Twin Tec — User Instructions for Twin Scan 3 Probe Kit

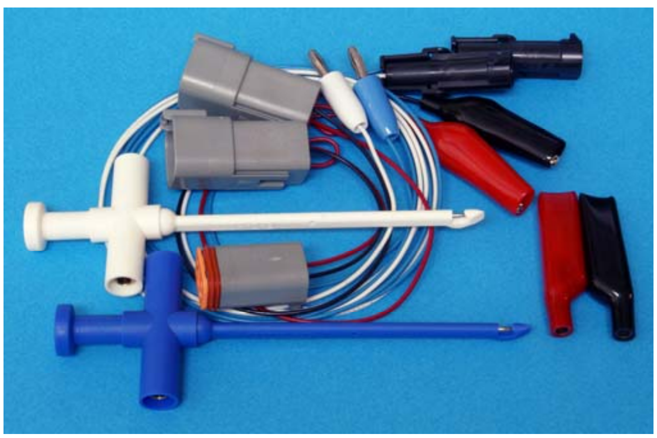
CAUTION: CAREFULLY READ INSTRUCTIONS BEFORE PROCEEDING. THE USER IS ASSUMED TO BE FAMILIAR WITH MICROSOFT WINDOWS AND PC OPERATION.

OVERVIEW

The Twin Scan 3 probe kit includes:

- Blue and white insulation piercing probes and 48 inch extension wires with mating Weather-Pack connectors that plug into the white (channel 1) and blue (channel 2) analog inputs on the Twin Scan 3
- Alligator clips (red and black) that can be used in place of the insulation piercing probes for accessing signals
- Power adapter for use on earlier H-D® motorcycles with four terminal diagnostic connector
- Power cord with red and black alligator clips for general purpose use with any +12 volt power source.

Figure 1 – Twin Scan 3 Probe Kit



As shown in Figure 2, insulation piercing probes allow easy connection to any point on a vehicle wire harness.

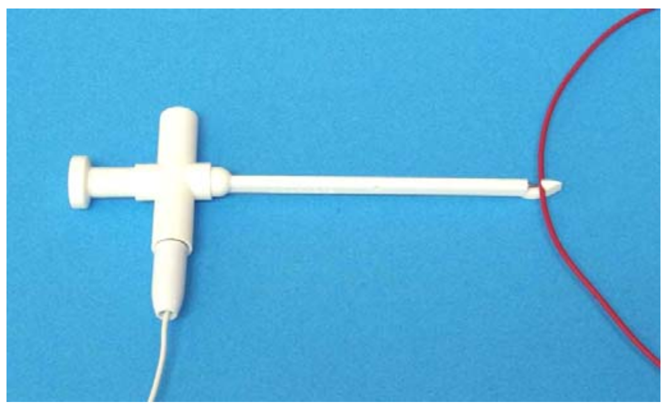
Please note that the power adapter for use on earlier H-D® motorcycles only provides power for the scopemeter feature of the Twin Scan 3. Other than the scopemeter feature that can be used for diagnostic purposes with any vehicle, the Twin Scan 3 is not compatible with earlier H-D® models that lack the CAN data bus.

When using the power cord, connect the red alligator clip direct to +12V power at the battery and connect the black alligator clip to a good frame ground connection (not to the battery negative terminal).

Replacement insulation piercing probes are available from E-Z-Hook as P/N XEL.

WARNING: To avoid electrical shock and damage to the Twin Scan 3, never try to probe any high voltage spark plug wire or any other high voltage signal other than coil and injector drive signals direct from an ECM.

Figure 2 – Insulation Piercing Probe



SCOPEMETER FEATURE

The Twin Scan 3 includes a scopemeter feature that allows display of two signal waveforms and is very useful for diagnostic purposes. The optional probe kit P/N TSCAN3-PROBE-KIT includes two insulation displacement probes and extension wires with mating Weather-Pack connectors that plug into the white (channel 1) and blue (channel 2) analog inputs on the

Twin Scan 3. Insulation piercing probes allow easy connection to any point on the motorcycle wire harness. The scopemeter feature is independent of the scan tool capability and can be used on **any** vehicle.

Two switches on the side of the Twin Scan 3 allow selection of the voltage range for the channel 1 and channel 2 analog inputs. The low range is 0-20V and is suitable for most signals except crankshaft position sensor, coil drive, and injector drive signals that require the high ±200V range.

To use the scopemeter feature, connect the probes to the desired signals, make the appropriate range switch selections, make sure the Twin Scan 3 has power, and click on View Scopemeter Data on the View menu. The scopemeter display will appear similar to Figure 3 that shows coil drive and crankshaft position sensor waveforms.

Much of the display functionality is similar to the data logging chart display except that you are looking at signal waveforms in real time. You can select:

Channel 1 and Channel 2 – voltage range selections will appear based on the low/high range switch setting. Use the lowest voltage range for the best display resolution. If data appears off the display, use a higher range selection.

Time Base – use the time base setting that gives the best display. Values are in milliseconds (msec) per division. The horizontal axis has ten divisions shown by tick marks.

Trigger Select/Edge – you can select which channel and signal edge (rising or falling) the unit will trigger on. The trigger point is at 20% of the horizontal time scale (2 divisions or tick marks from the left side). In Figure 3, the unit is triggering on the rising edge of the coil drive waveform on channel 1 at 10 msec. The unit automatically selects an optimum trigger threshold based on the minimum and maximum signal values.

Run/Stop/Single – you can select the operating mode. In run mode, the unit continually captures new signal data. The Stop button freezes the last data captured. Each time you click the Single button, one signal waveform is captured.

The remaining functions operate the same as in the data logging chart display. You can zoom in or out, move the cursor to measure signal levels, print the signal waveforms, and save or open waveform files from the File menu. Waveform files use a .wfm extension. You should create a separate folder to store these files.

REFERENCE WAVEFORMS AND DIAGNOSTIC TIPS

Use the voltage range and time base settings shown in the examples below as a starting point when observing signal waveforms. All reference waveforms except Figure 4 are from fuel injected Twin-Cam models.

Ignition Coil and Fuel Injectors

If the engine is misfiring or not firing on one cylinder, observe the coil and injector drive waveforms for each cylinder as shown in Figures 3-5.

Figure 3 shows front coil drive and crankshaft position (CKP) sensor waveforms from a Twin-Cam engine running around 2,000 RPM. The high voltage pulse that occurs at the spark firing event when coil current is shut off may not always be clearly visible because it only lasts a few microseconds. Note that the timing relationship between the CKP sensor missing pulse event and the spark firing event differs between front and rear cylinders and will change with operating conditions. If the waveforms appear normal, but no spark occurs, the ignition coil is defective. An open or partially shorted coil will cause abnormal waveforms.

Figure 4 shows coil drive and camshaft position (CMP) sensor waveforms from a mid-90s Evolution® engine running around 1,500 RPM. The shorter time base (2 msec/div compared to 5 msec/div for Figure 3) allows a clearer display of the high voltage pulse that occurs at the spark firing event when coil current is shut off.

Figure 5 shows front injector drive and crankshaft position (CKP) sensor waveforms with the engine running around 1,500 RPM. The high voltage pulse that occurs when the injector closes may not always be clearly visible because it only lasts a few microseconds. Note that the timing relationship between the CKP sensor missing pulse event and the injector event differs between front and rear cylinders and will change with operating conditions. The injector pulse width will also change with engine load. If the waveforms appear normal, but no fuel is injected, the injector is defective. An open or partially shorted injector will cause abnormal waveforms.

Figure 3 – Front Coil and CKP Sensor Waveforms

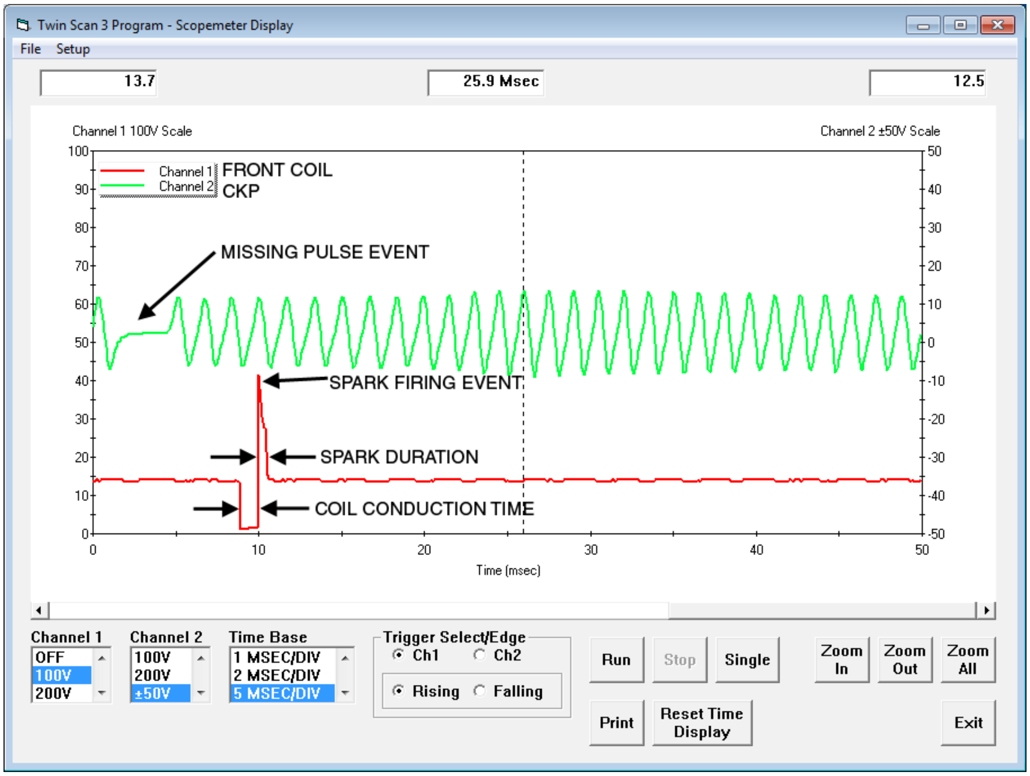
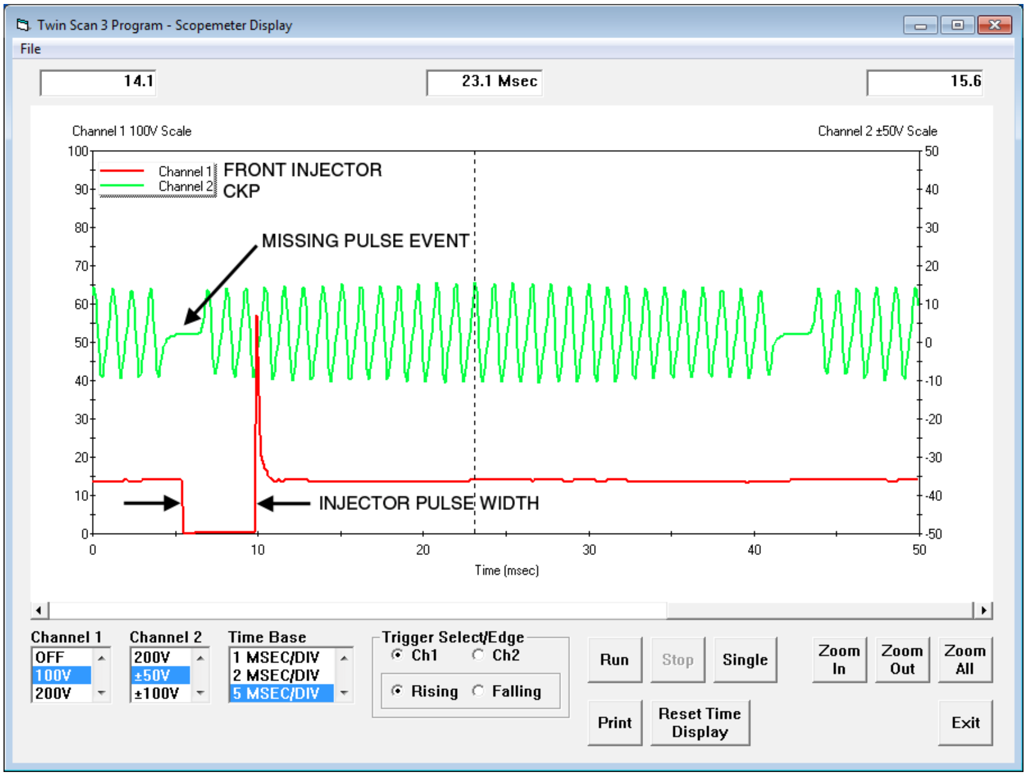


Figure 4 – Evo Coil and CMP Sensor Waveforms

Figure 5 – Front Injector and CKP Sensor Waveforms



Manifold Absolute Pressure (MAP) and Throttle Position (TPS) Sensors

Erratic operation, including lack of throttle response and spark knock, is often caused by a defective MAP or TPS sensor.

Figure 6 shows MAP and crankshaft position (CKP) sensor waveforms with the engine running around 1,800 RPM. On V-twin motorcycle engines, manifold pressure greatly varies with crank angle because of the small plenum volume. This effect is clearly visible. The ECM samples manifold pressure near bottom-dead-center (BDC) on the intake stroke just before the intake valve closes. For the Delphi sensors used in H-D® applications, voltage levels will be between:

0.5V at 20 kPa (6 In-Hg) and

4.85V at 101 kPa (30 In-Hg)

Due to the 315º and 405º firing angles on H-D® engines, there is some asymmetry in the MAP waveform between front and rear cylinders. However, a flattened MAP waveform on one cylinder indicates an inoperative or bent valve.

Figure 7 shows throttle position sensor (TPS) and MAP sensor waveforms when the throttle is momentarily opened. The TPS waveform should be smooth. Slight electrical noise (as visible in the figure) is normal, but sudden jumps in the TPS waveform indicates a worn out or defective sensor. The normal range for TPS voltage levels in H-D® applications is:

0.4V at idle (throttle closed)

4.1V at wide open throttle

Vehicle Speed Sensor (VSS) and Tach Signal

Figure 8 shows VSS and tach signal waveforms with the engine idling in first gear. While all H-D® fuel injection ECMs have a VSS input, the tach signal output (pin 3 on 36 pin ECMs) is not available on all models (check wiring diagram for details). Original equipment tachs on 2004 and later models connect to the J1850 or CAN data bus and do not use the tach signal. The VSS signal is a 0-5V square wave. The tach signal (if used) is a 0-12V (nominal) square wave. The actual maximum tach signal voltage will be close to 13V.

Figure 6 – MAP and CKP Sensor Waveforms

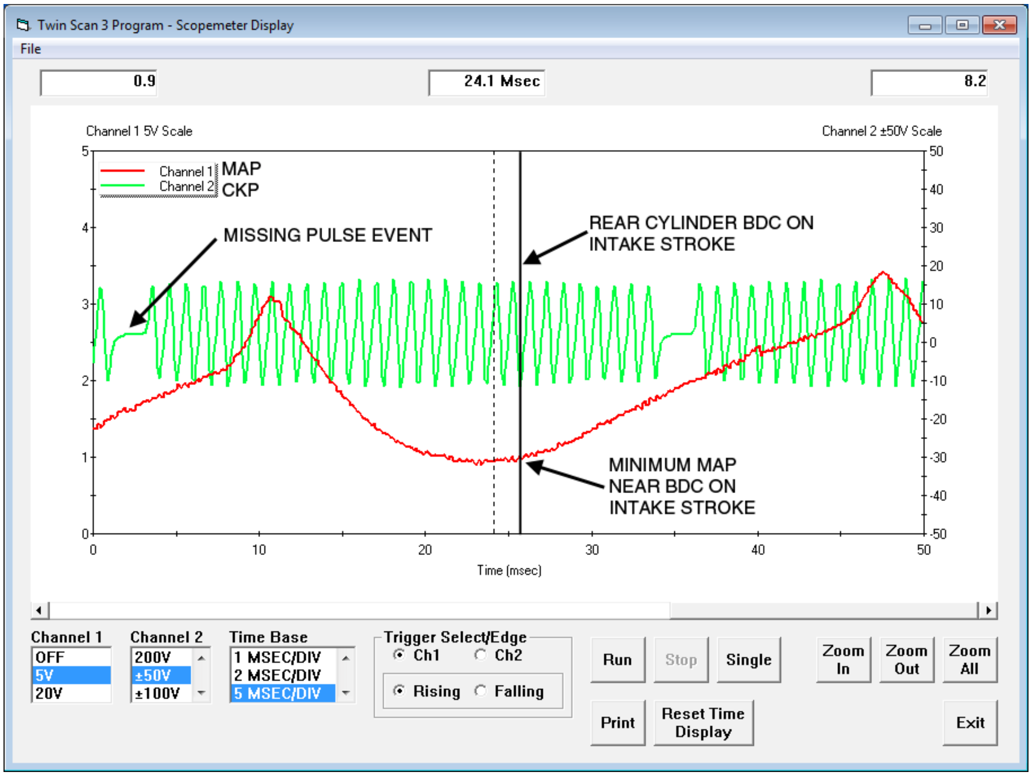


Figure 7 – TPS and MAP Sensor Waveforms

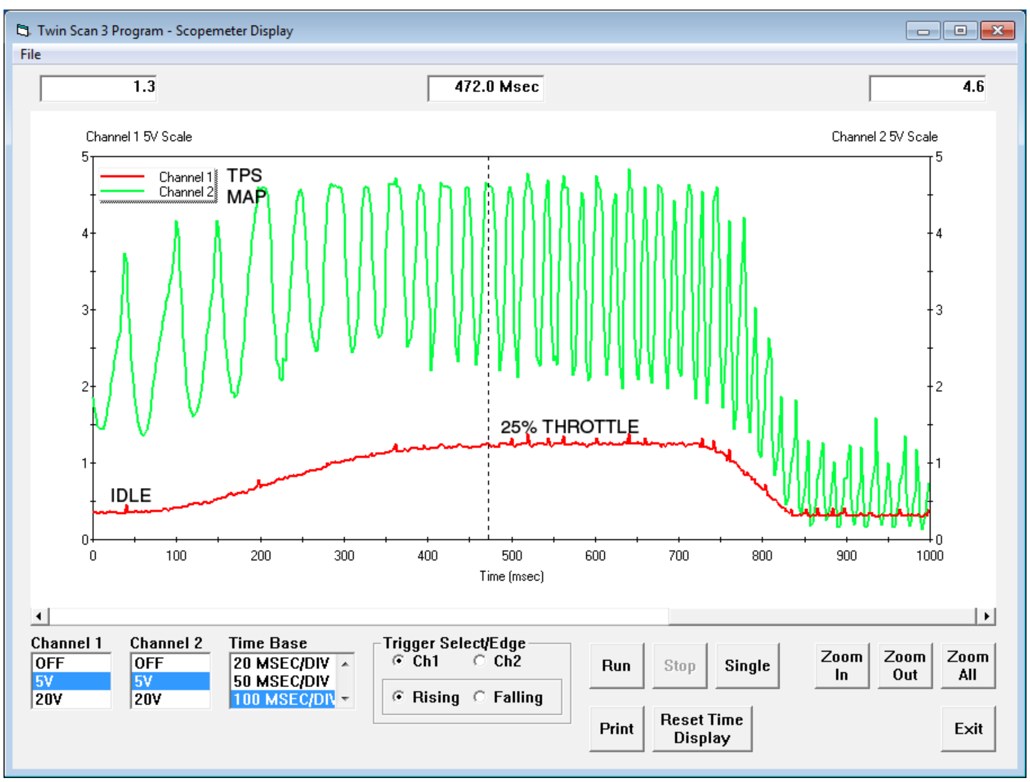
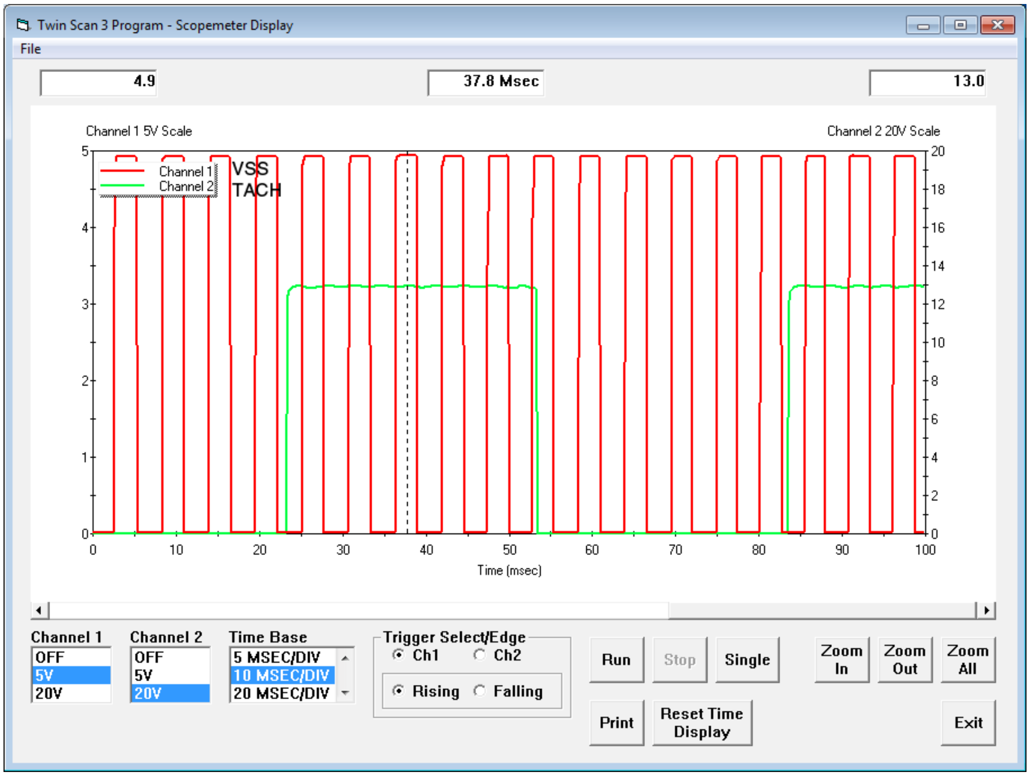


Figure 8 – VSS and Tach Signal Waveforms



Idle Air Control (IAC) Signals

The IAC stepper motor has two windings (A and B). Figure 9 shows IAC A high and B high signals while the IAC motor is stepping during decel (after throttle blipped from idle). Waveforms will vary depending on the action of the IAC, but switching action on both signals with low voltage levels near 1V and high voltage levels near 12V should be observed.

Figure 10 shows IAC A low and A high signals while the IAC stepper motor is returning to home position after the run/stop switch is turned off. The low and high signal lines should always be at opposite levels. Note that the maximum voltage level is slightly lower (just under 12V), since the charging system is now off.

Exhaust Gas Oxygen (EGO) Sensors

All 2007 and later H-D® models have front and rear EGO sensors. Figure 11 shows EGO sensor waveforms with the engine idling in closed loop after the sensors have warmed up. Sensor voltage levels constantly switch between approximately 0.6-0.8V on the rich side of stoichiometric air/fuel ratio and near 0V on the lean side. The switching action is random (not synchronized between cylinders). If no switching action or abnormally low voltage levels are observed, the sensor is defective or a tuning issue (improper exhaust or ECM calibration) prevents proper closed loop operation.

For additional information and resources including updated reference waveforms for common ECM signals and diagnostic tips, please visit the Twin Scan 3 Tec FAQ. You can also download a ZIP file that contains the reference waveforms for Figures 3-11 that you can load into your Twin Scan 3.

Figure 9 – IAC A and B Windings Waveforms

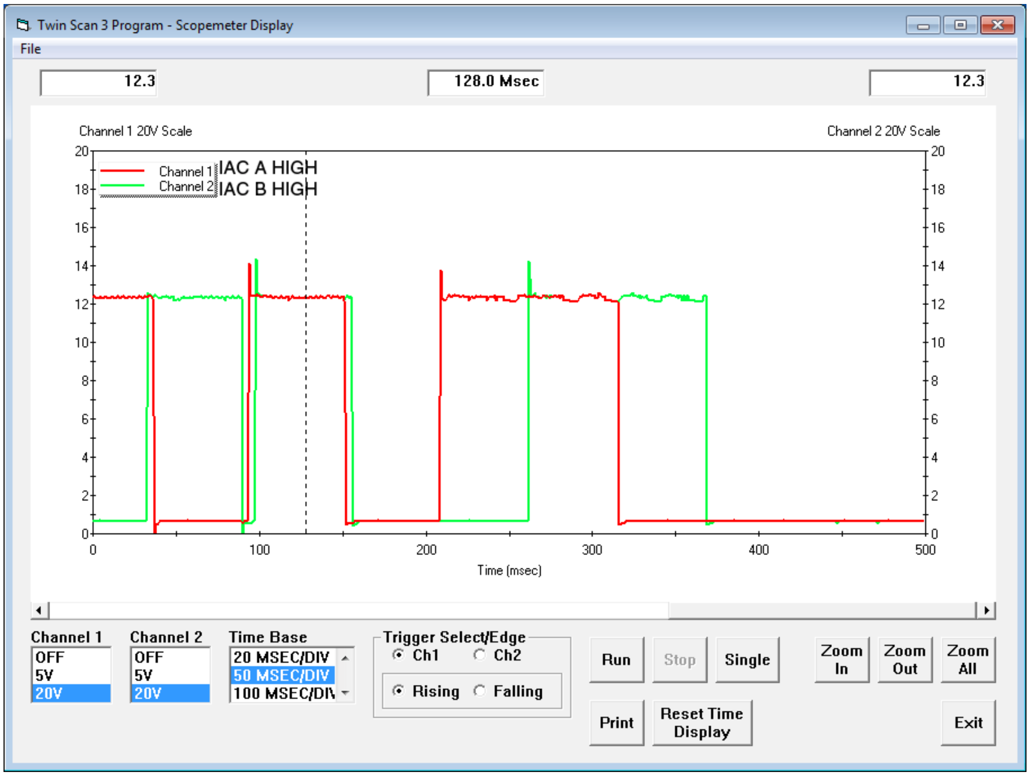


Figure 10 – IAC A Winding Waveforms

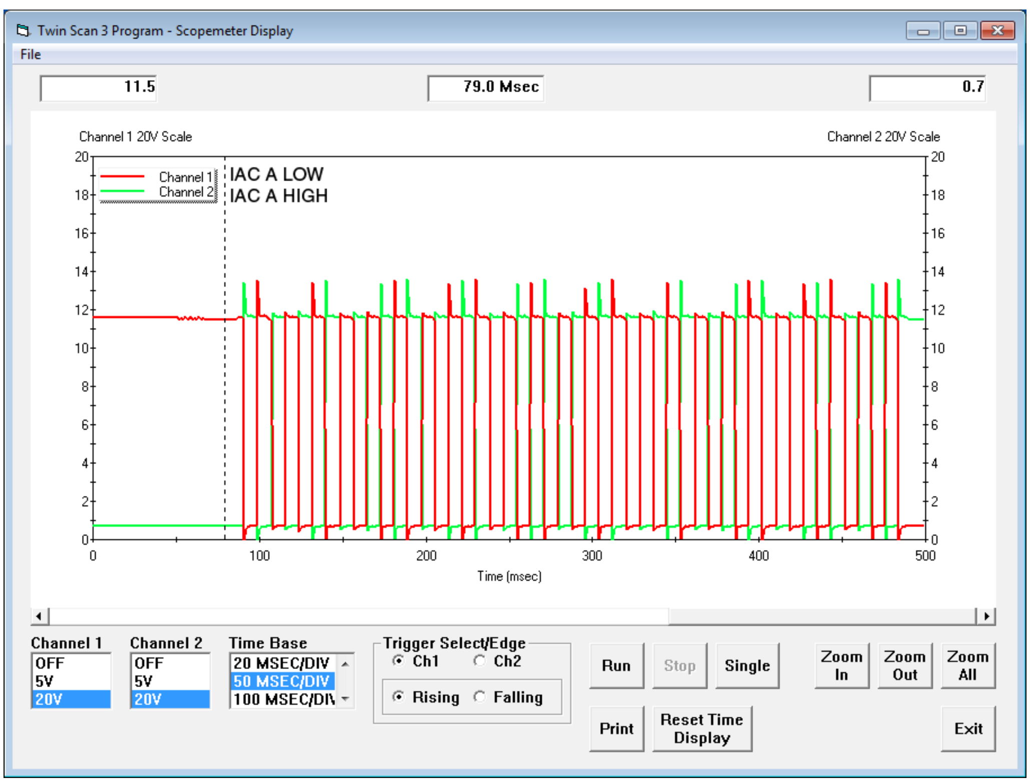


Figure 11 – Front and Rear EGO Sensors Waveforms