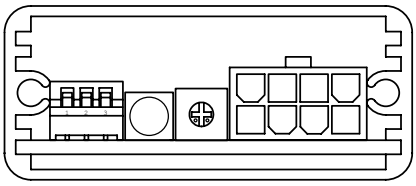
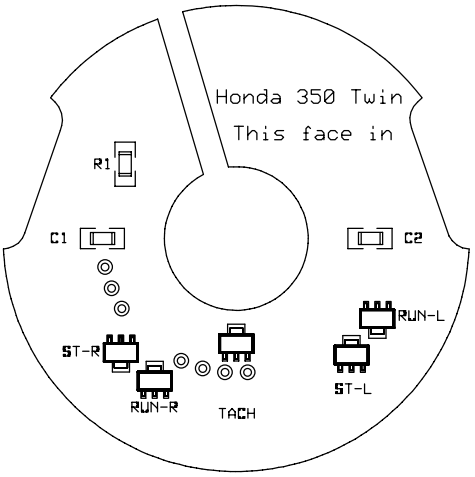
PROBE ENGINEERING, INC.

Installation Instructions

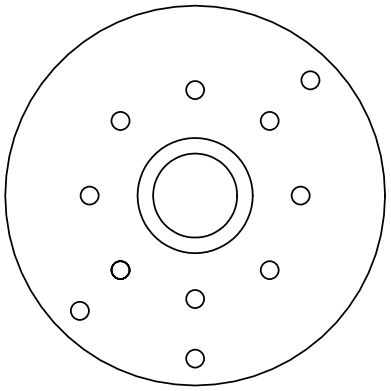
Model BT-05EL Ignition System



Control Module



Pickup Plate



Trigger Rotor

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The Model BT-05EL electronic ignition is designed specifically for 1970s Honda Models CB350, CL350, and SL350, all with derivatives of Honda's 180º crankshaft twin-cylinder engine.

The BT-05EL ignition system is a single-fire design, using two single-tower coils and firing each cylinder once per 720º of crankshaft rotation (no "wasted spark"). The BT-05EL is based on the earlier BT-05E system, but adds a user-adjustable rev-limiter circuit. When the rev limit is reached, each cylinder fires on every-other power stroke, cutting power in half and preventing engine over-speeding, but without accumulating excessive unburned fuel in the cylinders.

Table of Contents

What should be in the kit:

The Model BT-05EL kit includes the following components:

- Control Module
- Pickup Plate (with wire harness and connector)
- Trigger Rotor
- Power Cable Harness
- Pair of NGK BR8ES spark plugs (the use of resistor-type plugs is required)
- Rubber-faced flat washers (2 each, for retaining the Pickup Plate)
- 9V battery connector
- Spare white and orange wires (1-foot long each, for optional features)

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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:

- 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, if applicable (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 alternator rotor cover (for setting the timing later).

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, and put them aside (the screws will be reused to retain the electronic ignition's Pickup Plate).

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

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

11. Disconnect and remove the condensers (they should not be used with the solid-state ignition).

12. Remove the advancer mechanism from the quill (small-diameter extension shaft) on the end of the camshaft.

13. Clean any rust or debris from the cam-end quill and from the seating surface at the end of the quill.

14. Slip the Trigger Rotor over the quill, and align the notch in the rotor hub with the 3mm locating dowel on the camshaft end.

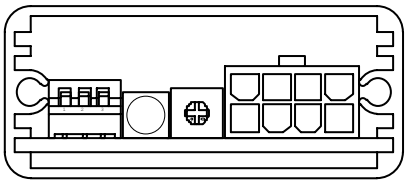
15. Using medium-strength (Loctite "blue" or equivalent) anaerobic thread locker and the original retaining bolt and washer from the centrifugal advancer, bolt the trigger rotor in place.

16. Slip the Pickup Plate over the trigger rotor, with the electrical components facing in toward the rotor and the wires facing out toward you. Align the slot in the pickup plate with the center of the notch in the points-plate housing.

17. Install the two rubber-faced washers provided in the kit onto your original points-plate retaining screws, with the washers' metal faces against the screw heads. 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 reinstall the screws to retain the plate, but don't tightening anything up yet.

18. Seat the pickup plate leads' flatted grommet into 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 washer, or the sharp edges of the points-plate housing. Don't bother routing the pickup plate lead wires out across the cylinder head yet; you're about to set the static timing, and will temporarily want the connector at the end of the leads dangling down near the alternator rotor.

19. Locate the Control Module in the kit. It looks like this:



20. There is an 8-pin connector toward the right side of the module, a three-position DIP switch toward the left side, and a red LED and blue potentiometer between the two. There is also a 6-pin connector (not shown in the line drawing) at the end of a short wire bundle coming out the module. For the next steps, statically timing the system, temporarily suspend the module somewhere near the alternator assembly, so that you

can see both the alternator's ignition timing marks and the module's red LED in your field of view at the same time.

21. 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.

22. 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 it into the module connector yet.

23. Snap a fresh 9V battery onto the matching 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.

24. Plug the 9V battery and harness into the module's 6-pin connector.

25. Using a 14mm socket or box end wrench on the alternator rotor's retaining nut, rotate the crankshaft slowly counterclockwise while watching the timing marks and the module's LED. You may prefer to remove the spark plugs at this point, so that you're not trying to spin the engine over against compression.

26. As you rotate the engine, the module's LED will alternately illuminate and go dark. The illumination signifies the left-hand coil's "dwell" time, when battery current will be flowing through it (when the installation is complete). The LED going dark occurs when the coil current is interrupted, which is the left-cylinder "fire" event.

27. Exactly as the LED goes dark at the end of the dwell mode is when the spark plug for the left cylinder will fire at the full-advance point. We want to see the LED go dark *JUST AS* the alternator rotor's full-advance timing marks align with the static pointer. **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.**

28. The left-cylinder's full-advance timing location is marked on the alternator rotor by a pair of parallel lines located counterclockwise from the "LT" and "LF" marks. When the pickup plate position is correct, the LED will just go dark as the fixed timing pointer aligns with or between the two full-advance lines.

29. If correction is needed in the pickup plate position to get the timing spot-on, loosen the two retaining screws and adjust the plate's position. Rotating the pickup plate clockwise will advance the timing, and rotating it counterclockwise will retard the

timing, just as with the original breaker-points setup. The timing will change by two degrees at the crankshaft for every 0.021" of movement at the edge of the pickup plate.

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

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

32. Find a place where you'd like to mount the control module. The module's blue potentiometer can be used to make small trim adjustments to the idle-speed spark advance, which is independent of the full-advance timing. It is preset for your bike at the factory, 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 blue potentiometer is accessible when the module is in place, it will make this adjustment easier.

33. The control module is delivered with Velcro fastening material. The "loop" side is attached 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 low 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.

34. Route the pickup plate assembly's wire bundle to the location of the control module. The pickup plate wires are insulated using high-temperature Teflon, and have a tinned-copper braided shield surrounding them; the wires can be routed pretty much anywhere (except to an exhaust pipe!) without major temperature concerns. *However, the wires must be kept well away from the spark-plug leads, so that the electronics won't get confused or damaged by spark-energy "pickup" from the high-voltage coil leads.*

35. 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 left-cylinder coil**
♦	Position 4:	**Heavy-gauge blue wire – goes to right-cylinder coil**
♦	Position 5:	Open (reserved for kill-switch option)
♦	Position 6:	Open (reserved for electronic tachometer option)

36. **Important notes**:

- When routing wires, keep the power cable harness wires separated from the pickup plate wires.
- It is important to keep *all* wires away from the high-voltage spark plug leads. We strongly recommended the use of carbon-type suppression plug wires or modern spiral-wound suppression plug wires with electronic ignition systems.
- If you cannot use suppression-type wires, you must use resistor plug caps (at least 5k ohm, as the Honda original components).
- Resistor-type spark plugs are included in the kit, and their use is required. NGK brand plugs will have an "R" in the alpha prefix if they are resistor type; you may prefer to use a different heat-range plug than the included BR8ES, but it should always be a resistor-type.

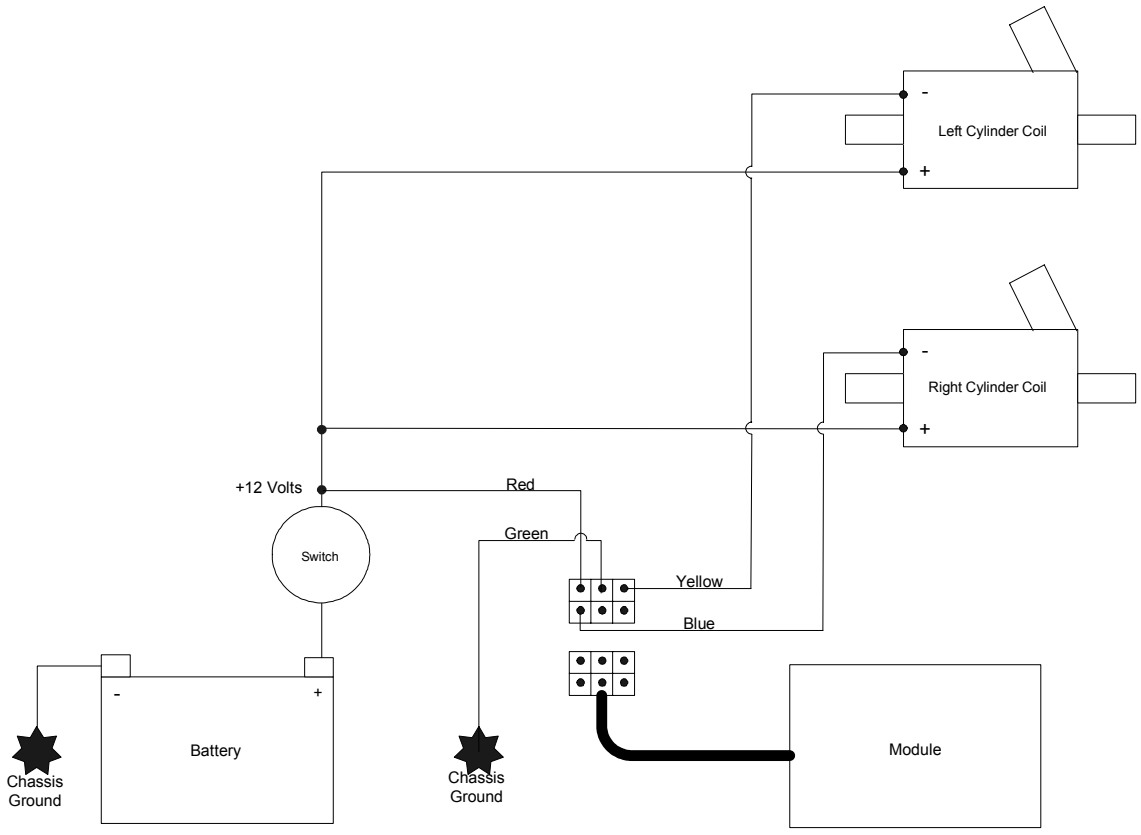
37. The power cable harness' heavy-gauge green wire (connector position 2) must go to a good chassis ground. A "good ground" means three things; it must have a low-resistance path to the battery's negative (-) terminal, it must have low-resistance path to the metal of the main chassis, and it must have 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.

38. 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 CB/CL/SL350 series, these are black with a white stripe in the original Honda wiring harness; they go to the coils' positive (+) terminals.

39. The heavy-gauge yellow wire (connector position 3) goes to the negative (-) terminal of the ignition coil for the left cylinder. On an original and stock bike, the left cylinder's ignition coil has a yellow lead coming out of it, and the colors will match.

40. The heavy-gauge blue wire (connector position 4) goes to the negative (-) terminal of the ignition coil for the right cylinder. On an original and stock bike, the right cylinder's ignition coil has a blue lead coming out of it, and the colors will match.

41. 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

42. 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.

43. Reconnect the battery.

44. Disconnect the spark plug caps and remove the spark plugs. Reinstall the caps onto the new BR8ES plugs, and lay the metal base of the plugs down so they contact 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.**

45. Turn the ignition key to the "on" position (or otherwise energize the ignition with battery power).

46. Rotate the engine through a couple of revolutions while keeping an eye on the spark gaps in the two plugs. Each plug should spark in turn.

47. If both plugs are sparking, switch off the ignition power.

48. Disconnect the spark plugs from the plug caps, install the BR8ES plugs in the engine, and reinstall the plug caps onto the plugs.

49. 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.

50. Loosely reinstall the alternator cover; you are about to start and warm up the engine, and this will minimize the oil-fling mess from the "wet" alternator cavity.

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

52. Warm up the engine, so that it will carburet cleanly.

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

54. With the engine stopped, remove the alternator cover again, and restart the engine. Watch out for oil fling.

55. With the timing light operating, slowly rev the engine up about 3,500 RPM. You'll see the timing advance from somewhere around the "LF" mark (at low speeds) to the full-advance marks; 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. Since calibration between tachometers is always in question, we'll measure the full-advance timing at about 3,500 RPM. At 3,500 RPM, the timing light should "freeze" the alternator rotor's timing indicator between the two full-advance marks, just as you set it using

the red LED and the 9V battery during initial setup. 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.

56. Once the full-advance timing is verified, check the idle-speed timing. Let the engine idle at its recommended idle speed, and shine the timing light on the alternator rotor. You will see the rotor's nominal "LF" idle-speed timing mark "frozen" somewhere near the fixed reference mark. To finalize idle-speed timing, the blue Idle Timing potentiometer on the face of the control module can be used to alter the low-speed timing delay. Turning the potentiometer clockwise increases the timing delay and retards the idle-speed ignition timing; turning the potentiometer counter-clockwise advances the timing.

57. Move the timing-light pickup to the right-hand cylinder's plug wire and check its timing at 3,500 RPM. The relative spark timing should be very close to that of the left-hand cylinder. Small differences can be "split" by repositioning the pickup plate a little, if desired. Generally, the timing will be as identical as printed-circuit board tolerances and Hall-effect device matching will allow.

58. When the desired timing has been set and verified, shut off the ignition power, close the petcock, reinstall the alternator rotor cover and points housing cover, and top up the oil level.

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 combinational settings. In ascending order, these are:

Rev Limit	Switch 1	Switch 2	Switch 3
RPM	Position	Position	Position
10,500	Down	Down	Down
11,000	Down	Down	Up
11,500	Down	Up	Down
12,000	Down	Up	Up
12,500	Up	Down	Down
13,000	Up	Down	Up
13,500	Up	Up	Down
None (limiter off)	Up	Up	Up

The as-delivered DIP switch setting is with all three toggles in the "down" position, with the rev limit set to 10,500 RPM. The toggles are numbered from one to three (from left to right); the numbers are visible on the switch housing.

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 reducing 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.

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 BT-05EL 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, and where the existing red, green, yellow, and blue wires are sticking out). The terminals "snap" into place and are then permanently retained; 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 (they only go one way) is to use one of the other wires already installed in the connector as a guide.

The first option is the Kill Switch; this one's easy. 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; they continue to operate (the module alone draws about 100 milliamperes).

The second option is the "digital" tachometer output signal (orange wire). The tachometer output is configured to give one signal pulse per crankshaft revolution; this is a common Japanese bike electronic-tachometer format for 4-cylinder bikes.

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Electronic tachometers will generally have either three or four wires. The three-wire versions have the following connections:

- +12V
- Ground
- Signal Input

Four-wire tachometers have an additional dedicated lead for the internal backlight.

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. The orange tachometer output wire of the ignition module would connect to the Signal Input wire of the tachometer.

Other details and notes:

- For those who are running high-compression, high-RPM applications and wish to use aftermarket coils for maximum spark energy in competition applications, coils with primary resistance down to 3.0 ohms are permissible. Coils with 5.0 ohms primary resistance will work well for street applications, and have the benefit of drawing less current, running cooler, and stressing your bike's charging system less.

- To prevent draining the battery or damaging the coils and module if the system is accidentally left energized, the BT-05EL system has an auto-shutoff feature that cuts off coil current if the engine is not started within 30 seconds of the key switch being turned on (or if the engine has been stopped for any reason with the ignition powered). Once "timed out," the module will automatically restore coil current when crank rotation is detected; you don't have to cycle the power to re-boot the system.

- Recheck ignition timing after each periodic cam chain adjustment. Since the ignition is driven from the end of the cam, a stretched cam chain will retard the ignition.

For questions and/or assistance, contact:
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