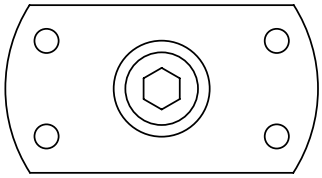
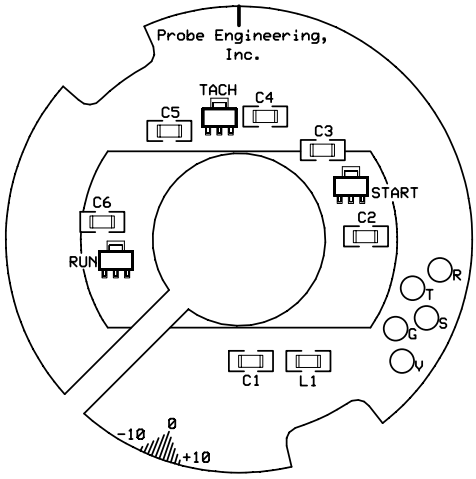
PROBE ENGINEERING, INC.

Installation Instructions

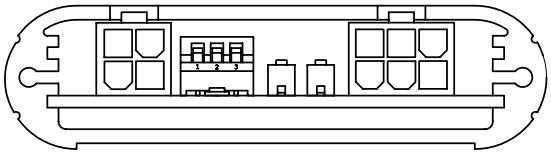
Model DX-65GL Ignition System



Trigger Rotor



Pickup Plate



Control Module

PROBE ENGINEERING, INC.

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Installation Instructions, Model DX-65GL

Version 9.0

The Model DX-65GL 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 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.

The Model DX-65GL is a dual-fire ignition system that works with a dual-tower coil to fire both spark plugs simultaneously, once per crankshaft revolution. The system will work with the 1980-and-later OEM dual-tower coil, but for superior performance, an aftermarket coil between 3 ohms and 5 ohms primary resistance should be used. 1979 and earlier XS650s used a pair of single-tower coils, which must be replaced with one dual-tower coil to be compatible with the DX-65GL ignition.

The DX-65GL module features progressive dwell control, which minimizes average coil current consumption with no reduction of spark energy. Reduced average coil current makes lower demands on the XS650's charging system; as an added benefit, the coil and module run cooler.

The DX-65GL ignition incorporates a user-adjustable synchronous rev limiter, and also offers a digital tachometer output signal.

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What should be in the kit:

The Model DX-65GL kit includes the following components:

- Control Module
- Pickup Plate (with shielded leads and 6-pin connector)
- Power Cable Harness (with 4-pin 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
- Pair of NGK LB05F resistor spark plug caps (**use of resistor caps 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:

- 1/4" NPT pipe tap (tapered pipe tap, available at most hardware stores)
- 1/4" 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 using your core (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 side of the camshaft must be removed to install the

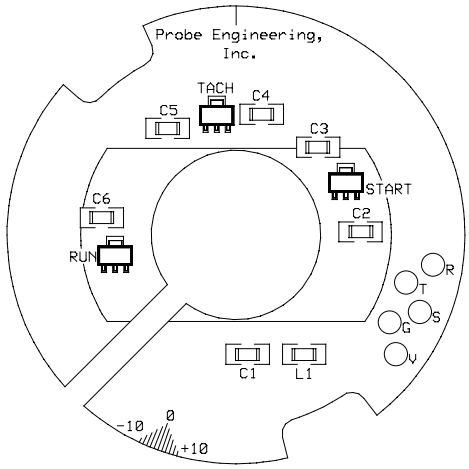
Trigger Rotor. To remove the seal, thread the 1/4" NPT (National Pipe Thread) tap partway into it. You can use a tap handle for this if you have one handy; if not, an adjustable end wrench on the drive flats of the tap will work fine. Once the tap has a decent "bite," the seal will usually twist out of the end of the camshaft without much trouble if you simultaneously pull it toward you while twisting. If the seal doesn't twist out while tapping, there are two ways to deal with it. The first method is to thread a 1/4" pipe plug 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 1/4" 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 1/4" 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).

For 1980-and-later engines, resume here:

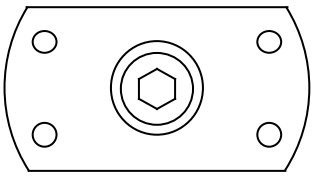
19. Using brake cleaner, electric parts cleaner, acetone, or some other non-residue solvent, clean and degrease the internal bore of the camshaft on the left side.

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 direction), 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.

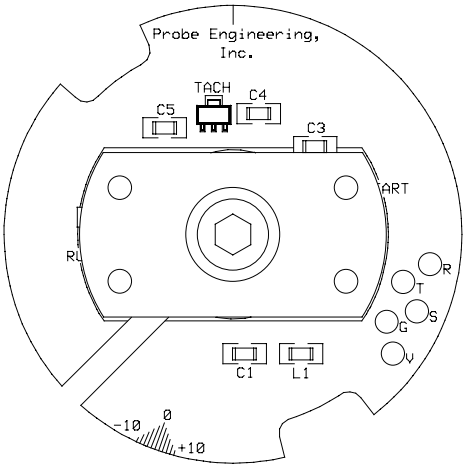
24. Remove the spark plugs, so that you will not be fighting against compression in the next steps (you will still be fighting valve spring pressure, which is trouble enough).

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. 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 3-ohm and 5-ohm dual-tower coils have been extensively tested with this system, and have given excellent results.

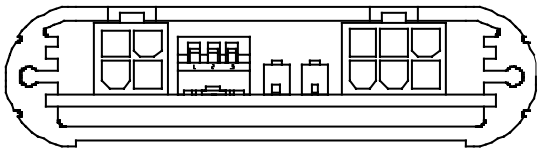
IMPORTANT NOTE: Ignition coils intended for capacitive-discharge ignition (CDI) systems generally have less than 1 ohm primary resistance, and are incompatible with the Model DX-65GL system. Using a CDI-type coil will cause immediate, permanent damage to the Control Module. Many inexpensive multimeters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

31. If you are reusing an existing dual-tower coil, disconnect your old spark plug caps from the HT leads and replace them with the NGK resistor plug caps included in the kit; the new plug caps "screw in" to the wire. If you are installing a new dual-

tower coil, you may use stranded copper-core plug wire with the NGK resistor plug caps if you wish. Suppression-type plug wire (either resistor-type wire or helical-wound type), is also acceptable with a new coil and the NGK plug caps. You must remove the coke-bottle-shaped nut from the end of your spark plug, if so equipped; the new plug caps push down onto the plug's threaded stud, not the nut.

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 adequate, but not great), see the recommendations above. In any case, you must use the NGK plug caps that come with the DX-65GL kit; remove and replace your old caps with the new ones. If your coil has replaceable HT leads (some don't), you may also choose to replace your plug wires at this time; follow the guidelines in step 31 if you are replacing your plug wires.

33. Locate the Control Module in the kit. The business end of the module looks like this:



34. There is a 4-pin connector near the left side of the module and a 6-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).

35. Find a place where you'd like to mount the control module. **NOTE: the module should not be mounted close to the coil; a coil typically has 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 Yamaha's original specifications. If the pushbuttons are accessible when the module is in place, it will make any adjustment easier.

36. 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 very low power, and will get barely warm to the touch during operation. It does not require aggressive airflow, but should not be mounted in a sealed space with no airflow at all.

37. 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. *NOTE: the pickup assembly wires must be kept well away from the coil body 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.*

38. The sensor assembly's wire bundle has a 6-pin plug that matches the module's 6-pin connector housing. Plug them together; they are keyed, so that they only fit one way. The retaining latch will "click" when the connectors are fully mated.

39. There is a 4-pin connector on the Power Cable Harness. On the connector's rear surface (where the wires enter), molded-in numbers show each wire's position, 1 through 4. The wires in each position are as follows. For the basic installation, you only have to deal with the three 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 ignition coil**
♦ Position 4:	Heavy-gauge orange wire – digital tachometer output signal

40. The red wire (connector position 1) goes to a switched source of +12 volts from the battery. Your bike's wire harness will have a switched source of +12V that brings battery voltage to one of the ignition coil's primary terminals; you can connect the red module wire to that terminal, as well.

41. The green wire (connector position 2) goes to a good chassis ground. A "good ground" in this case means two things; it must have low-resistance path to the metal of the main chassis, and it must have a low-resistance path to the battery's negative (-) terminal. If these two things are not electrically well-connected, you will have problems. **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. If you want to make it shorter, you may, but it should not be extended.

42. The yellow wire (connector position 3) goes to the coil's primary terminal that is OPPOSITE the primary terminal connected to +12 volts.

43. Figure 1 is a diagram of 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.

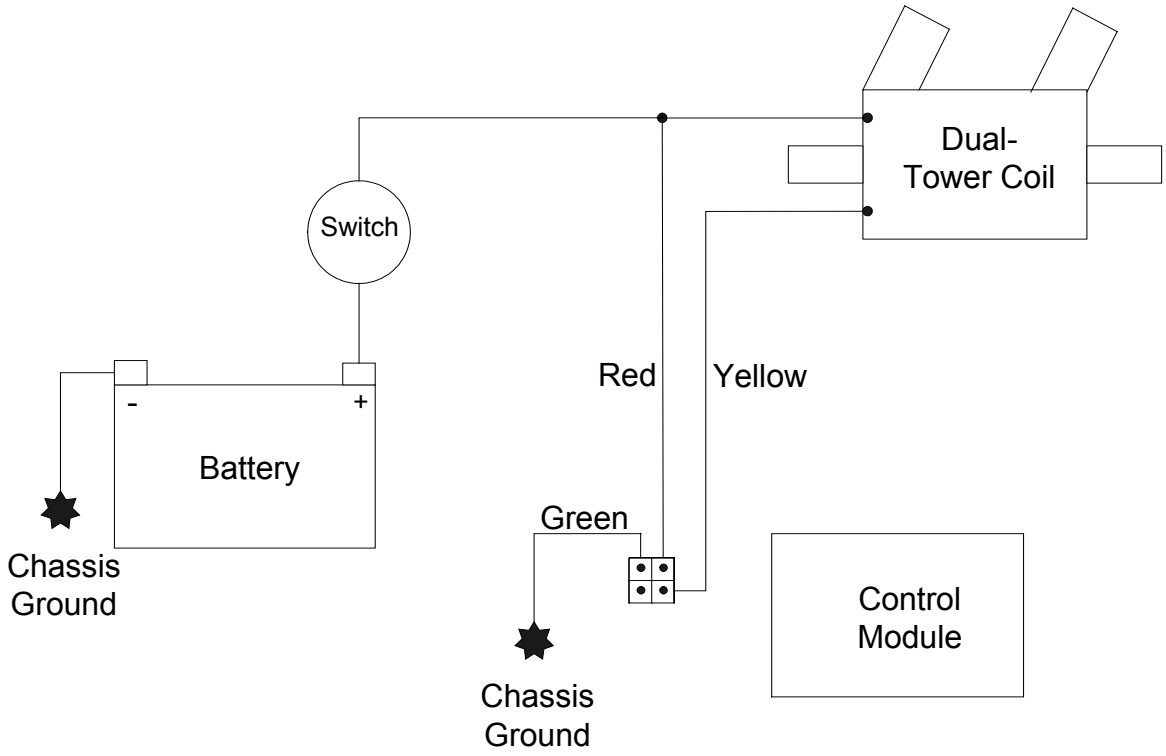


Figure 1

44. Plug the 4-pin connector into the control module's matching connector. 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.

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

46. Reconnect the battery.

47. Reinstall the fuel tank, open the petcock (if you have non-vacuum-operated petcocks), and set the enricheners ("chokes") as required for a cold start.

48. Turn the ignition switch on.

49. Start the engine.

50. Warm up the engine sufficiently that it will idle with the enricheners off.

51. Connect a xenon-flash type timing light to the left-hand cylinder's plug wire, and connect the timing light to the bike's battery (unless your timing light is self-powered; some are).

52. ***For 1979-and-earlier engines****:* With the timing light pointed at the alternator timing marks, rev the engine up to about 3,500 RPM (500 RPM above the speed at which the timing reaches full advance). The timing is correct when the strobe 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 #57. If the timing is not correct, go to step #54.

53. ***For 1980-and-later engines:*** With the engine idling between 1,000 RPM and 1,100 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 #58. If the timing is not correct, go to step #54.

54. 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.

55. 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.

56. 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.

57. 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 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. If you wish to adjust the idle-speed timing, 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, which will have been flashing on and off at one-half crank speed, will go dark and stay dark. When the LED stops flashing, 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 set to your satisfaction, flip all three toggles back to their "down" position; you will see that the red static-timing LED begins flashing again. This signifies that the adjuster buttons are back in

"safe" mode, which prevents the timing from being altered any further. The module "remembers" the last idle-speed timing setting, even after the power is turned off; the adjustment value is stored in non-volatile memory.

58. 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 cover, seat, side covers, the points-housing and advancer-housing covers, and any other covers or bodywork you removed.

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**
7,500	**Down**	**Down**	**Down**
7,750	**Down**	**Down**	**Up**
8,000	**Down**	**Up**	**Down**
8,250	**Down**	**Up**	**Up**
8,500	**Up**	**Down**	**Down**
8,750	**Up**	**Down**	**Up**
9,000	**Up**	**Up**	**Down**
None (limiter off)	**Up**	**Up**	**Up**

The as-delivered DIP switch setting is with all three toggles in the "down" position, with the rev limit set to 7,500 RPM (factory redline). 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; the resulting "stutter" sound and feel will alert the rider that the rev limit has been reached. 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; electronic tachometer option

The open position of the power cable harness connector, number 4, carries a digital tachometer output signal providing one signal pulse per crankshaft revolution and swinging from 12V to zero volts as a 50% duty-cycle square wave.

The DX-65GL kit includes a 12" long orange wire with the correct crimped-on terminal that can be inserted into the number 4 connector housing position from the back (where the molded-in numbers are). The terminal "snaps" into place and is then permanently retained. Use one of the wires already installed in the connector housing as a guide to how the terminal must be oriented for insertion.

A typical aftermarket electronic tachometer will have three basic connections (color codes vary by manufacturer, so check your tachometer's data sheet for guidance):

- +12V (powers the tachometer)
- Ground (returns the tachometer power to the battery)
- Signal Input (this connects to the module's orange wire)

Other details and notes:

- To prevent overheating the ignition coil and/or module, the DX-65GL system has an auto-shutoff feature that interrupts the coil current if the engine is not started within 32 seconds of the key switch being turned on (or if the engine is stalled). Once "timed out," the module will automatically resume normal operation when crank rotation is detected; you don not have to "re-boot" the ignition power to start the bike.

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

For questions and/or assistance, contact:
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