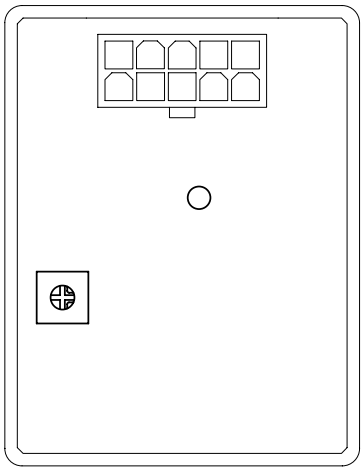
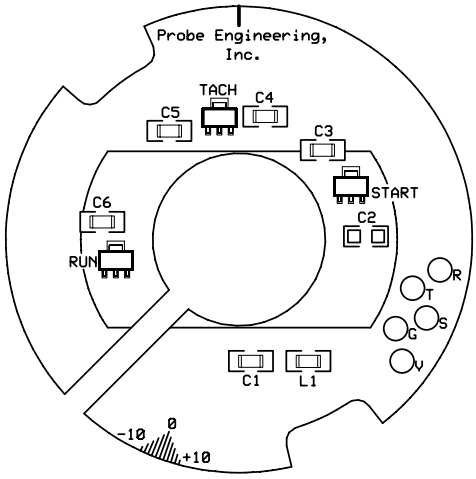
PROBE ENGINEERING, INC.

Installation Instructions

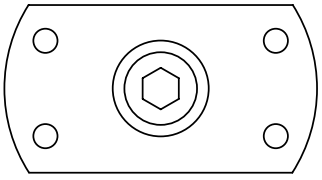
Model DX-65 Electronic Ignition



Control Module



Pickup Plate



Trigger Rotor

PROBE ENGINEERING, INC.

Installation Instructions, Model DX-65
Version 2.02

The Model DX-65 electronic ignition is designed for Yamaha XS650 twins from 1970 to 1982, and may be fitted to both early breaker-points engines and later transistorized ignition models.

The Model DX-65 is a dual-fire ignition system that fires both spark plugs simultaneously once per crankshaft revolution, using a dual-tower ignition coil. The system will work with the 1980-and-later OEM coil, but for superior performance, an aftermarket coil between 3 ohms and 5 ohms primary resistance should be used.

For competition applications, a 3-ohm coil will give hotter spark at sustained maximum RPM. For street applications, a 5-ohm coil will give very good performance, and will make lower demands on the XS650's charging system.

The system employs fully electronic spark timing advance-retard, and does not use the OEM mechanical advancer assembly. Once set, the spark timing remains fixed and stable.

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What should be in the kit:

The Model DX-65 kit includes the following components:

- Control Module
- Pickup Plate (with wire harness and connector)
- Trigger Rotor
- 3/16" hex wrench (to tighten internal-expander screw of Trigger Rotor)
- M6 by 12mm pan head screws with rubber-faced flat washers (2 each)
- Self-adhesive Velcro for mounting the Control Module
- Tie-wraps (for backing up the Velcro fastening and for organizing the wiring)
- Pair of NGK BPR7ES spark plugs (the use of resistor-type plugs is required)

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
- Xenon-flash timing light

If you have a 1979 or earlier points-type ignition, you will also need the following tools:

- 3/8" NPT pipe tap (tapered pipe tap, available at most hardware stores)
- 3/8" pipe plug and/or pipe nipple (short length of pipe, threaded at each end)
- Gear puller (not absolutely necessary, but very handy – see steps #17 and #18)

Installation:

1. Remove the side panels (for general access).

2. Raise and/or remove the seat.

3. Disconnect the battery.

4. Remove the fuel tank.

5. Remove the alternator rotor cover on the left side of the engine.

6. Remove the chromed-steel breaker-points cover on the left side of the cylinder head. *Remove this cover even if you have a 1980-or-later engine without breaker points*.

For 1980-and-later engines, or if you've installed a hard-weld camshaft (a hard-weld cam will be returned to you without the internal bushings and seals), skip steps #7 through #18, and go directly to step #19.

7. Remove the chromed-steel centrifugal advancer cover on the right side of the cylinder head.

8. Remove the breaker points and their backing plate as a complete assembly from the housing.

9. Disconnect the breaker points from the ignition coils.

10. Disconnect the condensers (condensers should not be used with the solid-state ignition).

11. Disconnect and remove the 2 ignition coils and their spark plug leads.

12. Remove the nut securing the breaker-points cam to the left end of the advancer shaft (the advancer shaft runs through the hollow center of the camshaft).

13. Remove the breaker-points cam from the left end of the advancer shaft (it pulls straight off the shaft).

14. Remove the nut on the right end of the advancer shaft that connects the shaft to the advancer mechanism.

15. Remove the advancer shaft and the advancer collar (the collar connects the shaft to the flying weights).

16. Remove the 2 "e-rings" retaining the flying weights on their respective pivots on the advancer mechanism, and remove the weights and springs. You can leave the rest of the advancer back plate assembly in place; it will not hurt anything, and will give you a convenient "push" point for the following steps, if needed.

17. There are a seal and a bushing installed in each end of the hollow camshaft. The seal and bushing on the left (points) side of the camshaft must be removed to

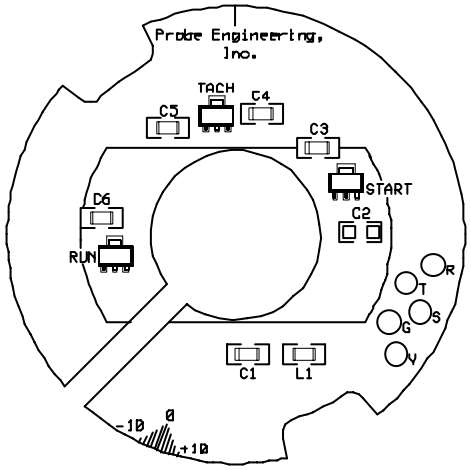
install the new ignition Trigger Rotor. To remove the seal, which is outermost in the camshaft, thread the 3/8" NPT tap partway into the seal. You can use a tap handle for this if you have one handy; if not, an adjustable end wrench on the drive flats of the tap will work fine. Once the tap has a decent "bite," the seal will usually twist out of the end of the camshaft without much trouble if you simultaneously pull it toward you while twisting the tap clockwise. If the seal doesn't twist out while tapping, there are two ways to deal with it. The first method is to thread a 3/8" pipe plug (or nipple) into the seal, and press the seal and plug out from the right side of the engine, using the advancer shaft you just removed as a "pusher." A conventional gear puller tool pulling against the advancer backplate and pushing on the shaft makes this easy. The second method is to thread a 3/8" pipe nipple into the seal, and pull it out from the left side.

18. To remove the (inboard) bushing from the left side of the camshaft, again use the 3/8" NPT tap to cut threads into the bushing. ***Be careful not to tap so far into the bushing that you begin cutting threads in the internal shoulder of the camshaft material that backs up the bushing***. The bushing is usually a little tighter in the bore than the seal is, and will often have to be pulled out (using the pipe nipple) or pushed out (using the advancer rod and gear puller combination) as described above.

For 1980-and-later engines, resume here:

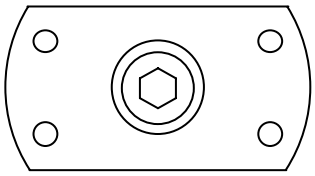
19. Using brake cleaner, electric parts cleaner, acetone, or some other non-residue solvent, clean and degrease the internal bore of the camshaft on the left side.

20. Locate the Pickup Plate in the kit. It looks like this (wires are not shown, for clarity):



21. Using the screws and washer supplied in the kit, install the pickup plate into the points-plate relief the left points housing. Position the plate so that the mounting screws are roughly centered in the two clearance spaces on the plate O.D. (to allow final timing adjustment either way), and lightly tighten the screws. The yellow line just above the words "Probe Engineering, Inc." at the top of the pickup plate will be at the 12:00 position.

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



23. Using a 3/16" hex wrench, loosen the internal-expander screw inside the trigger rotor a couple of turns, then slip the rotor into the freshly cleaned left-side bore of the camshaft until the rotor bottoms on its shoulder. Spin the rotor inside the camshaft a few turns to ensure that it doesn't foul the pickup plate's wires (or anything else). Don't tighten the internal-expander screw yet.

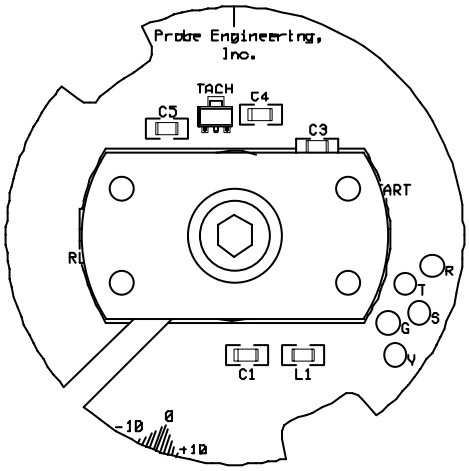
24. Remove the sparkplugs from the engine, so that you will not be fighting against compression in the next steps (you will still be fighting valve spring pressure, which is trouble enough).

25. Take a look inside the alternator housing. At about the 5:00 position on the stator housing casting are a letter "F" and a letter "T." Near each letter are the corresponding timing marks (lines). The letters will either be cast into the stator housing (early points-type engines) or stamped into a metal tag attached to the housing (1980-and-later engines). To the immediate right of the letter "T" is the line that denotes the Top Dead Center (TDC) position of the crankshaft. (If you've been setting valve clearances yourself, you already know about this mark – it's where you position the crank to adjust valve lash.) In the next step, you will be setting the alternator rotor pointer to the "T" mark.

26. Using a 17mm socket or box-end wrench on the alternator-rotor bolt head, turn the engine in the "running" direction (counterclockwise), and carefully align the timing mark on the alternator rotor with the "T" indicator mark on stator housing.

27. Remove the trigger rotor from the camshaft, and smear a few of drops of medium-strength blue Loctite (or equivalent thread-locking compound) around the inside diameter of the camshaft bore, where the rotor engages it. Reinstall the rotor.

28. The outline of the rotor is printed in yellow silkscreen ink on the face of the pickup plate. Align the rotor so that it matches the printed outline, hold it firmly in place, and tighten the internal-expander screw inside the rotor using a 3/16" hex wrench (an adjustable end-wrench is useful for holding the rotor across the flats while tightening the screw). The assembly should now look like this:



29. Check to make sure the alternator rotor mark is still aligned with the "T" mark on the stator housing. If the crankshaft position moved while you were tightening the rotor's expander screw, loosen the rotor and repeat steps #26 and #28 until everything looks right.

30. If you have a pre-1980 machine, you will have to mount a new dual-tower coil to replace the two original single-tower coils. A dual-tower coil can usually be mounted near the original coil mounting plate(s) beneath the lower frame backbone tube, under the fuel tank. A high-performance coil with a primary resistance as low as 3 ohms may be used. "Accel" brand 3-ohm dual-tower coils and "Dyna" brand 5-ohm and 3-ohm dual-tower coils have been extensively tested with this system, and have given excellent results.

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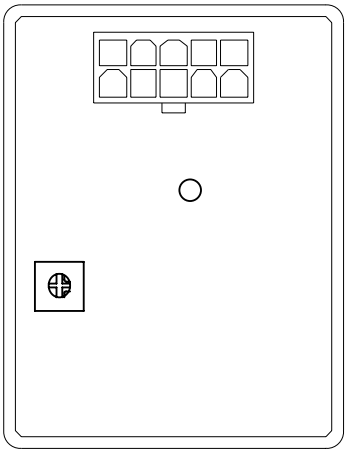
IMPORTANT NOTE: Ignition coils intended for capacitive-discharge ignition (CDI) systems generally have less than 1 ohm primary resistance, and are incompatible with the Model DX-65 system. The wrong type coil will cause immediate, irreversible damage to the Power Module. Many inexpensive multimeters can't measure accurately down to a few ohms, so be especially careful to know what coil resistance you have.

31. Cut and fit the new high-tension leads from the coil towers to the spark plugs. The plug leads must be resistor-core suppression-type or spiral-core suppression-type plug wire. Solid-core wire should not be used with electronic ignition systems.

32. If you have a 1980-or later-bike, you will already have a dual-tower ignition coil, and will not have to replace it. If your coil is in questionable condition, or if you want to use a higher-performance ignition coil (the stock dual-tower coil is decent, but not great), see the recommendations above.

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



34. Determine where you want to mount the module. The wire harness is long enough to have the module situated in or near one of the side covers that flank the air filters, but it can go almost anywhere that it won't be "cooked" by engine heat. The module must also not be mounted to or near the ignition coil, as the magnetic field developed around the coil can interfere with the module's operation. The self-adhesive Velcro supplied in the kit will let you mount the module to a flat surface. The long tie-wraps included in the kit should be used to "back up" the Velcro mounting, to ensure that it doesn't get shaken or vibrated off. Make sure

to leave room for the connector and wires when you select a mounting spot for the module.

35. There is a 10-pin connector at the far end of the pickup plate's wire harness. On the connector's rear surface (where the wires enter), molded-in numbers show 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 three heavy-gauge wires shown in **boldface** type:

♦ Position 1:	Light-gauge red wire – goes to Pickup Plate
♦ Position 2:	Light-gauge black wire – goes to Pickup Plate
♦ Position 3:	Open position – for optional tach-select connection
♦ Position 4:	Open position – for optional tachometer output
♦ **Position 5:**	**Heavy-gauge red wire – goes to switched +12 volts**
♦ Position 6:	Light-gauge green wire – goes to Pickup Plate
♦ Position 7:	Light-gauge yellow wire – goes to Pickup Plate
♦ Position 8:	Light-gauge orange wire – goes to Pickup Plate
♦ **Position 9:**	**Heavy-gauge green wire – goes to chassis ground**
♦ **Position 10:**	**Heavy-gauge yellow wire – goes to ignition coil**

36. **<u>Wire routing</u> – Route the three heavy-gauge power and ground wires away from the light-gauge signal wires (in the tinned copper braid) that go to the pickup plate. It is very important to keep the power, ground, and especially the pickup plate wires well away from the high-voltage ignition wires that go from the coils to the spark plugs.**

37. The heavy-gauge green wire (connector position 9) goes to a good chassis ground. The chassis ground must be free of paint and be clean, bright metal. **The battery box on the XS650 is NOT a good chassis ground** – it's isolated from the chassis by the four vibration-isolation rubber mounts at its top. The ground wire is 12" long as supplied, to ensure that it is grounded close to the module location.

38. The heavy-gauge red wire (connector position 5) goes to a switched source of +12 volts from the battery. You can pick this up from the wire supplying +12 volts to one of the ignition coil's primary terminals. Dual-tower coils are generally not marked for positive (+) and negative (-) primary terminals (since it does not matter).

39. The heavy-gauge yellow wire (connector position 10) goes to one primary terminal of the ignition coil (the other primary terminal of the coil is connected to +12 volts). Again, terminal polarity is generally not marked on a dual-tower coil, and it does not make any difference.

40. Figure 1 shows how the power wiring should look when you're done. 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. If you are unfamiliar with wiring diagrams, wires that have a "dot" at their intersection are electrically connected to one another.

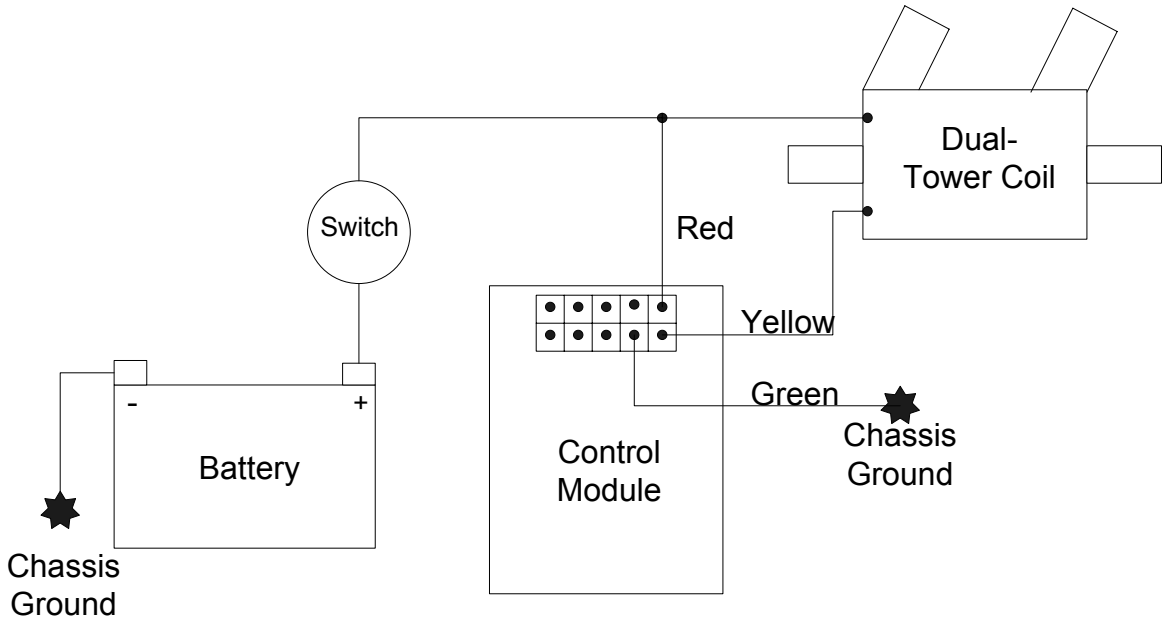


Figure 1

41. Plug the connector into the control module. It's keyed, so it only goes one way, and it will be obvious. Make sure the connector is completely seated– the latch will engage with a "click" when the connector is fully home.

42. Take a deep breath, clear your head, and double-check your wiring.

43. Install the BPR7ES plugs included in the kit into the engine and connect the plug caps.

44. Reconnect the battery.

45. Reinstall the fuel tank, open the petcock (if you have non-vacuum-operated petcocks), and set the choke(s) as required.

46. Turn the ignition switch on.

47. Start the engine.

48. Warm up the engine a little bit so that you can take the choke off, and so that the engine will idle when you need it to.

49. Connect a xenon-flash type timing light (the bright kind) to the left-hand cylinder's plug wire, and connect the timing light to the bike's battery.

50. ***For 1979-and-earlier engines****:* With the timing light pointed at the alternator timing marks, rev the engine up to about 3,500 RPM (about 500 RPM above the speed at which the timing reaches full advance). The timing is correct when the timing light "freezes" the alternator-rotor timing mark so that it aligns with the full-advance mark on the alternator housing. If the full-advance timing is correct, go to step #55. If the timing is not correct, go to step #52.

51. ***For 1980-and-later engines:*** With the engine idling at 1,200 RPM, shine the timing light on the alternator timing marks. The timing is correct when the timing light "freezes" the alternator rotor mark aligned with the "F" timing mark on the stator housing. After checking the idle timing, rev the engine to about 3,500 RPM to verify that the ignition timing advances as the revs increase (note that the 1980-and-later alternator housings do <u>not</u> have full-advance timing marks). If the timing is correct, go to step #56. If the timing is not correct, go to step #52.

52. If the timing is not correct, shut off the engine. Use a marking pen or a scribe, make a mark on the points housing in line with the central zero ("0") line of the timing-adjust marks silkscreened onto the pickup plate at about the 7:00 position.

53. Loosen the two pickup plate retaining screws, and rotate the plate in the housing to adjust the timing. Turning the plate counterclockwise *retards* the timing; turning it clockwise *advances* the timing. Each timing-adjust mark space on the pickup plate represents a timing change of two degrees at the crankshaft. After you've readjusted the timing, lightly tighten the pickup plate retaining screws.

54. Restart the engine and recheck the timing. Repeat the adjustment steps as necessary until the timing is correct. If you run up against the end of the pickup plate retainer screw clearance before the timing is correct, mark the position of the trigger rotor, loosen the internal expander screw, slightly reposition the rotor in

the end of the cam, and retighten the internal expander screw. If you were unable to retard the timing enough, reposition the rotor slightly clockwise inside the end of the cam. If you were unable to fully advance the timing, reposition the rotor slightly counterclockwise.

55. For early (pre-1980) engines that have both full-advance and idle-advance marks on the alternator housing, you can now check and adjust the idle-speed spark timing. The blue potentiometer on the control module controls the idle-speed timing. Turn the screw clockwise to increase the idle delay and retard the idle timing; turn it counterclockwise to advance the idle timing. The idle timing is correct when the timing light "freezes" the timing indicator mark on the alternator rotor somewhere between the two "F" timing marks on the stator housing.

56. When the timing is correctly set, turn off the ignition switch, tighten the two pickup plate screws, and close the petcocks (if you don't have vacuum-operated petcocks). Reinstall the alternator rotor cover, seat, side covers, the points-housing and advancer-housing covers, and any other covers or bodywork you removed.

Appendix, tachometer and kill switch options:

As noted in the wiring table on page 7, there are tachometer output and tach-select options available. If you've already completed the basic ignition system installation, you've dealt with the three heavy-gauge wires that came pre-installed in the 10-pin connector. The remaining two open positions on the connector housing are associated with the tachometer and tach-select options. They are:

- Position 3: Tach-select control
- Position 4: Tachometer output

Position 4, the tachometer drive output, is for connection to an electronic tach's engine-speed input wire. The tachometer output has two selectable pulse rates.

The **"4-cylinder"** output (the default mode) gives two signal pulses per crank revolution, the same as a 4-cylinder automobile engine. This gives you the option of tapping into the automotive aftermarket for tachometers, most of which have 4-6-8-cylinder setup options.

The **"2-cylinder"** tachometer output gives one signal pulse per crankshaft revolution.

The tach-select control on connector position 3 sets the tachometer output rate. If position 3 is left open (no wire), the tach output signal on pin 4 is in the default 4-

cylinder mode. If a wire is installed into connector position 3 and connected to ground, the tachometer output changes to the 2-cylinder mode.

For those who wish to use the electronic tach feature, the DX-65 kit includes two foot-long #18 wires, one white and one black, with crimped-on terminals, which you must install into the connector housing. The terminals "snap" into place in the housing from the wire-entry end. The simplest way to see how the terminals should be oriented is to use the wires already installed in the connector as a guide. Install the white wire in position 4 (tachometer output), and the black wire (if used) for position 3 (tach-select control).

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 POWER MODULE IS OPERATING "FULL-ON," AND CAN OVERHEAT.***

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

For questions and/or assistance, contact:
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