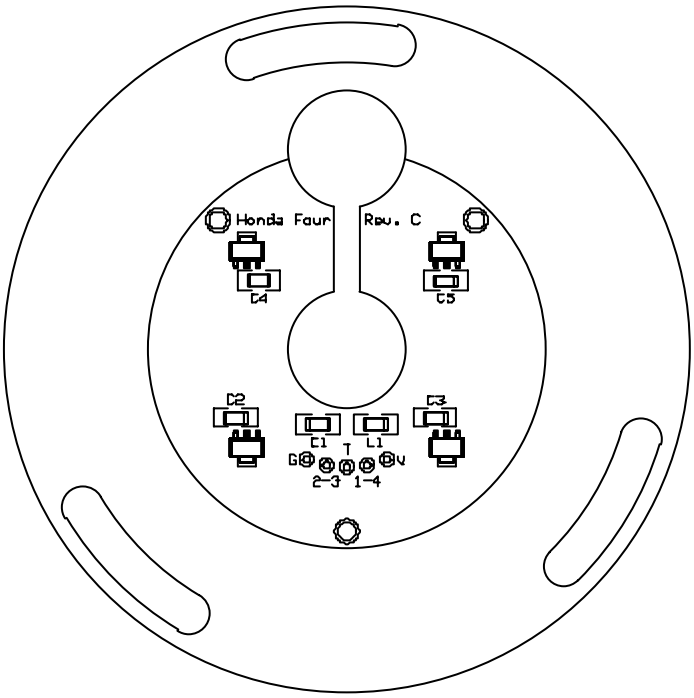
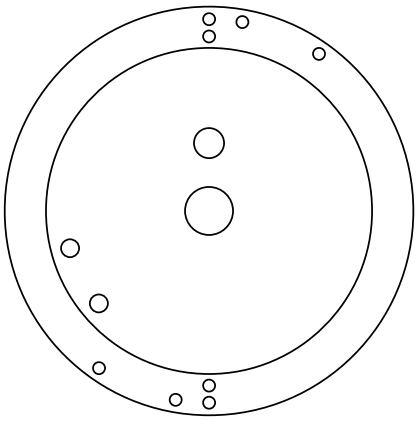
PROBE ENGINEERING, INC.

Installation Instructions

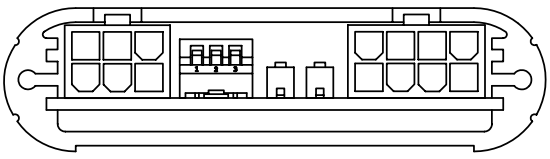
Model PR-350FL Ignition System



Pickup Plate



Trigger Rotor



Control Module

PROBE ENGINEERING, INC.

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Installation Instructions, Model PR-350FL

Version 1.0

The Model PR-350FL electronic ignition is designed specifically for all years of the 1970s Honda Models CB350F and CB400F four-cylinder engines.

The PR-350FL ignition system is a dual-fire design, using two dual-tower coils to fire cylinders in pairs (1-4 and 2-3) once per crankshaft revolution; each cylinder receives a "waste" spark on its exhaust stroke when its partner is receiving a spark on its respective compression stroke.

Spark timing advance and retard is electronically controlled; the OEM mechanical advance mechanism is not used. The system's magnetic trigger rotor mounts directly to the right end of the crankshaft, taking the place of the original advancer assembly.

The PR-350FL system incorporates a user-adjustable rev-limiter circuit. When the rev limit is reached, cylinders fire on every-other power stroke, cutting power in half and preventing engine over-speeding without accumulating unburned fuel in the cylinders.

The system also features progressive dwell control (to minimize current consumption without loss of spark energy at higher engine speeds), a "digital" pulse output for use with electronic tachometers, and a one-wire kill-switch option for competition applications.

What should be in the kit:

The Model PR-350FL kit includes the following components:

- Control Module
- Pickup Plate (with wire harness and connector)
- Trigger Rotor
- Power Cable Harness
- M6 integral-flange cap screw (for retaining the rotor)
- 9V battery connector
- Spare white and orange wires (1-foot long each, for optional features)
- Four NGK DR8EA resistor-type spark plugs (**use of resistor plugs and/or caps is required**)

What else you will need:

In addition to the usual small hand tools required to obtain 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:

- 9V snap-connect type battery (for setting the static timing)
- 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 (for general access).

2. Remove the seat.

3. Disconnect the battery.

4. Remove the fuel tank (you will need access to the ignition coils).

5. Remove the breaker-points cover on the right-hand side of the engine.

6. Remove the central bolt securing the centrifugal advancer mechanism.

7. Remove the three screws and washers that retain the points backing plate, and put them aside (the screws will be reused to retain the electronic ignition's Pickup Plate).

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

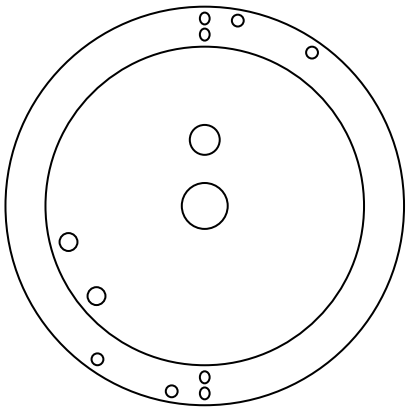
9. Remove the advancer mechanism from the end of the crankshaft.

10. Clean any rust or debris from the recess and 4mm dowel-pin hole in the end of the crankshaft.

11. Disconnect the breaker points lead wires from the ignition coils.

12. Disconnect and remove the condensers (they should not be used with the electronic ignition).

13. Locate the Trigger Rotor in the kit. From the front, it looks like this:

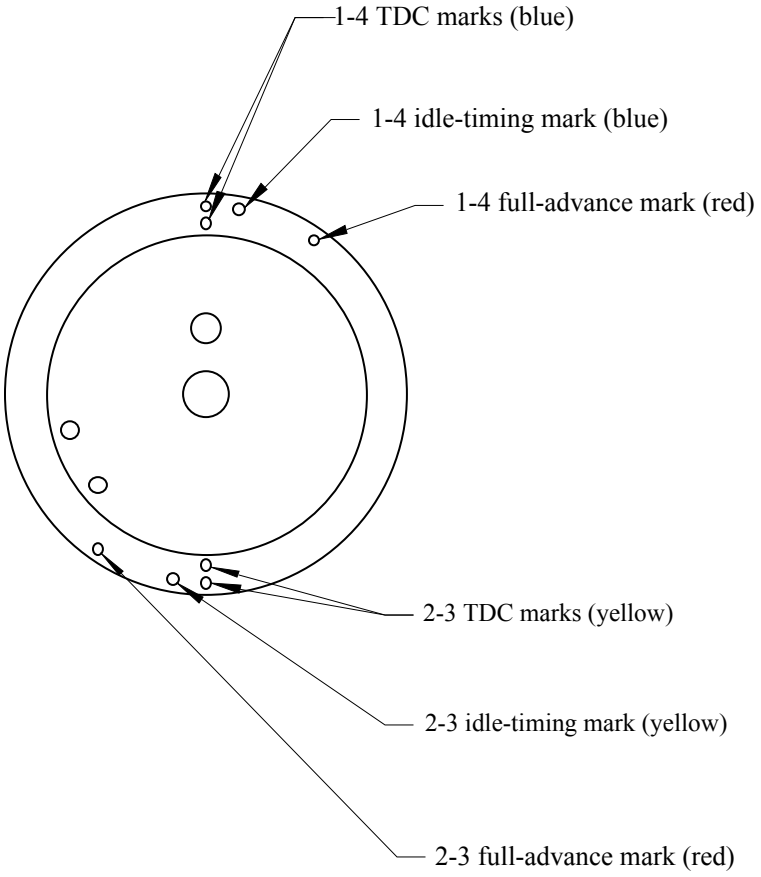


14. Note the paint-filled timing marks along the rim of the trigger rotor; there are radially paired marks filled with blue paint at the 12:00 position in the above drawing, and radially paired marks filled with yellow paint at the 6:00 position. The paired marks denote the Top Dead Center (TDC) location for cylinders #1 and #4 (blue) and cylinders #2 and #3 (yellow). These correspond to the "T" marks stamped into the OEM centrifugal advancer assembly; they are used to set the crankshaft to TDC when adjusting valve clearances.

15. Located 10° clockwise along the rotor rim from the TDC marks are a single blue dot (cylinders 1-4) and a single yellow dot (cylinders 2-3). These are the idle-speed timing marks, where the spark will occur at 1,200 RPM engine speed.

16. Located 35° clockwise along the rotor rim from the TDC marks are a single red dot (cylinders 1-4) and another single red dot (cylinders 2-3). These are the full-advance timing marks, where the spark will occur at engine speeds above 3,000 RPM.

17. The following annotated drawing shows the rotor's timing marks and color coding:



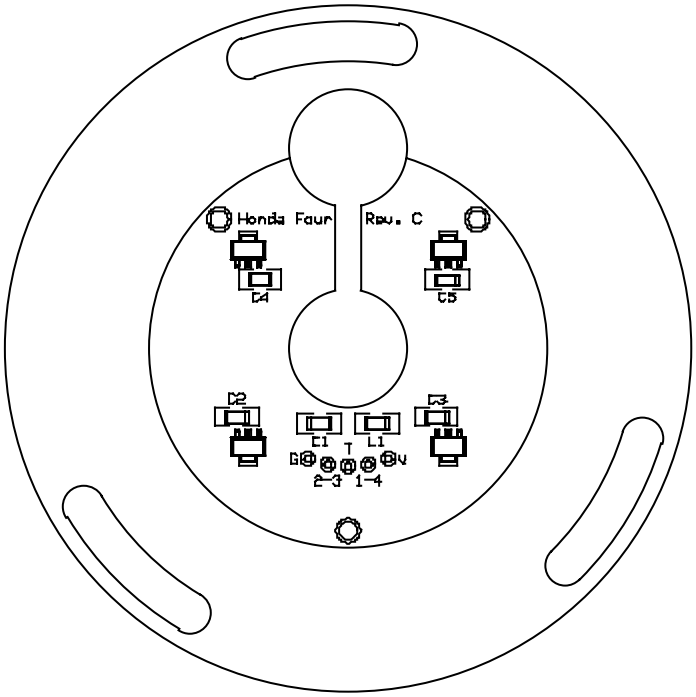
18. The rotor has a pressed-in 4mm-diameter dowel pin extending beyond its 24mm diameter hub surface (the rear face relative to the above drawing). With the rotor facing you as shown above, align the dowel pin with its matching 4mm hole in the end of the crankshaft, and using your thumbs, press the rotor hub firmly into the recess until it seats.

19. Apply a drop of medium-strength (Loctite "blue" or equivalent) anaerobic thread locker to the threaded end of the 6mm cap screw included in the kit, and thread the bolt into the center of the crankshaft. The screw head fits a 10mm socket or box-end wrench.

20. To prevent the crankshaft from turning as you tighten the cap screw, put the transmission into top gear and lock the rear wheel by depressing the brake pedal. If the final-drive chain is not in place yet, put the transmission into top gear and lock the front drive-chain sprocket while you tighten the cap screw.

21. **NOTE:** Once the cap screw retaining the trigger rotor has been tightened, **make sure to put the transmission back into neutral.**

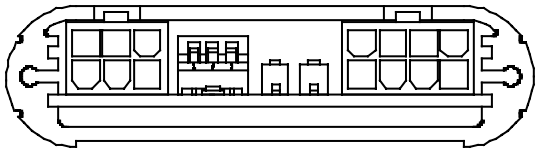
22. Locate the Pickup Plate assembly in the kit; it looks like this:



23. The pickup plate fits into the circular recess in the cases that previously held the points backing plate. Install the plate into the recess with the green fiberglass PC board and electrical components facing inward (toward the trigger rotor), and the wires facing outward (toward you). The circular cutout "window," half in the aluminum plate and half in the PC board, locates directly over the timing pointer cast into the upper crankcase half.

24. Install the original three points backing-plate retaining screws and washers with the slots centered on their respective screws. Leave the screws finger-tight for now; you will be adjusting the pickup position in the following static-timing steps.

25. Locate the Control Module in the kit. Its business end looks like this:



26. There is a 6-pin connector near the left side of the module and an 8-pin connector toward the right side; between the two are a three-position DIP switch and a pair of micro pushbuttons. There is also a small, flat red LED directly in front of the DIP switch (the LED lens is a milky-white color until the LED is illuminated; then it is bright red).

27. For the next steps, temporarily prop up or suspend the module somewhere near the pickup plate and rotor, so that you can see the module's red LED in your peripheral vision while observing the rotor's timing marks.

28. The sensor assembly's wire bundle has an 8-pin plug that matches the module's 8-pin connector housing. Plug them together; they are keyed, so that they only fit one way. The retaining latch that will "click" when the connectors are fully mated.

29. Remove the spark plugs, so that you won't have to fight against compression while you turn the engine over in the following steps to set the ignition timing.

30. Locate the 9V battery connector harness in the kit. It has a 9V battery "snap" connector on one end and a 6-pin plug that matches the corresponding module connector on the other end. Don't plug the harness into the module connector yet.

31. Snap a fresh 9V battery onto the mating terminals of the connector harness. Do this first, before plugging the harness into the module, so that if you get the battery terminals backward at first, you will not damage the module.

32. Plug the 9V harness into the module's 6-pin connector.

33. Using a 10mm socket on the alternator rotor's retaining nut, rotate the crankshaft a few turns clockwise (the normal "running" direction). Through the viewing hole in the pickup plate assembly, watch the fixed timing pointer's relationship to the rotor's timing marks; in your peripheral vision, watch the module's red LED.

34. As you rotate the engine, note that the module's LED will illuminate and then briefly go dark. The LED going dark signifies the precise moment when the coil's primary-winding current is interrupted at the end of the dwell period; this is the "fire" event for cylinders #1 and #4.

35. Exactly as the LED **goes dark** is the point at which the spark plugs in the #1 and #4 cylinder will fire **at the full-advance spark-timing point**. We want to see the LED go dark *just as* the trigger rotor's full-advance timing mark aligns with the pointer in the crankcase. **Yes, this is different from the way we're all used to setting "static timing" on a set of points, in that we're using the full-advance mark, not the idle-timing (retarded) mark, but it is correct for this system.**

36. The 1-4 cylinders' full-advance timing location is marked on the trigger rotor by a red-painted "dot". When the pickup plate position is correct, the LED will just go dark exactly as the crankcase's timing pointer aligns with the red dot.

37. If correction is needed in the pickup plate position to get the timing spot-on, loosen the three retaining screws and adjust the plate's position. Rotating the pickup plate counterclockwise advances the timing, and rotating it clockwise retards the timing, just as with the original breaker-points setup. The timing will change by two degrees at the crankshaft for each $1/16^{th}$ inch of movement at the outer edge of the aluminum plate.

38. When you've got the full-advance timing correctly set, tighten the three pickup plate hold-down screws.

39. Disconnect the pickup plate wire harness and the 9V battery harness from the control module.

40. Find a place where you'd like to mount the control module. **NOTE: the module should not be mounted close to either coil; the coils typically have large stray magnetic fields that will interfere with correct operation of the logic electronics.** The module's two micro pushbuttons can be used to make small trim adjustments to the idle-speed spark advance, which is independent of the full-advance timing. The idle-speed timing comes preset for your bike, and will usually not require adjustment unless you elect to run significantly more or less full-advance timing than Honda's original specifications. If the pushbuttons are accessible when the module is in place, it will make any adjustment easier.

41. The control module is delivered with attached Velcro fastening material. The "loop" side is adhered to the module; the "hook" side has an aggressive "peel-and-stick"

adhesive for attaching to a clean, flat surface on the bike. The module dissipates modest power, and will get warm to the touch during operation. It does not require aggressive airflow, but should not be mounted in a sealed volume with no airflow at all.

42. Seat the pickup plate leads' flatted rubber grommet into the lead-out hole at the lower-left of the housing. Leave a little slack in the wires between the grommet and the PC board, and be sure the wires are not making hard contact with the aluminum plate where they enter the housing.

43. Route the pickup assembly's wire bundle to the location of the control module. Typically, the wires will route down toward the lower-right frame rail, make a U-turn up into the space separating the points housing and the clutch housing, then route back along the edge of the clutch cover (beneath the #4 carburetor) before turning "up" toward the rear frame area. The pickup plate wires are insulated using high-temperature Teflon, and have a tinned-copper braided shield surrounding them.

NOTE: the pickup assembly wires must be kept well away from the coil bodies and the spark-plug leads, so that the electronics won't get confused or damaged by magnetic or spark-energy "pickup" from the high-voltage coil leads. Also note that the shield braid covering the wires is a bare ground-connected conductor, and must not make contact with any electrically "hot" items, such as the positive battery terminal or the starter solenoid terminals.

44. Examine the 6-pin connector at the end of the Power Cable Harness. On the connector's rear surface, where the wires enter, there are (hard-to-see) molded-in numbers showing each wire's position. Numbers 1 through 3 are in the first row (furthest away from the molded-in retaining latch), and numbers 4 through 6 are in the second row. The wires in each position are described in the following table. For the basic system installation, you only have to deal with the four wires shown in **boldface** type:

♦ Position 1:	**Heavy-gauge red wire – goes to switched +12 volts**
♦ Position 2:	**Heavy-gauge green wire – goes to chassis ground**
♦ Position 3:	**Heavy-gauge yellow wire – goes to 2-3 cylinder coil**
♦ Position 4:	**Heavy-gauge blue wire – goes to 1-4 cylinder coil**
♦ Position 5:	Open (reserved for kill-switch option)
♦ Position 6:	Open (reserved for electronic tachometer option)

45. **Important notes**:

- When routing wires, keep the power cable harness wires separated from the pickup plate wires.
- It is important to keep *all* ignition system wires, both pickup and power cable harness, spaced well away from the ignition coils and the high-voltage spark plug leads. Running system wiring alongside the HT plug leads is an invitation to damage from spark-energy coupling by induction.

46. The power cable harness' heavy-gauge red wire (connector position 1) goes to a switched source of +12 volts. You can pick this up from the wire supplying +12 volts to the ignition coils. On the stock CB350F/400F series wire harness, this wire is black with a white stripe. For a free online view of early Honda wiring diagrams, try the following website:
http://oldmanhonda.com/MC/WiringDiagrams/MCwiring.php

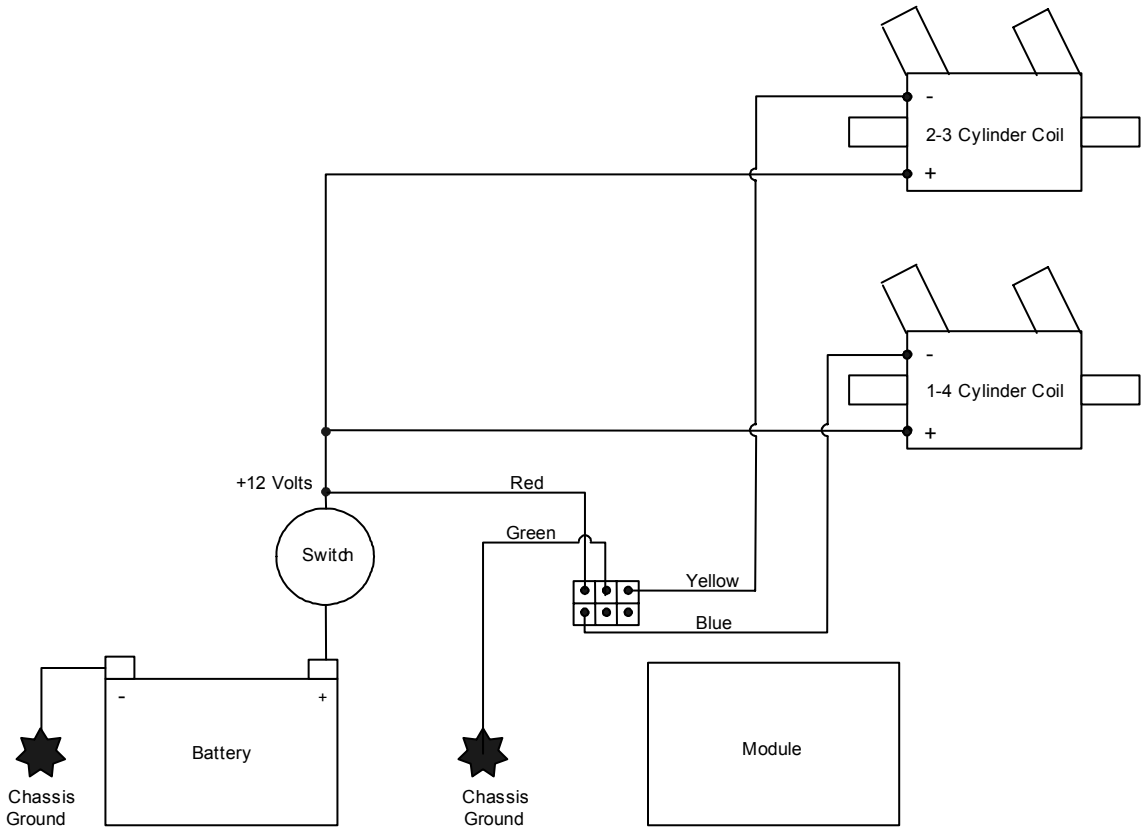
47. The power cable harness' heavy-gauge green wire (connector position 2) goes to a good chassis ground. A "good ground" means three things; it must have a low-resistance path to the battery's negative (-) terminal, it must have low-resistance path to the metal of the main chassis, and it must have a low-resistance path to the cylinder head. If these three things are not well-connected together electrically, you will have problems. The ground wire is 12" long as supplied. If you want to make it shorter, you may, but it should not be extended.

NOTE: the following steps refer to the "negative"-marked primary terminals of the ignition coils. Dual-tower coils may or may not be marked for primary-connection polarity; strictly speaking (unlike all single-tower coils), the direction of current flow in dual-tower coils' primary windings is immaterial – it does not matter. Many OEM Japanese dual-tower coils are marked with positive and negative symbols, but some aftermarket coils are not. If your coils are not marked, don't worry; the important thing is that, for each coil's primary winding, one wire (or terminal) goes to the battery's positive voltage (through the key switch, of course), and the other primary wire (or terminal) goes to the color-coded ignition power-cable harness wire.

48. The heavy-gauge yellow wire (connector position 3) goes to the negative (-) primary terminal of the 2-3 cylinders' ignition coil. The negative primary terminal is the one *opposite* the coil's connection to the +12V source.

49. The heavy-gauge blue wire (connector position 4) goes to the negative (-) primary terminal of the 1-4 cylinders' ignition coil. The negative primary terminal is the one *opposite* the coil's connection to the +12V source.

50. The following schematic wiring diagram shows how the system connections should be made. For those not familiar with such diagrams, a "dot" where wires meet signifies that they are connected together electrically, while a "jog" signifies that they are not connected.



Wiring Diagram

51. Once you've got the pickup plate wire harness and the power cable harness wiring and routing complete, plug the pickup plate and power cable harness connectors into the control module's mating connectors.

NOTE: the following steps call for use of the NGK DR8EA spark plugs included in the PR-350EL kit. The "R" in the NGK part number describes a resistor-type noise-suppression spark plug. With your new electronic ignition, using either resistor plugs or resistor plug caps is mandatory; both used together will not cause problems. From the factory, your Honda four was delivered with 5k (5,000) ohm resistor plug caps, but many older bikes have had their OEM caps replaced with non-resistor types. If you KNOW that you have 5k ohm resistor plug caps, and that they are good (to "know" means to measure with an ohmmeter, not guess or assume), you may use either resistor or non-resistor spark plugs in the future. However, for now*, use the plugs provided in the kit for the remainder of the installation*.

52. Find the four NGK DR8EA spark plugs in the kit. Install your plug caps onto the new plugs and lay the plugs' metal bases down so that they are in contact with the bare metal of the cylinder head. **Make sure that the spark gaps 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.**

53. Take a deep breath, clear your head, and double-check your wiring. When you are done checking, reconnect the battery.

54. Turn the ignition key to the "on" position.

55. Spin the engine through a few revolutions while watching the plugs' spark gaps. Plugs should spark in pairs, half a crankshaft revolution apart (#1 and #4 together and #2 and #3 together).

56. If all plugs are sparking, switch off the ignition power.

57. Disconnect the spark plugs from the caps, install the DR8EA plugs in the engine, and reinstall the caps onto the plugs.

58. Reinstall the seat, side panels, and the fuel tank; open the petcock and set the chokes, as required, for a cold start.

59. Start the engine. The kick or electric starter may be used (or bump start, if you've built a racer).

60. Warm the engine up so that it will carburet cleanly and idle reliably.

61. Connect a xenon-flash timing light to the #4 cylinder's spark plug wire and to the battery (if required; some timing lights have internal batteries).

62. With the timing light aimed through the pickup assembly's viewing hole, slowly rev the engine up about 3,500 RPM. As the revs increase, you'll see the timing advance from somewhere near the single-blue-dot mark (at low speeds) to the single-red-dot full-advance mark. As you approach 3,000 RPM, you'll see the last degree of two of spark lead come in, and thereafter, there will be no further advance. Above 3,000 RPM, the timing light should "freeze" the single-red-dot full-advance mark right at the fixed pointer, exactly as you set it using the red LED and the 9V battery during initial static timing. If small corrections are needed to get the full-advance timing spot-on, make them now in the same way that you did while setting the static timing.

63. Once the full-advance timing is verified, check the idle-speed timing. Idle the engine down to 1,200 RPM and shine the timing light on the rotor. You should see the single-blue-dot idle-speed timing mark for cylinders #1 and #4 "frozen" near the fixed timing pointer. **Normally, you will not need to make any further timing adjustments; the idle-speed timing is set correctly at the Probe Engineering, Inc. factory.** However, if you are building a race bike and running either considerably different full-advance timing than Honda's original 35° BTDC figure, you may want to readjust the idle-speed timing. If so, go to step #64; otherwise skip to step #65.

64. To change the idle-speed timing from the factory pre-set value, follow this procedure:

    a. The module's two micro pushbuttons have small black plastic actuators that project from their tops by about one millimeter. The actuators are pressed "down" (toward the green printed-circuit board beneath them) to make momentary contact; the switches are of the "tactile feedback" type, which make a little click when the buttons are depressed. The left pushbutton has a minus sign (-) printed on the PC board in front of it, and the right pushbutton has a plus (+) sign. The sign indicates the effect each button has on the idle-speed spark-timing adjustment; the (-) button retards the timing, while the (+) button advances the timing.

    b. The engine must be running to adjust the idle-speed timing; the adjustment buttons are disabled when the engine is stopped, whether or not the ignition is powered.

    c. With the engine idling, begin the adjustment process by flipping all three white toggles of the module's red DIP switch to the "up" position. When you have done this, and provided that engine speed is above 480 RPM, the red LED will go dark and stay dark. When the LED goes dark, you have entered the adjustment mode, and the two micro pushbuttons are active.

d. Now that you are in adjustment mode, advance or retard the idle-speed timing by pressing and releasing the appropriate micro pushbutton; (+) to advance or (-) to retard. Each press-release cycle of a button (i.e., a single "click") will change the idle-speed timing by just over one-half degree of spark-timing angle at the crankshaft (i.e., very fine adjustment steps). You must press and release the button for each increment of timing change; the timing adjustment will not "scroll" through multiple changes if the button is held down continuously.

e. When the idle-speed timing adjustment is complete, flip all three toggles back to their "down" position; you will see the red LED illuminate again. This signifies that the adjuster buttons are back in safe mode, which prevents the low-speed timing from being altered any further. The module stores the last idle-speed timing setting in non-volatile memory, and retains the new value even when the power is turned off.

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

Appendix 1; setting the rev limiter

The three toggles of the module's DIP switch allow the user to set the rev limiter to one of eight settings. The toggles are numbered from one to three (from left to right); the numbers are visible on the switch housing.

In ascending order, the rev limiter settings are:

Rev Limit	Switch 1	Switch 2	Switch 3
RPM	Position	Position	Position
9,000	Down	Down	Down
9,500	Down	Down	Up
10,000	Down	Up	Down
10,500	Down	Up	Up
11,000	Up	Down	Down
11,500	Up	Down	Up
12,000	Up	Up	Down
None (limiter off)	Up	Up	Up

The as-delivered DIP switch setting is with all three toggles in the down position, which sets the rev limit to 9,000 RPM.

When the engine reaches the set rev limit, each cylinder fires on every other power stroke (that is, every four crankshaft rotations, instead of every two crankshaft rotations, as is normal for a four-stroke engine). The resulting "stutter" sound and feel will alert the rider that the rev limit has been reached, at the same time cutting engine power by half to prevent over-revving. As soon as engine speed is reduced below the limit, normal ignition firing resumes.

Setting all three toggles to the up position disables the rev limiter and allows unrestricted engine RPM. **NOTE:** this is also the setting that enables the idle-speed timing adjustment pushbuttons and disables the LED (for all engine speeds above 480 RPM), so **it is recommended that you normally leave the rev limiter set to one of the seven available speed-limit settings, not in the "limiter off" position. If you feel it is necessary to permanently defeat the rev limiter, be aware that the idle-speed adjustment pushbuttons will be in their active mode, and that depressing them, whether intentionally of otherwise, will alter your idle-speed spark-timing setting.**

Appendix 2; kill switch and tachometer options

As noted in the wiring table earlier in this document, there are tachometer and kill switch options available. If you've completed the basic ignition system installation, you've already dealt with the four heavy-gauge wires that came pre-installed in the 6-pin power cable harness connector. The two remaining connector positions are associated with the tachometer and kill switch options. Their numbers are:

- Position 5: Kill switch
- Position 6: Tachometer output

The PR-350FL installation kit includes one white and one orange wire that can be inserted into the 6-pin connector housing to make the kill switch and tachometer connections.

The terminals are preinstalled onto the ends of the wires; these may be inserted into the connector housing from the back (where the molded-in numbers are). The terminals "snap" into place; you can feel and hear them "click" when they go all the way home. The simplest way to see how the terminals must be oriented for insertion is to use one of the other wires already installed in the connector as a guide.

The first option is the kill switch. If you install the kit's accessory white wire in connector position 5, and short the other end of the wire to chassis ground, the plugs will stop sparking for as long as the electrical connection is made. The kill function does NOT disable the ignition's control module or tachometer output signal, just the spark.

The second option is the "digital" tachometer output signal (orange wire), which is configured to give one signal pulse per crankshaft revolution, swinging between 0V and 12V with a 50% duty-cycle square wave.

Electronic tachometers will generally have either three or four wires (four-wire tachometers have an additional dedicated lead for the internal backlight). The three-wire versions typically have the following connections:

- +12V
- Ground
- Signal Input

Color coding for the tachometer's wiring varies from manufacturer to manufacturer, so you will have to determine which is which according to your tachometer's documentation.

Other details and notes:

- For those who wish to use aftermarket coils for maximum spark energy, coils with primary resistance as low as 3.0 ohms are permissible. The PR-350FL system incorporates a "progressive dwell control" feature that minimizes average coil current without compromising spark energy.

- To prevent draining the battery or damaging the coils and/or module if the system is accidentally left energized, the PR-350FL system has an auto-shutoff feature that cuts off coil current if the engine is not started within 32 seconds of the key switch being turned on (or if the engine is started, then stalls). Once "timed out," the module will automatically restore coil current when crankshaft rotation is detected; you don't have to cycle the power to re-boot the system.

For questions and/or assistance, contact:
Mark Whitebook
Probe Engineering, Inc.
34661 Calle Rosita
Capistrano Beach, CA 92624
e-mails to: mwhitebook@yahoo.com