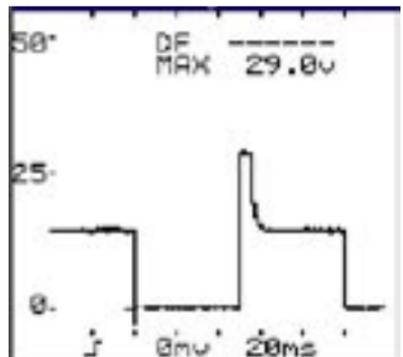
Turbo Boost Control

Connect COM probe to the engine block, or negative battery post. Connect CH1 probe to the solenoid/valve's control signal from the PCM (the pulsing side of the solenoid/valve). Start the engine. Drive the vehicle and accelerate to activate the turbocharger system. Check the waveform for proper duty cycle, shape, frequency, and amplitude required to maintain desired boost pressure.



Canister Purge Ctrl

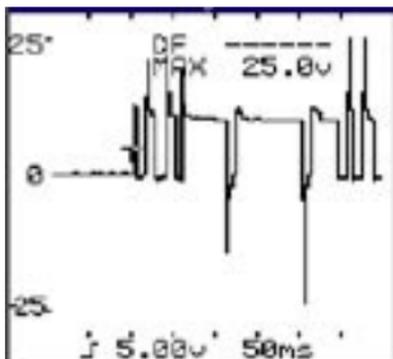
Connect the COM probe to the engine block, or negative battery post. Connect the CH1 probe to the solenoid/valve's control signal from the PCM (the pulsing side of the solenoid/valve). Start the engine, drive the vehicle and accelerate to activate the canister purge system. Check the waveform for proper duty cycle, shape, frequency, and amplitude required to purge the canister.



Actuator Tests

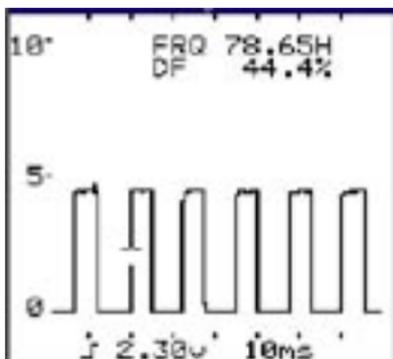
ABS Ctrl Solenoid

Connect COM probe to the solenoid/valve ground circuit, engine block, or negative battery post. Connect the CH1 probe to the solenoid/valve control signal from the ABS control unit. Drive the vehicle as needed to make the ABS system become active. Make sure the critical dimensions of amplitude, frequency, shape, and pulse width are correct, repeatable, and consistent for the type of ABS solenoid being tested.



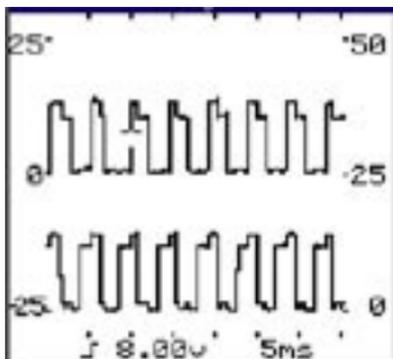
EST - common, GM

Connect COM probe to a PCM ground circuit, the engine block, or negative battery post. Connect CH1 probe to the EST control signal from the PCM to the ignition module. Crank or start the engine. Drive the vehicle to make the driveability or emissions problems occur. Check the waveform for proper duty cycle, shape, frequency, and amplitude at different engine speeds and loads. Look for abnormalities in the waveform to coincide with engine sputter or driveability problems.



EST - Ford SPOUT

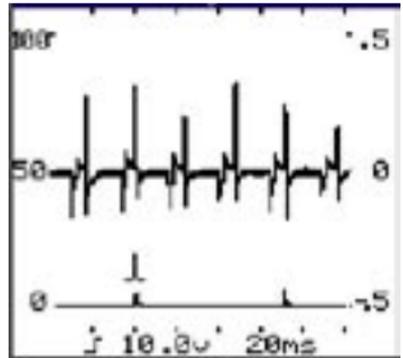
Connect COM probe in a PCM ground circuit. Connect CH1 probe to the PIP signal from the TFI ignition module to the PCM. Connect the CH2 probe to the SPOUT signal from the PCM to the TFI ignition module. Crank or start the engine. Drive the vehicle to make the driveability or emissions problem occur. Check the waveform for proper duty cycle, shape, frequency, and amplitude at different engine speeds and loads. Look for abnormalities in the waveform to coincide with engine sputter or driveability problems.



Actuator Tests

Secondary Ignition

Connect LabScope KV Adapter to CH2. Connect Cylinder #1 Pickup to CH1. Connect the Ground Lead on the LabScope KV Adapter to a good engine ground source such as the negative battery post or engine block. Connect the LabScope KV adapter to the Ignition System. Connect the Cylinder #1 Pickup around #1 Sparkplug wire. With the key on, engine running, use the throttle or drive the vehicle to make a misfire or drivability problem occur. Check waveform for proper shape and amplitude.



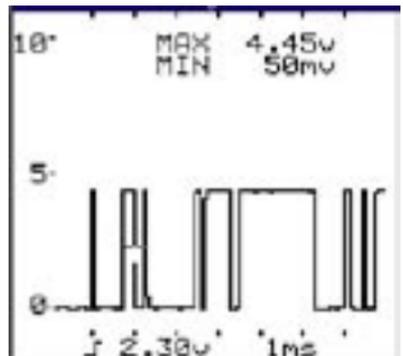
On a typical Double Output DIS system, you will have half of the connectors plugged into the Red side of the LabScope KV Adapter, and the other half plugged into the Blue side. The screen above shows what a 6 cylinder DIS engine looks like on the Ferret 93. At this point, you may use the features of the scope to display and analyze the ignition waveform.

On distributor Ignitions all instructions remain the same, except you connect only one KV Clip to the Coil wire. Do not connect KV Clips to each individual spark plug wire. Simply plug the single KV Lead into either a Blue or Red connector. For Distributor ignitions where the coil is in the cap, you will need the appropriate KV Pickup Plate found in the Available Accessories Section.

Communications Tests

Serial Data

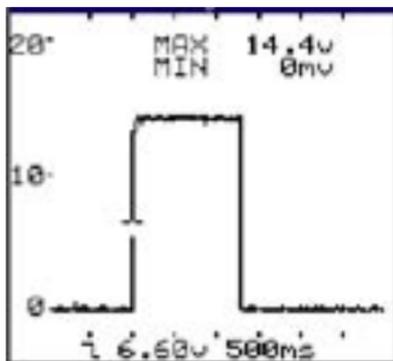
Connect COM probe to serial data ground circuit, engine block or negative battery post. Connect CH1 probe to serial data signal from PCM or other control unit. Turn key on and check DSO display. Digital pulses of varying frequency and duty cycle should be going by. This indicates PCM or control unit is alive. Most PCM's go to sleep (PCM stops making and sending data) from 6 to 15 seconds after key is shut off. Other vehicle systems will send serial data for up to 20 minutes after key is shut off.



Electrical Tests

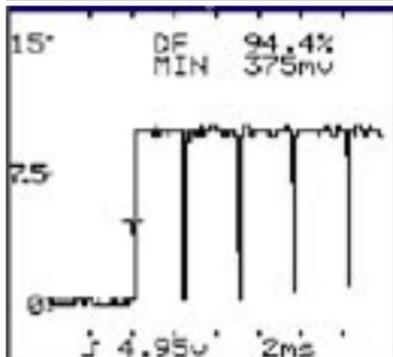
Apply Switch

Connect COM probe to the switch's ground circuit, engine block, or negative battery post. Connect the CH1 probe to the switch's signal circuit. Make sure power is switched on in the circuit so that the sensor, device or circuit is operational. The waveform should stay in a predetermined voltage range for a given condition.



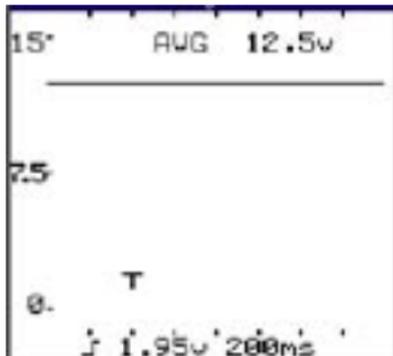
Alt Field Ctrl

Connect COM probe to the regulator ground circuit, engine block, or negative battery post. Connect CH1 probe to the Alternator Field Control signal from the PCM. Start the engine and hold at 2500 RPM. Turn headlights or other electrical loads on, or use battery load tester to vary the load on the vehicle's electrical system. When electrical load is high, the waveform should go high to increase alternator output. Frequency may also increase with electrical load.



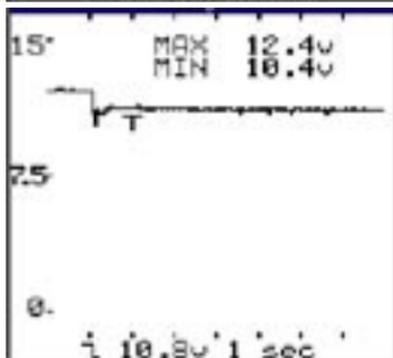
Battery B+ Supply V

Connect COM probe to the ground circuit, engine block, or negative battery post. Connect the CH1 probe to the power supply signal circuit. Make sure power is switched on in the circuit so that the sensor, device or circuit is operational. The waveform should stay in a predetermined voltage range (amplitude) for a given condition.



Battery Test Cranking

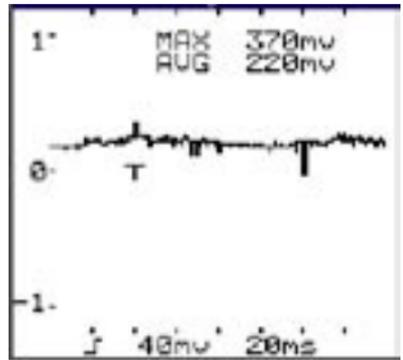
Connect COM probe to the engine block, or negative battery post. Connect the CH1 probe to the positive battery post. Crank the engine for 10 seconds. The voltage should not drop below 9.60 volts (at 70 Deg. F) during the test.



Electrical Tests

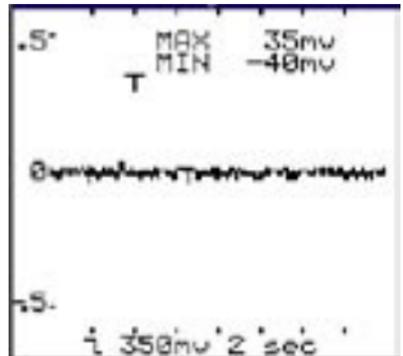
V Drop high current

Connect COM probe to negative battery post or portion of circuit closest to battery ground. Connect CH1 probe to ground connector or test point of suspected circuit farthest away from battery negative post (NOTE: probes may be connected in opposite fashion to measure voltage drops in power circuits). Make sure power in circuit, so normal current is flowing through circuit. Check amplitude of signal. It should generally not exceed 300mV. Clean, repair, or replace connections or connectors as needed.



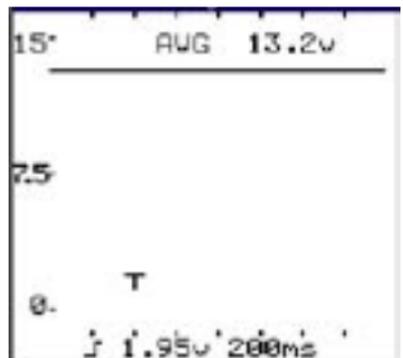
V Drop low current

Connect COM probe to negative battery post or portion of circuit closest to battery ground. Connect CH1 probe to ground connector or test point of suspected circuit farthest away from battery negative post (NOTE: probes may be connected in opposite fashion to measure voltage drops in power circuits). Make sure power is on in circuit, so normal current is flowing through circuit. Check amplitude of signal. It should generally not exceed 100mV. Clean, repair, or replace connections or connectors as needed.



Alt Output V Test

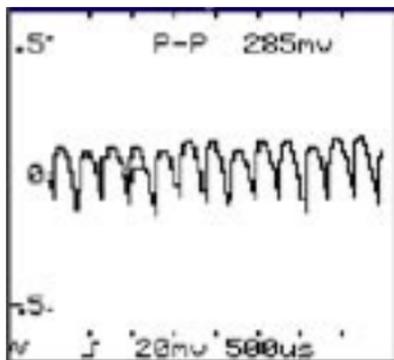
Connect COM probe to the ground circuit, engine block, or negative battery post. Connect the CH1 probe to the positive battery post. Turn off all accessories, start the engine and hold at 2500 RPM for 2-3 minutes. The alternator's output voltage should generally be 0.5 - 2.0 volts higher than the static battery voltage was with the key off. Consult the vehicle manufacturer's specifications for specific acceptable voltage ranges.



Electrical Tests

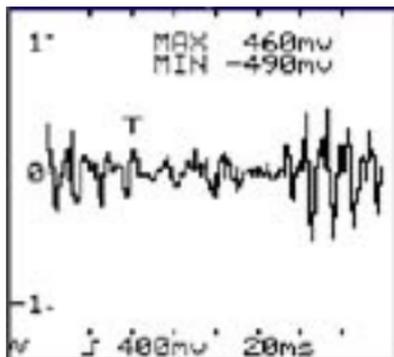
Alt Diode Test

Connect COM probe to negative battery post, or alternator case. Connect CH1 probe to positive battery post, or better, B+ output terminal in back of alternator. With key on, engine off, turn all accessories on for 3 minutes. Start engine and let it idle. A waveform that looks like a string of back-to-back rolling hills should appear if alternator's diodes are good. Bad diodes will appear as large 2-3 times normal amplitude dropouts in waveform. Some spikes or noise may be normal in some systems.



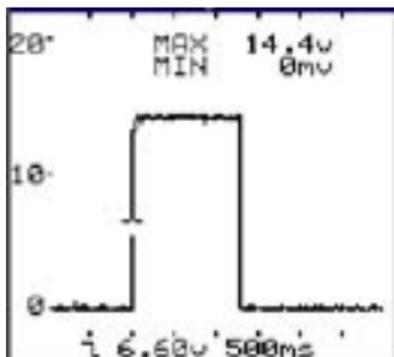
Audio Speaker Test

Connect COM probe to the negative speaker circuit. Connect the CH1 probe to the positive speaker circuit. Turn the radio on and watch the DSO display. Amplitude, frequency, and shape will all vary according to the sound being produced. Frequency ranges from 16Hz to 20,000 Hz are normally detectable by the human ear.



12 V DC Switches

Connect COM probe to the switch's or accessory's ground circuit, engine block, or negative battery post. Connect the CH1 probe to the switch's or accessory's output circuit. Make sure power is switched on in the circuit so that the switch, device or circuit is operational. The waveform should stay in a predetermined voltage range (amplitude) for a given condition.



Memory

There are four memory locations in the LabScope that can be used to store acquired waveforms, setups, and other information relating to the current test. These memory locations can also be loaded with test data downloaded from the optional WaveFile AutoPro™ software package.

Storing Test Data

To store a displayed waveform and related test data, press the HOLD button, then press SELECT. The Labscope asks which memory

location you want to send the information to. Choose either MEMORY 1 or MEMORY 2. If the memory location you are saving to contains previously saved data, that data will be overwritten without further warning. After the data is saved, the scope returns to the last setup and acquisition resumes.

The Labscope saves the current CH1 waveform and CH2 waveform if it is displayed. In addition it saves the current instrument setup. Test title and help information from the most recent factory setup is also saved. All of this data is saved together into a single memory location. If the most recent factory setup was MANUAL SETUP or STANDARD SETUP, the test title saved is the name of the memory location (i.e., MEMORY 1) and no help is saved.



RS-232 Communications

The Ferret 93 is equipped with an RS232 port for easy communication with a variety of computers. WaveFile AutoPro™ is an automotive labscope software accessory and repair information resource. WaveFile AutoPro™ has an extensive library of automotive sensor and actuator waveforms, on-line diagnostic and repair procedures, and interactive computer-based training. It allows the user to transfer waveforms to and from the Ferret 93 with just the touch of a button. Coupling the Ferret 93 with the WaveFile Auto Pro software will give you instant information on every aspect of automotive electronic troubleshooting.

Warranty & Service

Questions or inquiries about service can be answered by contacting GxT at:
(231) 627-5664, Fax: (231) 627-2727, Toll Free (800) 627-5655.

When sending an item to the factory address it to:

GxT Repair, Inc.
1310 Higgins Dr.
Cheboygan, MI 49721-1061

Include a note describing the problem. Your local tool dealer may carry some replacement parts and have an alternate service program.

Options & Replacement Parts

Optional Accessories

10 Cylinder Adapter Kit/Coil Per Plug Adapter Kit	X020-43
KV Pickup Plate for GM HEI Internal Coil Ignitions	X020-44
KV Pickup Plate for Toyota Internal Coil Ignitions	X020-45
KV Pickup Plate for Ninpondenso Internal Coil Ignitions	X020-46
KV Pickup Plate for BMW Coil per Plug Ignitions	X015-05
RPM Pickup with Banana Jacks	952

Replacement Parts

Black Test Lead	W090-00
Red Test Lead	W090-01

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FERRET BRAND LIMITED PRODUCT WARRANTY

GxT, Inc. of Cheboygan Michigan, warrants to the original purchaser that FERRET brand products are free from defects in materials and workmanship for a period of two years from date of purchase. Our sole obligation for a product within the above warranties will be to repair or replace, at our option, any defective parts and return the product to the sender within the U.S.A., shipping prepaid, if it is sent to our Repair Department shipping prepaid and accompanied by proof of purchase.

This Warranty does not apply to products which have been altered outside the factory; or repaired by anyone other than the factory or its authorized service centers; or which have been damaged from accidents, negligence, or abuse; or have been used differently than described in the printed instructions. Please note that wear and tear on leads and replacement of consumable items such as: NOx Sensors, Oxygen Sensors, and paper, is not covered by warranty.

GxT Inc.'s sole liability and buyer's exclusive remedy is limited to repair or replacement of the product as stated in the Limited Product Warranty. THERE ARE NO OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING THOSE OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND GxT, INC. SHALL NOT BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM THE SALE OR USE OF THE PRODUCT.

Some states do not allow limitations on the length of implied warranties nor exclusion or limitations of incidental or consequential damages, so that the above limitations and/or exclusion may not apply to you.

This warranty gives you specific legal rights and you may also have other rights which may vary from state to state.

Notes

Notes

