PROBE ENGINEERING, INC.

Installation Instructions, Model FS-09
Version 0.3

The Model FS-09 electronic ignition is designed specifically for 1960s through1970s Honda Models CB160, CL160, CB175, CL175, and SL175, all with derivatives of Honda's early ("sloper") or later ("upright") 360º crankshaft twin-cylinder engine. The system was designed in cooperation with Bill Moeller of Bore Tech (Batavia, Ohio).

The Model FS-09 is a competition-only system that uses neither mechanical nor electronic advance/retard; the ignition timing is fixed at the full-advance position. The kick-starter should not be used with this ignition, as it may kick back, and could cause injury.

Bump (push or powered-roller) starting is recommended for motorcycles equipped with fixed-timing ignition systems. For best bump-start results, battery power should not be applied to the ignition until the engine is spinning over.

The Model FS-09 is a single-fire ignition system, requiring two single-tower ignition coils (one for each cylinder) to replace the original dual-tower coil. The new coils can be anywhere in the range from 3 to 5 ohms primary resistance; 3-ohm coils will give somewhat hotter spark at maximum RPM, while 5-ohm coils will give lower current consumption (with consequent longer battery run-time, which you may want if you're running a total-loss system).

There are many suitable coils out there, both used and in the new-parts aftermarket. Bore Tech has done successful, cost-effective installations using original Honda 350 twin coils, which they are making available to clients at attractive prices. Dyna's Model DC3-1 coils (green, single-tower, with 3 ohms primary resistance) and DC10-1 coils (black, single-tower, with 5 ohms primary resistance) are proven, robust, reliable products, and are also available through Bore Tech.

What should be in the kit:

The Model FS-09 kit includes the following components:

- Control Module
- Trigger Rotor (with upper & lower spacer shims for CB160 use pre-installed)
- Pickup Plate (with wire harness and connector)
- 5mm Phillips-head machine screws (2 each, for retaining the Pickup Plate)
- Rubber-faced flat washers (2 each, for retaining the Pickup Plate)
- Self-adhesive Velcro pads (one "hooks," one "loops")
- Tie-wraps (for backing up the Velcro fastening and for organizing the wiring)

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What else you will need:

In addition to the usual small hand tools required to get access to the engine's breaker-points assembly and to remove the fuel tank, side panels, etc., installation will require the following tools and supplies:

- Wire cutters/strippers
- Solderless crimp-type connectors, bullet connectors, or solder and shrink tubing
- Loctite® "blue" medium-strength thread-locking compound or equivalent

Installation:

1. Remove the side panels, if applicable (for general access).

2. Remove the seat.

3. Disconnect the battery.

4. Remove the fuel tank.

5. Remove the alternator rotor cover (for setting the timing).

6. Remove the breaker points cover.

7. Remove the bolt and washer that secure the centrifugal advancer mechanism and put them aside (they will be reused to retain the electronic ignition's Trigger Rotor).

8. Remove the two screws and washers that retain the points backing plate.

9. Remove the breaker points and backing plate as an assembly.

10. Disconnect the breaker points lead wires from the ignition coil.

11. Remove the original ignition coil, complete with its spark plug leads and plug caps.

12. Disconnect and remove the condenser (condensers should NOT be used with the Model FS-09 system).

13. Find a place to mount your two new ignition coils. Closer to the spark plugs is generally better, but if you can't find a close, convenient spot, pay attention to plug-wire routing considerations as you choose a location.

14. Install your new spark plug wires between the coils and their respective plugs. We strongly recommend the use of either spiral-core suppression plug wire or good quality resistor-core suppression wire. Either of these may be used without resistor plug caps. If you are using coils with integral (non-removable) stranded-wire high-tension leads, you should use resistor plug caps with at least 5,000 (5k) ohms resistance, or else use resistor-type spark plugs.

15. Connect a switched source of +12 volts from the battery to the coils' "plus" (+) terminal (the +12V source should not come "through" any other electrical component except the main power switch). The coils' (+) terminal will either be marked on the coils or will be indicated in the instructions that come with the coils (or both). If you are using OEM Honda 350 twin coils, the (+) lead is black with a white stripe (b/w). It is important to get the polarity right; coils that are wired the wrong way 'round may still sort-of work, but the spark energy will be greatly reduced, and will likely create high-speed misfires that can be maddening to diagnose.

16. Remove the advancer mechanism from the quill on the end of the camshaft. It may need gentle persuasion in the form of mild heat, penetrating oil, or a puller. If a puller is required, you can loosely reinstall the retaining nut a few threads shy of full engagement to use as the "push" point.

17. Clean any gross rust or debris from the cam-end quill and from the seating surface (shoulder) at the end of the quill.

18. Rotate the crankshaft so that the 3mm diameter locating dowel at the base (shoulder end) of the quill is at the 12:00 position (this will be at TDC for the compression stroke of the left-hand cylinder). If you have any question about the dowel being firmly retained, remove it, degrease the dowel and its bore, and reinstall it with medium-strength (blue) Loctite or equivalent thread-locking compound.

19. **For CB/CL160 engines**: The 160 engines have a camshaft quill that is 10mm diameter, versus the 175 engines' 11mm quill diameter; the two engines' camshafts are otherwise similar. The Trigger Rotor has a bore ID machined to fit over the 175's 11mm quill. So that the same ignition kit can be used for either engine, the Trigger Rotor is delivered with spacer shims installed at the top and bottom of its bore, which reduce the ID to match the smaller quill of the 160 engine. If you're installing the Trigger Rotor onto a 160 cam, carefully slip the Trigger Rotor over the quill, taking care not to disturb the two spacer shims. Align the notch in the Trigger Rotor hub with the 3mm locating dowel at the 12:00 position (there is a 0.094" through-hole in the Trigger Rotor's face that aligns with the notch in the hub, so that you can tell where you are). Seat the Trigger Rotor's hub end firmly against the shoulder at the base of the quill.

20. **For CB/CL/SL175 engines**: The 160 engines have a camshaft quill that is 10mm diameter, versus the 175 engines' 11mm quill diameter; the two engines' camshafts are otherwise similar. The Trigger Rotor has a bore ID machined to fit over the 175's 11mm quill. So that the same ignition kit can be used for either engine, the Trigger Rotor is delivered with spacer shims installed at the top and bottom of its bore, which reduce the ID to match the smaller quill of the 160 engine. If you're installing the Trigger Rotor onto a 175 cam, first use a pointed object to tease the two shims out of the ID of the rotor. With the shims removed, slip the Trigger Rotor over the quill, aligning the notch in the Trigger Rotor hub with the 3mm locating dowel at the 12:00 position. (There is a 0.094" through-hole in the Trigger Rotor's face that aligns with the notch in the hub, so that you can tell where you are.) Seat the Trigger Rotor's hub end firmly against the shoulder at the base of the quill.

21. Using the original retaining bolt and washer from the centrifugal advancer, bolt the Trigger Rotor in place. It's good practice to use the medium-strength (Loctite "blue" or equivalent) anaerobic thread locker on the Trigger Rotor retaining bolt.

22. Slip the Pickup Plate over the Trigger Rotor (the plate's center hole is large enough to clear the retaining bolt and washer), with the electrical components facing in toward the Trigger Rotor, and the wires facing out toward you. Note that the words "Probe Engineering, Inc." are etched in copper across the top of the Pickup Plate's outward-facing side. You will also see the words "Model BT-08" etched in copper along the bottom edge of the outward-facing side of the Pickup Plate, and in white silk-screened lettering on the inside face. The same basic Pickup Plate printed-circuit board is used for both the FS-09 and BT-08 systems, but the simpler FS-09 system does not have all of the component locations "populated" (some parts are omitted from the assembly).

23. The two rubber-faced washers provided in the kit come pre-installed onto two new 5mm points-plate retaining screws. The compliant rubber face of the washers provides a way of taking up the small "step" clearance between the thickness of the Pickup Plate and the depth of the recess into which it locates (the original points-plate recess). Loosely thread the screws and washers into the retaining holes in the left cam-box casting.

24. Align the words "Probe Engineering, Inc." on the Pickup Plate parallel with the plane of the head gasket (horizontally for 175 engines, and angled for 160 "sloper" engines), and lightly tighten the screws to retain the plate. Don't bother really locking down the retaining screws yet; you will final-adjust the Pickup Plate position to accurately set the timing in subsequent steps.

25. Seat the flatted grommet in the lead-out hole at the lower right of the points housing. Leave a little play in the wires so that the Pickup Plate can be rotated later to finalize the timing, and be sure that none of the Pickup Plate's wires are in contact with the Trigger Rotor, the retaining bolt and/or washer, or sharp edges of the housing..

26. Route the wires from the Pickup Plate out over the cylinder head, similar to the original points wires.

27. Find a place where you'd like to mount the Control Module. It's best not to have it directly exposed to radiated engine heat, and mounting it in a zone with a little airflow when the bike's moving is a good idea. It doesn't take much airflow – don't worry about a big breeze. The self-adhesive Velcro may be used to mount the Control Module, depending on where you'd like it. If you use the Velcro, don't mount the Control Module so that it's "upside-down;" if it hangs from the Velcro so that gravity wants to pull it straight off, gravity (and the vibration) will eventually succeed in doing exactly that. Once the Control Module is mounted with Velcro, back up the Velcro fastening with a positive retention method; the large zip-ties included in the kit are provided for that purpose.

28. Look at the 10-pin connector at the end of the wire harness. On the connector's rear surface (where the wires enter), there are molded-in numbers showing each wire's position. Numbers 1 through 5 are in the first row (furthest away from the molded "latch"), and 6 through 10 are in the second row. The wires in each position are as follows. You only have to deal with the five heavy-gauge wires shown in **boldface** type:

♦ **Position 1:**	**Heavy-gauge red wire – goes to switched +12 volts**
♦ Position 2:	Light-gauge red wire – goes to Pickup Plate
♦ Position 3:	Light-gauge black wire – goes to Pickup Plate
♦ Position 4:	Light-gauge black wire – goes to shield braid
♦ **Position 5:**	**Heavy-gauge green wire – goes to chassis ground**
♦ **Position 6:**	**Heavy-gauge yellow wire – goes to left-cylinder coil**
♦ **Position 7:**	**Heavy-gauge green wire – goes to chassis ground**
♦ Position 8:	Light-gauge yellow wire – goes to Pickup Plate
♦ Position 9:	Light-gauge blue wire – goes to Pickup Plate
♦ **Position 10:**	**Heavy-gauge blue wire – goes to right-cylinder coil**

29. **Wire routing** – Route the five heavy-gauge power and ground wires away from the light-gauge signal wires (in the tinned copper braid) that go to the Pickup Plate. Also, it is very important to keep the power, ground, and Pickup Plate wires well away from the high-voltage ignition wires that go from the coils to the spark plugs.

30. The two heavy-gauge green wires (connector positions 5 and 7) go to a good chassis ground. All the usual notes apply regarding the ground being free of paint and being clean, bright metal. These two green wires are 12" long as supplied, to ensure that they are grounded somewhere close to where the Control Module is located. The ground wires may be cut shorter if you wish, but remember to leave enough length to form a "service loop" that will let you plug and unplug the connector without straining the wires.

31. The heavy-gauge red wire (connector position 1) goes to a switched source of +12 volts from the battery. You can pick this up from the wire supplying +12 volts to the ignition coils' "plus" (+) terminals, if you wish, or any other source that is switched on and off. As you did with power to the coils, ensure that the +12V source to the Module does not come "through" any other electrical component except the main power switch.

32. The heavy-gauge yellow wire (connector position 6) goes to the left-cylinder ignition coil's "minus" (-) terminal. (If you are using OEM Honda 350 twin coils, the left-side coil has a matching yellow wire.)

33. The heavy-gauge blue wire (connector position 10) goes to the right-cylinder ignition coil's "minus" (-) terminal. (If you are using OEM Honda 350 twin coils, the right-side coil has a matching blue wire.)

34. Figure 1 shows how the power wiring should look when you're done. If you are unfamiliar with wiring diagrams, wires that cross one another without a "dot," but with a "jog," at their intersection are NOT connected to one another. Wires with a "dot" at their intersection are electrically connected to one another. (The Pickup Plate and its wires are left out of the diagram for clarity – only the wires that the installer is responsible for connecting are shown.)

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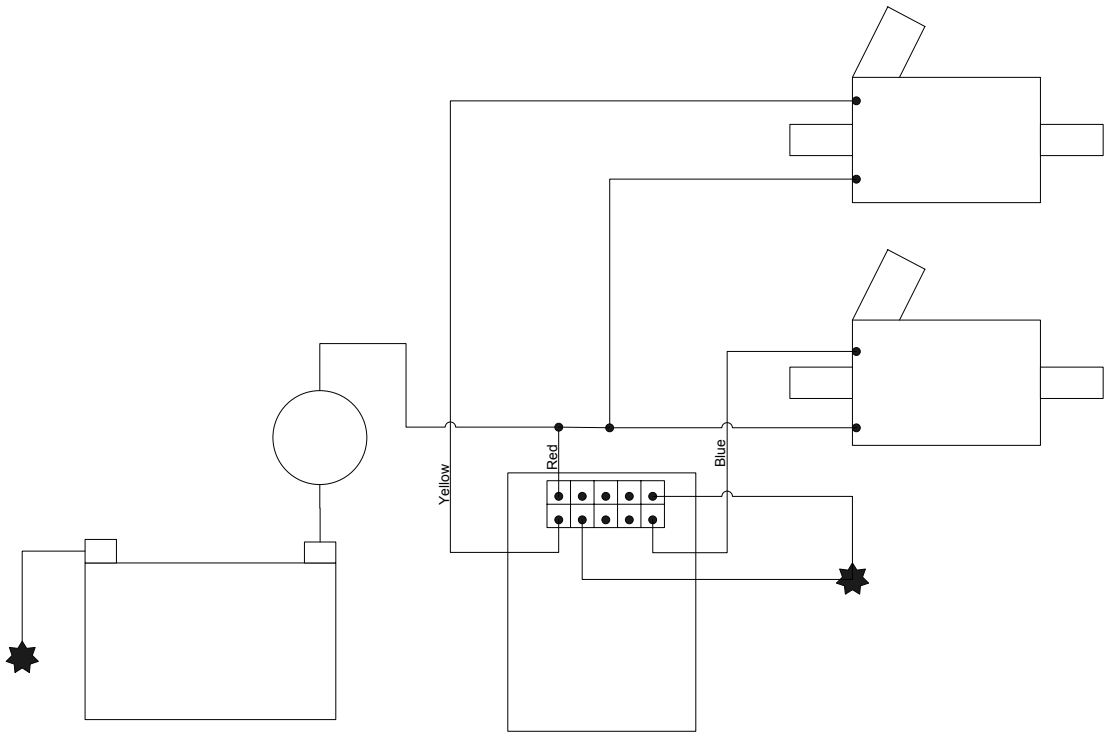

35. After the wiring is complete and you have carefully checked your work, plug the connector into the Control Module. It's keyed, so it only goes one way, but it will be obvious – the notch in the finned heat sink of the Control Module is there to clear the latch of the connector. Make sure the connector is seated fully – the latch will engage with an audible "click" when it's fully home.

36. Reconnect the battery.

37. Disconnect the spark plug caps and remove the spark plugs. Reinstall the plug caps onto the plugs, and lay the metal base of the plugs down so they make electrical contact with the cylinder head surface. **Make sure that the spark plugs are well away from the empty spark plug holes in the head, and that the carburetors and cylinders are "dry" (no fuel), so that you will not ignite fuel vapor with the sparks you are about to create at the plug gaps.**

38. Connect a xenon-flash timing light (the bright kind) to the left-hand cylinder's spark plug wire and to the battery (if required; some of us are lucky enough to use the Summit Racing/Flaming River self-powered timing light, and love it).

39. Turn the ignition power to the "on" position, or otherwise energize the ignition with battery power. **Note: As you execute the next several steps, the Control Module and the coils will be energized, and will become warm. If it takes more than a couple of minutes to execute the following steps through to Step #44, switch off the power for a few minutes to let the Control Module and coils cool, then turn the power back on and continue the work. This is necessary because there is not airflow over the components during this step.**

40. Using a socket or box end wrench on the crankshaft's alternator rotor retaining bolt, rotate the engine counterclockwise through three or four revolutions while keeping an eye on the gaps of the two spark plugs. Each plug should spark in turn; since the Model FS-09 is a single-fire system, each plug will fire once per two turns of the crankshaft, and the plugs will fire exactly one crankshaft revolution apart.

41. Aim the timing light at the alternator rotor, and slowly rotate the engine counterclockwise until the light flashes, to determine how close the timing was initially set to your desired full-advance point. Generally, Honda uses a pair of closely-spaced, parallel inscribed marks on the alternator rotor to indicate the range of full-advance timing. If the timing is right where you want it, tighten the two Pickup Plate retaining screws now. (To make the rubber facing deform enough to make up the small "step" between Pickup Plate and recess, you may have to tighten the screws fairly firmly.)

42. If you need to adjust the full-advance timing point, loosen the two retaining screws and rotate the Pickup Plate clockwise to advance the timing, or counterclockwise to retard the timing. The timing will change about 2° at the crankshaft for each .022" of rotation at the edge of the Pickup Plate. Note: the relative timing of the right- and left-hand cylinders is set by the physical location of their respective Hall-effect sensors on the Pickup Plate, and is fixed at manufacture. The sensors are located exactly 180º apart on the Pickup Plate, which corresponds to the 360º of crankshaft rotation between the two "fire" events.

43. Once you've fine-tuned the Pickup Plate position to get your desired timing, tighten the Pickup Plate retaining screws. (To make the rubber facing deform enough to make up the small "step" between Pickup Plate and recess, you may have to tighten the screws fairly firmly.)

44. Switch ignition power to the "off" position.

45. Disconnect the spark plugs from the plug caps, reinstall the plugs in the engine, and reinstall the plug caps onto the plugs.

46. Reinstall the seat, any side panels, and the fuel tank; open the petcock, and set the choke or enrichener, as required for a cold start.

47. Put the bike in gear for a bump-start, and get it rolling before switching ignition power on to start the engine.

48. Warm up the engine a little bit, so that it will carburet cleanly.

49. Reconnect the xenon-flash timing light to the left-hand (#1) cylinder's plug wire, and connect the timing light to the battery, if required.

50. With the timing light operating, rev the engine up to around 3,000 RPM. The timing light should "freeze" the alternator rotor's timing indicator between the two full-advance marks for the #1 cylinder (if you're using stock timing). If small corrections are needed to get the timing spot-on, make them now in the same way that you did while setting the static timing. If you are using a full-advance timing marker different from stock, adjust the Pickup Plate position to obtain the desired timing.

51. Move the timing-light pickup to the right-hand (#2) cylinder's plug wire and check its timing at about 3,000 RPM. The spark timing should be very close to that of the #1 cylinder. If there are small differences, you may want to rotate the Pickup Plate to "split" the difference.

52. When the desired timing has been set and verified, shut off the ignition power, close the petcock, and reinstall the alternator rotor cover and points housing cover.

Other details and notes:

- **IMPORTANT: NEVER TURN ON THE IGNITION AND LEAVE IT ON FOR MORE THAN 2 MINUTES WITHOUT STARTING THE ENGINE! WHEN THE ENGINE IS NOT RUNNING AND THE KEY IS IN THE "ON" POSITION, THE CONTROL MODULE MAY BE OPERATING "FULL-ON," AND CAN OVERHEAT.**

- The Model FS-09 ignition system has two magnets spaced at 180º on the Trigger Rotor; one magnet results in a "fire" command from each cylinder's Hall-effect sensor pickup, and the other magnet results in a "dwell" command. "Fire" interrupts battery current through the ignition coil's primary windings, and "dwell" resumes current through the coil; this means that each coil's "crankshaft dwell" angle is 360º, much longer than can be provided by the OEM points-type ignition. At 13,000 crankshaft RPM, 360° of dwell equates to a dwell time of just over 4.6 milliseconds,

which is sufficiently long to get most of each coil's peak energy to its plug. One important benefit of the electronic ignition's longer dwell time compared to points is higher spark energy (able to jump a larger gap at higher cylinder pressures), and this is particularly true at higher engine speeds, just where you need it for competition.

- Coils intended for capacitive-discharge ignition (CDI) systems are generally less than 1 ohm primary resistance, and are incompatible with the Model FS-09 ignition system. The wrong ignition coils may cause rapid, irreversible damage to the Control Module. Many inexpensive multimeters can't measure accurately down to a few ohms, so be especially careful to know what coil resistance you've really got.

For questions and/or assistance, contact:
Mark Whitebook
Probe Engineering, Inc.
34661 Calle Rosita
Capistrano Beach, CA 92624
(949) 489-9561
mwhitebook@yahoo.com