

MSD **IGNITION** **INSTALLATION INSTRUCTIONS**

MSD Pulse Ignition for Harley-Davidson® PN 4221 1

IMPORTANT: Read these instructions before attempting the installation! It is also recommended to have your bike's Service Manual available during the installation.

Parts Included In This Kit

1 – MSD Pulse Ignition, PN 42211
1 – Ignition Coil Pack, PN 43952
2 – Super Conductor Spark Plug Wires,
PN 32019
1 – Trigger Pickup & Rotor Assembly, PN 42315

Parts Not Included In This Kit

1 – Mounting Kit, PN 4393 (1"),
PN 43931 (1.2"), PN 43932 (1.5")
1 – Distributor Kit
1 – MSD MC Ignition Tester, PN 43751

WARNING: During installation, disconnect the battery cables. When disconnecting the battery, always remove the negative cable first and install it last.

Note: The optional MSD Pulse breakerless distributor must be installed on Panhead, Knucklehead or early-model Shovelhead V-Twins equipped with a distributor.

PREPARING FOR INSTALLATION

Take the engine out of gear and rotate the engine until the front cylinder (timing cylinder) is positioned at top-dead-center on the compression firing cycle. Do not rotate the engine again until the installation of the MSD is complete.

MOUNTING

The original ignition module may be removed or left in place. If it is left on the bike, disconnect all of the connections to avoid interference with the MSD Pulse.

The MSD Pulse Ignition can be mounted in any position as long as it is kept away from direct engine heat sources. MSD offers three unique flex mount kits that are available for different diameter down tubes; PN 4393 (1" – 1 1/16"), PN 43931 (1 1/2" – 1 9/32") and PN 43932 (1 7/16" – 1 17/32"). If you are going to make a custom mount, remember to:

- Make it easy to access the programming switches.
- Select a location that will not interfere with airflow to the front cylinder.
- Ensure the location allows for the upward/rearward movement of the fender/wheel as the fork compresses and does not interfere with steering clearance.

MOUNTING COILS

Remove the existing coil assembly, and then install the MSD dual coil pack/bracket to the frame using the existing fasteners.

Note: On some applications, such as the Sportster, the MSD coil mount may require modification to clear the gas tank. Never modify the black coil assemblies.

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PICKUP PLATE INSTALLATION

Remove the existing trigger/points plate and rotor, points cam and advance. Refer to the bike's Service Manual for the proper procedure.

EVOLUTION AND LATE MODEL SHOVELHEAD V-TWINS

1. From inside the cam/ignition housing, feed the free end of the MSD pickup harness through the wire access port.

Note: The harness includes a heat-resistant acrylic sleeve that fits snugly inside the port opening. Do not pull the sleeve completely through the port. It must be positioned to protect the wires as they pass through the port opening.

2. Mount the MSD pickup plate inside the housing (Figure 1). Note the "adjusting notch" on the edge of the plate. This notch must be located over the series of "steps" inside the housing (about the 7 o'clock position as you face the housing). One of the sensor units will be at approximately 12 o'clock.

SPORTSTER MODELS

1. On Sportsters, the wire access port must be enlarged. Use a 9/32" drill bit to enlarge the wire port.

2. Remove the wire harness clamp of the pickup assembly and route the wires through the port.

3. Mount the MSD pickup plate inside the housing (Figure 2). Note the "adjusting notch on the edge of the plate. This notch must be located over the "cast notch" inside the housing (about the 11 o'clock position as you face the housing). The shorter of the two sensors will be approximately in the 9 o'clock position.

4. Install the hold-down/standoff screws with flat washers until they are snug - do not tighten at this time (Figure 3).

3. Put the MSD rotor in place on the end of the camshaft. The locating pin in the rotor bore must align with the groove in the cam. Do not force the rotor on the camshaft! Push the rotor into place until it is tightly against the end of the cam then snug the retaining screw.

4. Check the distance from the outer surface of the pickup plate to the end of the installed rotor (Figure 4). If necessary, add shims until the measured rotor height is 9/16" (+/- 1/32").

5. When the rotor height has been verified, remove the retaining screw, place a drop of Red Loctite on the threads and re-install the screw to the factory recommended torque.

Note: On Sportsters, ensure that the loose pickup wires are clear of the rotor. Apply a small bead of silicone to the wires to secure them.



Figure 1 Installing the MSD Pickup Assembly.

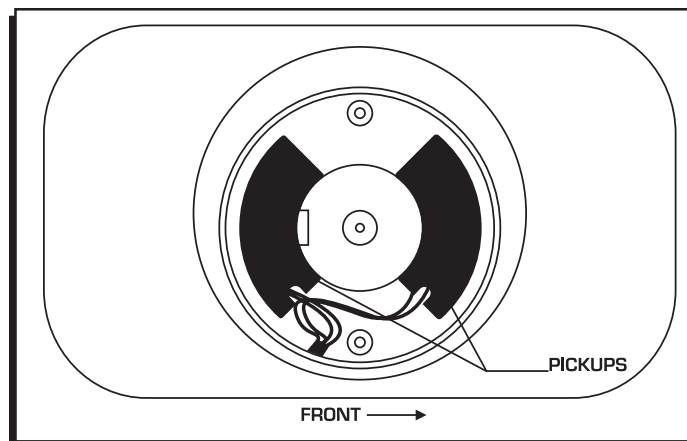


Figure 2 Pickup Position for Sportsters.

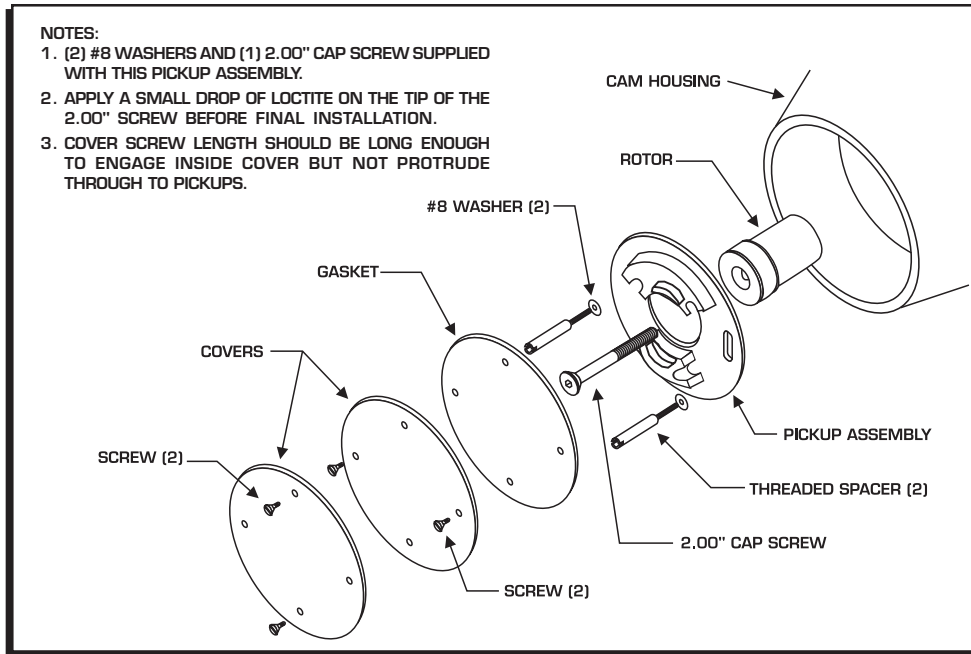


Figure 3 Installing the Pickup Plate Retainers.

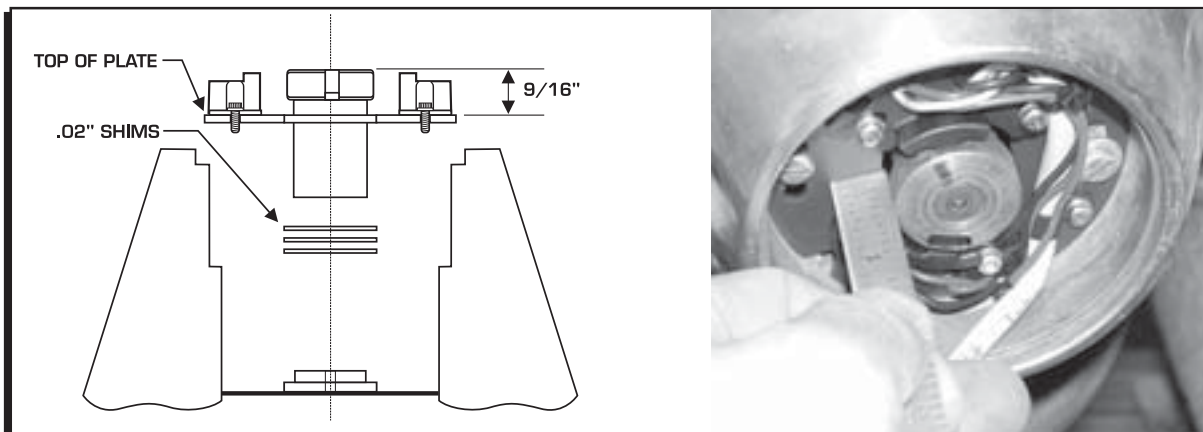


Figure 4 Checking the Rotor Height.

Note: If shims are used, make sure the rotor runs true. The shims may ride on the cam shoulder radius if not properly installed.

6. The epoxy-covered magnet in the outer edge of the rotor should align just to the left of the slight bulge on the inner surface of the upper pickup. If the alignment is not correct, the engine may have been rotated from top-dead-center or the pickup plate is improperly installed. Verify this alignment before proceeding. The housing cover should not be reinstalled until the timing procedures are completed.

Before making any connections, check the following:

- Verify that all wire harnesses are routed away from exhaust heat and sharp edges.
- Ensure at least one inch separation between the coil harness and the pickup harness to reduce electrical interference.
- Leave some “slack” in the wire harnesses to accommodate engine and road vibration.
- It is not recommended to extend or shorten the coil or pickup harnesses.

WARNING: Do not connect the negative (-) battery wire until the entire installation is complete.

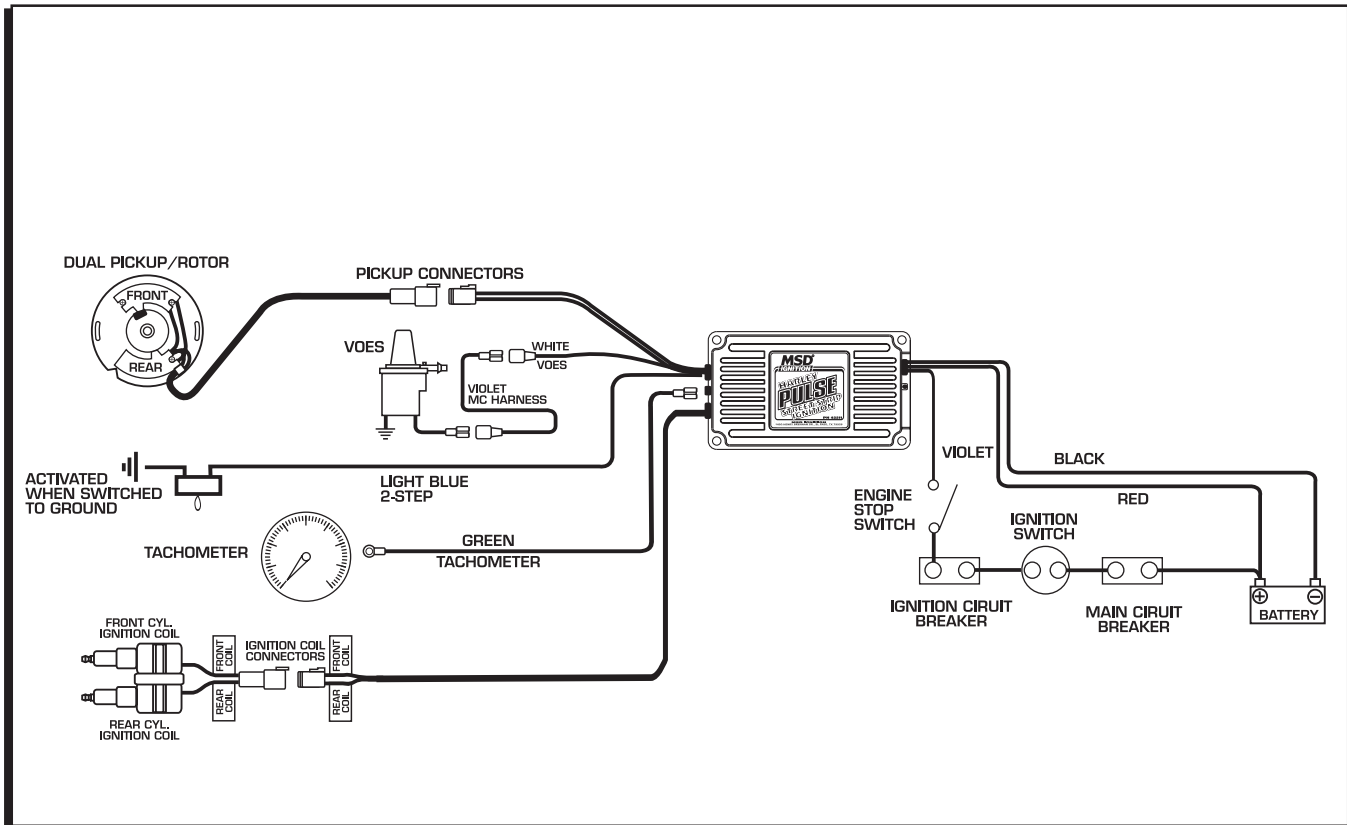


Figure 5 Wiring the MSD Pulse Ignition.

WIRING

RED	Connects to the battery positive terminal.
BLACK	Connects to the battery negative terminal.
VIOLET	On/Off wire. Connect to the ignition switch.
LIGHT BLUE	Two step rev limiter. When connected to ground, the two step rpm limit will be active.
TACH TERMINAL	This terminal provides a standard tach signal.
COIL HARNESS	This is the longer 4-wire harness with two wires tagged Front Cyl. (for the front cylinder) and the other two marked Rear Cyl.
PICKUP HARNESS	This is the short 4-wire harness that connects to the MSD pickup assembly.

ASSEMBLE THE PICKUP HARNESS

1. Plug the female connector housing (without the wires installed) to the male connector on the main pickup harness.
2. Note the location of the color-coded wires in the pickup pigtail to the corresponding wires of the male connector. Remove the connector housing.
3. Insert the pre-crimped wire terminals into the female connector.
4. Insert the orange locking plug through the open end of the connector. Use a screwdriver to push the plug into the shell until it locks (Figure 6). Once assembled, pull on each wire to ensure it is locked in position.
5. Connect the pickup harness to the amplifier pickup harness and verify that the color codes of the wires are connected properly.

TACHOMETER OR SHIFT LIGHT

There are two suggested methods to connect a tachometer or shift light to the MSD:

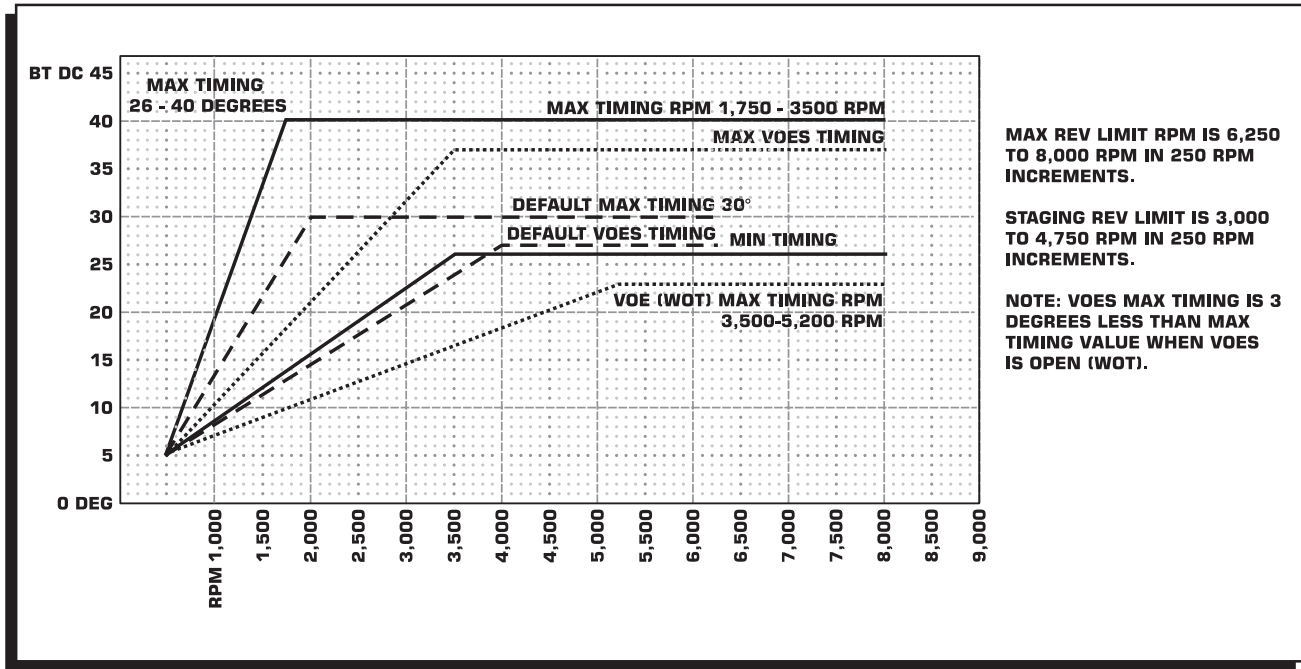
- The free length of Green wire may be used to connect the MSD tach terminal directly to the tachometer or shift light input.
- A single wire connected to the coil (generally pink) usually provides the input signal to the factory tachometer. The Green wire and connectors can be used to join the MSD terminal to the free end of the existing tach wire.



Figure 6 Assembling the Connector.

PROGRAMMING THE PN 42211 PULSE IGNITION

Note: The factory program settings are suitable for most Harley-Davidson V-Twins. Program changes may be made for special requirements.



MAX REV LIMIT RPM IS 6,250 TO 8,000 RPM IN 250 RPM INCREMENTS.

STAGING REV LIMIT IS 3,000 TO 4,750 RPM IN 250 RPM INCREMENTS.

NOTE: VOES MAX TIMING IS 3 DEGREES LESS THAN MAX TIMING VALUE WHEN VOES IS OPEN (WOT).

Figure 7 Timing Curve.

OPERATION

The MSD Pulse produces the computer-generated timing curve shown in Figure 7. Several programming options are available to tune the ignition to your application. There are two switch assemblies behind the aluminum base plate on the back of the MSD unit where programming changes are made (Figure 8).

The MSD Pulse is programmed at the factory for operation on most engines. It is recommended to install and run the MSD before making any adjustments. Figure 8 shows the factory settings. Sportster timing will typically be 30° or less. Big Twin 36° or less, max timing BTDC.

MAX TIMING BTDC				MAX TIMING RPM				VOES MAX TIMING RPM				STAGING REV LIMIT				MAX SPEED REV LIMIT			
DEG	S2	S3	S4	RPM	S5	S6	S7	RPM	S8	S1	S2	RPM	S3	S4	S5	RPM	S6	S7	S8
40	OFF	OFF	OFF	1750	OFF	OFF	OFF	3500	OFF	OFF	OFF	3000	OFF	OFF	OFF	6250	OFF	OFF	OFF
38	ON	OFF	OFF	2000	ON	OFF	OFF	3750	ON	OFF	OFF	3250	ON	OFF	OFF	6500	ON	OFF	OFF
36	OFF	ON	OFF	2250	OFF	ON	OFF	4000	OFF	ON	OFF	3500	OFF	ON	OFF	6750	OFF	ON	OFF
34	ON	ON	OFF	2500	ON	ON	OFF	4250	ON	ON	OFF	3750	ON	ON	OFF	7000	ON	ON	OFF
32	OFF	OFF	ON	2750	OFF	OFF	ON	4500	OFF	OFF	ON	4000	OFF	OFF	ON	7250	OFF	OFF	ON
30	ON	OFF	ON	3000	ON	OFF	ON	4750	ON	OFF	ON	4250	ON	OFF	ON	7500	ON	OFF	ON
28	OFF	ON	ON	3250	OFF	ON	ON	5000	OFF	ON	ON	4500	OFF	ON	ON	7750	OFF	ON	ON
26	ON	ON	ON	3500	ON	ON	ON	5250	ON	ON	ON	4750	ON	ON	ON	8000	ON	ON	ON

Electric Start	S1	OFF	PN 42211
Kick Start	S1	ON	

ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF
1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8	1	2	3	4

1. MAX TIMING SET FOR 30 DEGREES
2. MAX TIMING RPM, 2,000 RPM
3. VOES MAX TIMING, 4,000 RPM
4. TWO STEP REV LIMIT, 3,500 RPM
5. MAX SPEED REV LIMIT, 6,250 RPM

Figure 8 Programming Switches and Factory Settings.

ELECTRIC OR KICK START

Selector S1 of Switch 1 defines the ignition for Electric Start (Off position) or Kick Start (On position). When in the Off position, the engine will rotate 2-3 revolutions before the ignition outputs any sparks to allow less loading or kickback on the starter motor.

MAX TIMING BTDC

Selectors S2-S4 of Switch 1 control the Maximum Timing. There are eight selectable Max Timing values available, from 26° to 40° BTDC. The default is 30° BTDC. The timing ramps from 500 rpm at 5° BTDC to max timing value (Figure 9).

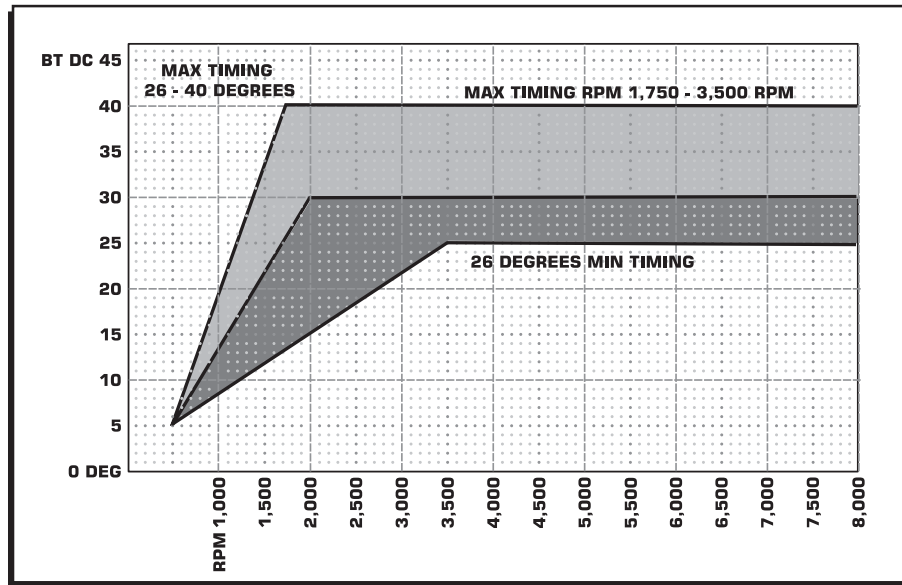


Figure 9 Max Timing RPM.

MAX TIMING RPM

Selectors S5 – S7 of Switch 1 control the engine rpm when the timing is at the max value (programmed by the Max Timing selector switch). There are eight selectable advance curves for advancing the ignition timing from 500 rpm to 1,750 rpm rapid advance or 500 rpm to 3,500 rpm for a milder advance curve. The default is 2,000 rpm.

TWO STEP REV LIMIT

Selectors S3 – S5 of Switch 2 control the Two Step rev limit (or staging rpm). There are eight selectable staging rev limit rpm values from 3,000 rpm to 4,750 rpm. The default is 3,500 rpm. The Two Step rev limit overrides the Max Rev limit when its Light Blue control wire is grounded.

MAX REV LIMIT

The Maximum Rev Limit is controlled by S6 - S8 of Switch 2. The rpm limit is adjusted in 250 rpm increments between 6,250 rpm and 8,000 rpm. The default is set at 6,250 rpm.

Note: It is **not** recommended to raise the limit above 6,250 rpm unless the valvetrain has been altered to increase the safe rpm limit of the engine.

VOES MAX TIMING

The VOES timing is variable from 500 rpm up to the programmed VOES max rpm value selected on S8 of switch 1 and S1 - S2 of switch 2. The minimum VOES rpm is 3,500 and the maximum is 5,250. With the VOES open (at WOT) the VOES is activated and will ramp the timing from 500 rpm to 3° less than the programmed max timing value at the VOES max timing rpm programmed value. The VOES default is 4,000 rpm. This feature is available only when the MSD White wire is connected to a functional VOES manifold switch.

The basic advance curve is always provided by the MSD Pulse, except when the VOES detects low vacuum conditions in the manifold. A low vacuum signal causes the micro-processor to ramp to the VOES curve over 1/2-second. When the VOES turns off the timing ramps to the max timing in one second.

Note: Figure 7 on page 6 shows an example of the basic advance curve with a 4,000 rpm VOES curve.

STATIC TIMING WITH THE LED

When static timing the engine, the primary output to the coil is disabled and the built-in LED indicator is activated. In effect, this function discontinues all spark delivery and substitutes a visual cue. It is best to disconnect the coil connector while static timing the engine. After the static timing set, reconnect the coil connector.

VOES CONTROL SWITCH

An auxiliary SPDT Switch (not included in the MSD Pulse kit) may be used to easily turn the VOES Curve on or off (Figure 10). Connect the White wire of the MSD and a wire of the VOES Switch to one terminal of the Switch. The other terminal of the switch goes to ground.

- When the switch is OPEN, the VOES curve is enabled via the VOES Switch. This is suited for less aggressive operation and highway cruising.
- When the switch is closed (connected to ground), the VOES curve is disabled. This configuration reverts to the basic advance program, providing full advance at all engine speeds in excess of the programmed max timing rpm value 1,750 to 3,500 rpm.

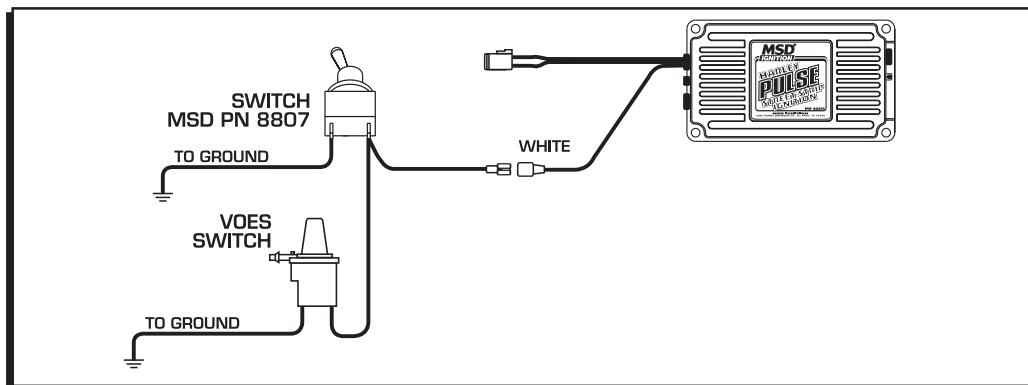


Figure 10 Connecting a VOES Switch.

TIMING THE ENGINE

The ignition timing should be set and checked at start-up (static) and total (high rpm).

CHECKING STATIC TIMING

1. Verify that the top dead-center index for timing cylinder (front) is still centered in the timing port. If the TDC index is not in view, rotate the engine until the front cylinder is on the compression-firing stroke and the TDC index is centered in the timing port.
2. Attach the black wire of the MSD control harness to the negative (-) terminal of the battery and turn the ignition switch On. Observe the Pulse Monitor LED.
 - If the LED is On: Rotate the pickup plate clockwise slowly until the LED just turns off.
 - If the LED is Off: Rotate the pickup plate counterclockwise until the LED turns on. Then, rotate the pickup plate clockwise slowly until the LED just turns off.
3. Tighten the standoff/holddown screws (do not completely lock the plate until the total timing is set).

Note: Do not replace the cam/ignition housing cover plate until total timing has been set.

CHECKING TOTAL TIMING

Note: It is recommended that total timing not exceed 36° (BTDC) for Big Twins or 30° for Sportsters.

1. Install a clear sight plug (Harley-Davidson part number HD-96295-65D) in the timing port.
2. Connect a timing light to the front cylinder's plug wire. **Note:** It is important to have a high quality timing light such as the MSD PN 8990 to ensure correct timing signals.
3. Start the engine. If the engine does not start within a few seconds, review and verify the installation, wiring and programming procedures.
4. Once the engine has started, increase the engine speed until the rpm exceeds 2,000 rpm and check the timing. Verify that the maximum timing matches the switch programmed value (default 30° for Sportsters, change to 36° for Big Twins). Adjust the timing; to Advance rotate the pickup plate clockwise. To retard the timing rotate the plate counterclockwise.
5. Repeat the procedure until the timing index is centered in the port when engine speed is above 2,000 rpm. (This is 35° mark on Big Twins and 30° for Sportsters).
6. Shut the engine off and tighten the pickup plate screws.
7. Replace the cam/ignition housing cover plate. Be certain the cover screws do not protrude into the pickups. Also, remove the clear plug from the timing view port and install the conventional plug.
8. If it is desirable to run different timing on the rear cylinder vs. front, first set the timing on rear by adjusting the pickup. Then, loosen the pickup screws of the front pickup and move it until the desired timing is achieved.

TUNING AND TESTING

Road or track testing is the most realistic method to verify the timing program. **Note:** If the timing is advanced excessively, detonation may occur which could result in engine damage. For best and the most accurate performance tests:

- The engine should be warmed to normal operating temperature.
- Shift into high gear and snap the throttle to the wide open stop.
- Listen carefully for any "pinging" or "knocking" sounds. These are characteristics of detonation which indicate too much advance.

VOES EQUIPPED ENGINES

If there are no indications of detonation during testing, the VOES curve can be defined to a lower rpm setting. This should increase engine response during mid-range throttle up. Reduce the curve in 250 rpm increments. Testing must be performed after each change to verify that there are no signs of detonation.

If the VOES curve is reduced to the lowest point (3,500 rpm) and signs of detonation are not present, the total timing can be increased above the suggested default value, 36° BT, 30° Sportster. When timing exceeds 36° it is highly recommended that the setting is incremented in only two-degree steps, followed by thorough testing.

In some cases the engine may respond to more timing at lower engine speeds and less timing on the upper ranges. In this instance the total timing can be increased for better low-end response and the VOES intercept can be defined higher in the range to reduce the timing in the upper rpm ranges during wide open throttle acceleration. When VOES is enabled (WOT) the max timing at high speed is 3° less than the max timing value.

ENGINES WITHOUT VOES

The ignition timing is only controlled by the Max Timing value and the Max Timing RPM values to set the advance curve and maximum timing. If detonation at lower speeds under hard acceleration occurs, use a higher Max Timing RPM. Then proceed to set the Max Timing value for high speed operation.

TROUBLESHOOTING

INOPERATIVE TACHOMETER

The MSD Pulse delivers a conventional 12-13 volt square wave signal that is compatible with most factory tachometers. Some aftermarket tachometers require a high voltage spike. If the tachometer does not operate properly, an MSD PN 8920 Tach Adaptor should be used to provide a suitable signal.

CHECK WIRING

- Check wiring routing and connections.
- Make sure all of the terminals and pins are crimped tightly and are fully seated in the connectors.
- Confirm all of the connections with the wiring diagram in the installation instructions.
- If any wires or connections have been modified or shortened, use an ohm meter to confirm continuity through the connectors.

CHECK THE BATTERY

- Verify the Red wire of the MSD is firmly connected to the positive (+) battery terminal.
- Verify the Black wire is firmly connected to the negative (-) battery terminal.

Battery Condition: Connect a volt-ohm meter across the battery to check battery voltage. If the meter indicates less than 10 volts static (non-cranking, ignition switch On) or less than 7 volts while cranking the engine with the starter, the MSD Pulse will not operate properly.

Ignition Supply: Check for a 12-volt input to the MSD Module. With the ignition switch On, use a volt-ohm meter to verify that at least 10 volts is supplied to the MSD Violet wire. If less than 10 volts is supplied, the MSD Pulse will not operate properly.

SYSTEM FUNCTION CHECKS

If the system meets all the above criteria but will not start, the difficulty may be in one of the three areas: the pickup assembly, the coils or the ignition module. The following procedures may be used to identify a possible difficulty:

Pickup Test

Turn ignition switch On and crank the engine. The LED should blink which means that it is receiving a trigger signal and that the problem is in the amplifier or coil section.

- Inspect the pickup harness for proper connections.
- Inspect the rotor installation.
- Check the operation of the Ignition using the following test.

CHECKING FOR SPARK

Note: MSD PN 43751 MC Ignition Tester is available for complete ignition testing.

This test false triggers each channel of the ignition so the operation of the Ignition or pickup(s) can be determined. Set the selector S1 of Switch 1 to On, for the kick start position.

1. With the ignition Off remove both spark plugs. Re-attach the plug wires and position the threaded section of each spark plug to the engine case (ground).
2. Disconnect the trigger harness of the MSD amplifier from the pickup plate harness.

3. Using a jumper wire (a straightened paper clip works well), link the terminal of the black wire in the MSD connector to the terminal of the white wire in the pickup connector.
4. Attach a similar jumper wire to the terminal of the Blue wire in the pickup connector and join it to the first paper clip.
5. Turn the ignition switch On and separate the jumpers. A spark should jump from one of the spark plugs.
6. Turn the ignition switch Off and reverse the connection. Link the terminal of Black wire in MSD connector to the terminal of the Blue wire in the pickup connector. Attach the second jumper to the terminal of the White wire in the pickup connector.
7. Turn the ignition switch On and separate the jumpers. A spark should jump from the other spark plug.
 - If both the plugs fired, the MSD and the Coils are working properly and the corresponding pickup(s) is probably at fault.
 - If one or both plugs did not fire, check the operation of the Coils.

COIL TEST

If the ignition is receiving a trigger signal from the pickups, but failed the spark test on one or both cylinders, the resistance of the coils should be checked.

1. Disconnect the negative battery cable.
2. Disconnect the coil connector harness.
3. To check the primary resistance: Connect the ohm meter to the two terminals of the Front Coil. Get a reading, and then connect the meter to the terminals of the Rear coil. The primary resistance should be less than 0.5 ohm.
4. To check the secondary resistance: Remove the plug wires from the coils and connect the ohm meter to the plug wire terminal and the corresponding primary coil terminal at the 4-pin connector. The resistance should be between 1.5K – 2K ohms.
5. If the coil(s) is out of specification, swap it with a known good coil and test for spark again. If only one could fail, follow the proceeding procedure.

If an ohm meter is not available and only one of the plugs sparked in the original coil:

1. Turn the ignition switch off and disconnect the coil harness of the MSD amplifier from the coil-pack harness.
2. Remove the orange lock plug from the open end of the connector on the coil-pack harness. This plug is firmly locked in place and requires a hook-like tool between the edge of the plug and the body of the plug. Note: It is possible to make a suitable tool from a ten-penny nail. Grind or file the head of the nail away until there is about a 0.100-inch wide hook left then bend the tip over 90° (Figure 11).
3. Turn the hook under the edge of the plug and pull it free. Push the gray tab and pull the pins out of the sockets in the back of the connector.
4. Carefully swap both pins of each coil circuit to the corresponding positions of the other coil. Be certain to maintain the wire pairings (Black to Brown and Orange to Orange/Green).
5. Re-assemble the connector with the swapped wiring and check for spark.
 - If the same plug fails during each test, the coil is at fault and requires replacement.
 - If the opposite plug fails during the test, the ignition or pickup is at fault.

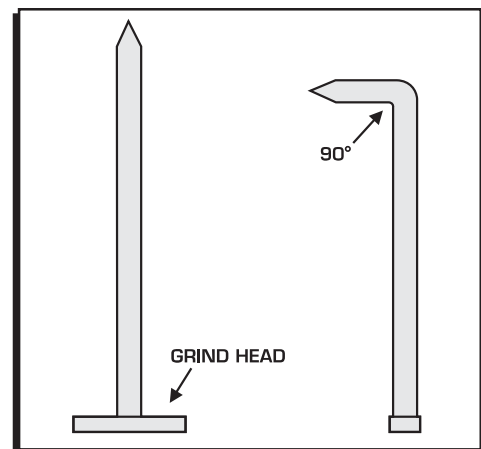


Figure11 Custom Wire Removal Tool.



INSTALLATION INSTRUCTIONS

TECH NOTES

Service

In case of malfunction, this component will be repaired free of charge according to the terms of the warranty. When returning components for service, Proof of Purchase must be supplied for warranty verification. After the warranty period has expired, repair service is charged based on a minimum and maximum charge.

Send the unit prepaid with proof of purchase to the attention of: **Customer Service Department, MSD Powersports, 1490 Henry Brennan Dr., El Paso Texas 79936.**

When returning the unit for repair, leave all wires at the length in which you have them installed. Be sure to include a detailed account of any problems experienced, and what components and accessories are installed on the vehicle.

The repaired unit will be returned as soon as possible after receipt, COD/Cashiers Check for any charges. For more information, call the MSD Powersports Customer Service Line **(915) 858-3365**. MSD Powersports technicians are available from 8:00 a.m. to 5:00 p.m. Monday - Friday (Mountain Time).

Limited Warranty

MSD Powersports warrants this product to be free from defects in material and workmanship under its intended normal use* and if properly installed, for a period of one year from the date of original purchase. If found to be defective as mentioned above, it will be repaired or replaced at the option of MSD Powersports. Any item that is covered under this warranty will be returned free of charge through standard shipping methods. If faster service is required the customer has the option of paying for this service.

This shall constitute the sole remedy of the purchaser and the sole liability of MSD Powersports. To the extent permitted by law, the foregoing is exclusive and in lieu of all other warranties or representations whether expressed or implied, including any implied warranty of merchantability or fitness. In no event shall MSD Powersports or its suppliers be liable for special or consequential damages.

*Intended normal use means that this item is being used as was originally intended and for the original application as sold by MSD Powersports. Any modifications to this item or if it is used on an application other than what MSD Powersports markets the product, the warranty will be void. It is the sole responsibility of the customer to determine that this item will work for the application they are intending. MSD Powersports will accept no liability for custom applications.