



Johnson/Evinrude 60° 4 Cylinder Optical Ignition (OIS 2000) Carbureted 1995-2006 Model Years

Due to the differences in this ignition system, troubleshooting can be somewhat difficult if you are not familiar with the design. The other Johnson/Evinrude Quick-Start ignitions use stator charge coils and a power coil to provide high voltage and power for the Quick-Start and rev limiter circuits. They require a sensor for triggering and use separate magnets for the high voltage and triggering the sensor. The OIS 2000 Optical system uses the stator charge coil to provide high voltage for the firing of the ignition coils *and a power coil to provide power for the electronics, both inside the power pack and inside the sensor.* The other Quick-Start models will run the engine without the power coil being connected (of course this will burn out the control circuits inside the power pack). The OIS 2000 ignition has to have the power coil supplying power in order to operate the Quick-Start, S.L.O.W., rev limiter, and spark the coils beyond cranking speed. The optical sensor located on the top is fed power from the power pack and sends crankshaft position, cylinder location and direction of rotation back to the power pack. The pack is smart enough to know not to spark if the engine is not turning in the right direction. S.L.O.W. functions reduce the engine RPM to approximately 2500 when the engine over-heats or the no oil warning is activated. Quick-Start (a 10° timing advance) activates as long as the engine RPM is below 1100, the engine temperature is below 105° F and the Yellow/Red wire from the starter solenoid is not feeding 12V DC to the power pack all of the time. Quick-Start will also activate for 5-10 seconds each time the engine is started regardless of engine temperature. CDI Electronics (Blue case with Red sleeve) power packs have a built-in feature to compensate for a shorted cold sensor, allowing the engine to come out of Quick-Start after 5 minutes of running time regardless of the condition of the cold sensor. The CDI power pack will not spark if the wrong encoder wheel (6 cylinder) is installed by mistake.

At cranking speed the voltage from the stator may not be enough to operate the circuits inside the power pack, therefore there is battery voltage supplied from the starter solenoid via the Yellow/Red striped wire. The extra voltage is needed in order for the optical sensor to operate correctly as low voltage from the battery and/or stator can cause intermittent spark or no spark at all. There are a couple of critical items you should be aware of on these engines. First, the spark plug wires have to be the Gray *inductive* resistor wires – these are NOT automotive wires. Secondly, the spark plugs have to be the factory recommended QL78YC. Use of other spark plugs or wires can cause problems inside the power pack from RFI and MFI noise. CDI Electronics has the spark plug wires available as a set, P/N: 931-4921.

A breakthrough at CDI Electronics has allowed the use of microprocessor digital control circuits to handle the timing, Quick-Start, S.L.O.W. and rev limiter functions inside the power pack. This allows the timing to be set using a timing light, remote starter, spark gap tester, piston stop tool and a jumper wire. With these new digital power packs, you disconnect the port temperature switch/sensor leads and use a jumper wire to short the tan temperature sensor wire to engine ground. Once you have verified the timing pointer using a piston stop tool (Or a dial indicator), connect all spark plug wires to a spark gap tester, connect a remote starter to the engine and a timing light to # 1 spark plug wire. When you crank the engine over with the remote starter and check the timing, you should see the timing is set to approximately 4°-6° ATDC (After Top Dead Center). By advancing the throttle all the way and rechecking the timing for WOT (Wide Open Throttle), you should see approximately 19° - 21° BTDC (Before Top Dead Center) Without this timing feature built into the power pack, you would not be able to easily set the timing for idle or WOT without a optical diagnostic tool. Additional advantages offered by the digital circuitry include the ability to compensate for a bad temperature switch, a smoother rev limit, customized rev limiters and special timing curves.

Additional items to be aware of:

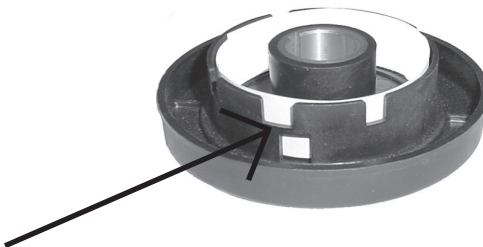
1. Originally the spark plugs were the QL82YC, but that recommendation was changed to the QL78YC for improved performance.
2. Some engines do not have the RFI/MFI noise shield between the ignition coils and the power pack. If it is missing, replace it.

NO SPARK ON ANY CYLINDER:

1. Disconnect the Black/Yellow stop wire AT THE POWER PACK and retest. If the engine's ignition has spark, the stop circuit has a fault. Check the key switch, harness and shift switch.
2. Disconnect the Yellow wires from the stator to the rectifier and retest. If the engine sparks, replace the rectifier.
3. Check the cranking RPM. A cranking speed of less than 250-RPM will not allow the system to spark properly. This can be caused by a weak battery, dragging starter, bad battery cables or a mechanical problem inside the engine.
4. Verify the engine is turning in a clockwise direction. If not, see TRIES TO RUN BACKWARDS below.
5. Check the power pack and ignition coil ground wires for corrosion and tightness.
6. Connect a spark gap tester to all cylinders.
7. Disconnect the boat side harness and connect a remote starter unit. Check for spark. If the engine has spark, check the boat side harness's Black/Yellow wire for shorts to ground.
8. Disconnect the Port 4 pin connector (with the Yellow/Red, Black/Yellow, Tan and White/Black wires) from the power pack and see if spark returns. If it does spark, check resistance to see if the Black/Yellow wire is shorted to engine ground.
9. If it loses spark after the key switch is disengaged, check the DVA voltage on the stator's power coil (Orange to Orange/Black) as given below in Step #13. Either the power coil or power pack is the fault.
10. Check the battery voltage on the Yellow/Red wire while cranking the engine. If below 11 VDC, charge the battery and check all battery cables. A continued low battery reading could be from a dragging starter. If still below 11 VDC, disconnect the power pack's Yellow/Red wire from the starter solenoid and apply a verified 12 + VDC to the Yellow/Red wire. If the engine now runs good, check the DVA voltage on the stator's power coil (Orange to Orange/Black) as given below in Step #13. Either the power coil or power pack is the fault.



- Remove the sensor wheel and check for damage, especially where the top slots are located. Sometimes the wheels will break out where the windows overlap.



The thin area between the crank position and the cylinder position is the most common breakout location.

- Check the sensor eyes for dirt, grease, etc. If you have to clean it, use denatured alcohol and a Q-tip. Do not use any other cleaning agent because damage to the optical lens will occur.

- Check the stator resistance and DVA voltage as given below:

WIRE	READ TO	RESISTANCE	DVA (Connected)	DVA (Disconnected)
Brown	Brown/Yellow (or Brown/White)	900-1200	150-400 V	150-400 V (*)
Orange	Orange/Black	50-60	11-22 V	45-120 V (*)

(*) This reading can be used to determine if a stator or pack has a problem. For instance, if you have no spark on any cylinder and the stator's DVA reading is out of spec – disconnect the stator wires and recheck the DVA output. If the reading is still out of spec – the stator is bad. If the reading is now within spec – the pack is bad.

(NOTE) Low readings on all checks indicate a possible problem with the flywheel magnets that require checking.

(SERVICE NOTE) It is recommended that liquid neoprene be applied to the areas where piercing probes were used.

- Check the DVA output from the power pack to the primary coil wires as follows:

WIRE	READ TO	DVA (Connected)
Orange/Blue	Engine Ground	150 V +
Orange/Green	Engine Ground	150 V +

(NOTE) If the DVA values are below these specifications, the power pack or sensor is likely bad.

- Check the sensor DC voltage as follows:

WIRE	READ TO	DC voltage (Connected)
Orange/Red	Engine Ground	10.5-12 VDC
Black/Orange	Engine Ground	8-10 VDC

(WARNING!!) The Black/Orange wire should NEVER be shorted to engine ground as this will damage the sensor.

- Check the center hub triggering magnet in the flywheel. A loose magnet can cause this problem.

- Check the triggering and charge coil flywheel magnets for cracked, broken and loose magnets.

ONLY HAS SPARK AS LONG AS THE KEY SWITCH IS ENGAGED OR WILL NOT REV ABOVE IDLE SPEED:

Check the DVA voltage on the stator's power coil (Orange to Orange/Black) as given above in Step #13:

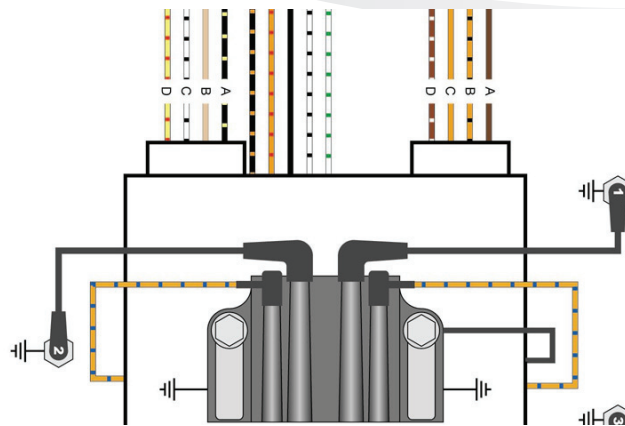
(NOTE) The readings should rapidly increase as the engine RPM increases and stabilize below 22 volts DVA (voltage exceeding 22 V DVA indicates a bad power pack). A sharp drop in voltage right before the miss becomes apparent usually indicates a bad stator winding. A sharp drop in voltage when you disengage the key switch indicates a bad power coil on the stator.

TRIES TO RUN BACKWARDS:

- Check the encoder wheel. It must have 5 notches.
- Check the timing. Before Quick-Start, it must be set to 4° BTDC. After Quick-Start, it must be set to 6° ATDC.
- Try another sensor.
- Replace the power pack.

NO SPARK OR INTERMITTENT SPARK ON ONE BANK:

- Disconnect the Black/Yellow stop wire AT THE POWER PACK and retest. If the engine's ignition has spark, the stop circuit has a fault. Check the key switch, harness and shift switch.
- Disconnect the Yellow wires from the stator to the rectifier and retest. If the engine sparks, replace the rectifier.
- Check the cranking RPM. A cranking speed of less than 250-RPM will not allow the system to spark properly. This can be caused by a weak battery, dragging starter, bad battery cables or a mechanical problem inside the engine.
- Check the stator resistance and DVA output (see Step #13 on NO SPARK ON ANY CYLINDER above). If the power pack has no spark on one bank and the readings are good, replace the power pack.
- Disconnect the 4-pin connector on the port side of the power pack and see if the spark returns. If it does spark, check resistance to see if the Black/Yellow wire is shorted to engine ground. Check to see if the Shift Interrupter switch is located in the circuit where there is no spark.



Port 4 Pin Connector	Starboard 4 Pin Connector
a) Black/Yellow	a) Brown
b) Tan	b) Orange/Black
c) White/Black	c) Orange
d) Yellow/Red	d) Brown/Yellow

POWER PACK OR TIMER BASE REPEATEDLY BLOWS ON SAME CYLINDER:

1. Check the sensor wires for shorts to engine ground as a shorted sensor wire can destroy a SCR inside the power pack.
2. In contrast, a shorted SCR inside the power pack can destroy a sensor coil. Check the sensor DVA output (see NO SPARK ON ANY CYLINDER above).
3. Replace the ignition coil on the cylinder dropping spark.

ENGINE WILL NOT SHUT OFF:

Disconnect the stop wire at the power pack. Connect a jumper wire to the stop wire from the pack and short it to engine ground. If this stops the pack from sparking, the stop circuit has a fault. Check the key switch, harness and shift switch. If this does not stop the pack from sparking, replace the power pack. Repeat test as necessary for additional packs.

ONLY SPARKS #1 CYLINDER:

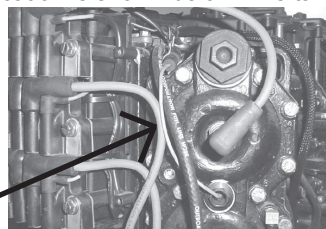
Check the optical sensor to encoder wheel mesh. You may need to shim the optical sensor upwards 25/1000" at a time to make it engage the encoder wheel.

MISS AT ANY RPM:

1. Disconnect the Yellow wires from the stator to the rectifier and retest. If the miss clears, replace the rectifier.
2. In the water or on a Dynameters, check the DVA output on the Orange wires from the power pack while connected to the ignition coils. You should have a reading of at least 150V DVA or more, increasing with engine RPM until it reaches 300-400V DVA maximum. A sharp drop in DVA right before the miss becomes apparent on all cylinders will normally be caused by a bad stator. A sharp drop in DVA on less than all cylinders will normally be the power pack.
3. If the engine runs fine until you get above 4900 RPM and then starts missing, check the Orange to Orange/Black power coil wires with an oscilloscope (if available) or replace the pack. A breakdown inside the pack could cause RFI noise to activate the rev limiter for no apparent reason.
4. Connect an inductive tachometer to the spark plug wires one at a time and compare the readings. If most of the cylinders show the same reading and one or two show different readings, check the primary wires with the inductive pickup to see if the readings are the same from the power pack. A difference in readings between the primary and secondary coil wires usually indicates a bad coil or bad ignition wires. No difference indicates a bad power pack.
5. Perform a high-speed shutdown and read the spark plugs. Check for water. A crack in the block can cause a miss at high speed when the water pressure gets high, but a normal shutdown will mask the problem.
6. Check the triggering and charge coil flywheel magnets for cracked, broken and loose magnets.
7. Rotate the stator one bolt hole in either direction and retest.

ENGINE WILL NOT REV ABOVE 2500 RPM AND SHAKES HARD (SLOW ACTIVATED):

1. Verify the engine is not actually over-heating by using a digital pyrometer.
2. Check the routing of the tan temperature wires, an example of a bad location is shown below. The tan wires have to be located as far away as possible from the spark plug wires.



Unacceptable routing for the temp wire



3. Verify the engine is not overheating and disconnect the Tan temperature sensor wire. If the engine performs normally, check both temperature sensors and replace the defective one.
4. If there is not any indication of a problem at this point, replace the power pack.

ENGINE STAYS IN QUICK-START:

1. Check the Yellow/Red wire for DC volts while the engine is running. You should only see voltage on this wire while the starter solenoid is engaged. A DC voltage of 5-7 volts will not engage the starter solenoid, but will engage Quick-Start.
2. Short the White/Black temperature switch wire FROM the power pack to engine ground. Start the engine, if the Quick-Start drops out after approximately 5 seconds, replace the White/Black temperature switch.
3. Disconnect the Black/White wire from the power pack. If the Quick-Start feature is not now working, replace the power pack.

ENGINE DIES WHEN QUICK-START DROPS OUT:

Check ignition timing at idle with the White/Black temperature wire disconnected. Remember to allow for the drop in ignition timing when Quick-Start disengages. Verify ignition timing after engine has warmed up, according to the service manual.

