SPARK PLUG WIRES

Choice of spark plug wires is an important consideration when using an electronic ignition system. Electronic ignitions utilize IC's (integrated circuits) in there design for counting & timing purposes. These IC's, contrary to most thinking, are not effected by RFI (Radio Frequency Interference) noise generated by the high voltage breakdown of coils, producing the ignition spark. They are effected by the conducted EMI (Electro Magnetic Interference) produced by the switching on & off of the primary 12 volt side of the coil primary. When the primary of the coil is switched from the on, saturated state to the off or discharged state, a 400 to 500 volt positive & negative voltage spike is produced. This voltage spike is not what damages the IC's, but the current associated with this is what destroys the component. The most effective way to limit the current produced is to use carbon core resistor plug wires. Solid or spiral wound wires will not suppress this conducted EMI noise.

SPARK PLUGS

Use resistor spark plugs with electronic ignitions to limit the EMI noise discussed in the spark plug wire section above.

Spark plug gap should be limited to as small as possible, while still maintaining performance.

A wide spark plug gap can cause the following problems: Hard cold starting, misfires during rich or lean fuel conditions, and reduction of upper rpm range.

Maximum Initial settings for spark plug gaps are:

Single plug stock compression	0.032 - factory
Single plug raised compression	0.028-0.032"
Dual plug,stock compression	0.028-0.030"
Dual plug raised compression	0.022-0.028"

In Dual plug applications added side plug should be gapped at 0.010" less than stock side.

Many things effect spark plug gap settings:

Compression Ratio: The higher the engine compression, the more voltage required to fire the plug, and the narrower the plug gap should be.

RPM: The higher the rpm's the less time the coil has to charge to break over voltage or complete saturation. A narrower spark plug gap will help high rpm stability.

Coil choice, Fuel flow, Intake velocities, & Fuel temperature: These are but a few of the factors that can effect spark plug gap.

Multi-Spark: To maintain a good secondary spark within a wider rpm range it is wise to run a narrower spark plug gap. It is better to precisely place two stable, consistant sparks than to fire one wider spark that may cause misfires in rich or lean conditions, or from any of the above reasons.

OWNERS MANUAL

Power Arc Ignitions Co., Inc.
2518 N.E. 102 Ave.
Ankeny, IA 50021
(515) 964-7608

THE FOLLOWING CUSTOMER ACTIONS AUTOMATICALLY VOIDS THE WARRANTY
1) Use of any other spark plug wires other than resistor type wires with at least 3,000 ohms of resistance. 2) Use of non-resistor spark plugs. 3) Drilling or cutting of any kind into the module or trigger plate. 4) Incorrect wiring of the module. 5) Use of module on systems with defective charging systems. 6) Use of defective coils. 7) Directly shorting the coil output wires to +12 VDC. 8) Physical damage to the adjusters (potentiometers). 9) Any other items covered in the warranty.

LIMITED WARRANTY

P. A.Ignition Co., Inc. warrants to the original retail purchaser of a Power Arc DS ignition that it will, free of charge, repair or replace at its own option, the product if returned to P. A.Ignition Co., Inc. within 6 months after purchase and if found by P. A.Ignition Co., Inc. to be defective in material or workmanship. This warranty is not transferable by the purchaser and shall be voided: if alterations not authorized by P. A.Ignition Co., Inc. are made in the equipment or if the serial number or date of manufacture has been altered, defaced or removed. Nor does this warranty apply: if the equipment has been subjected to accident, misuse, improper hookup, damaged by flood, fire, or act of God, or has been used on circuits or voltages other than those indicated in its instruction manual. If the equipment is found to be defective in materials or workmanship the equipment will be returned and P. A.Ignition Co., Inc. will pay the return shipping (this does not include next day shipping, second day shipping, shipments outside of the continental U. S. A. or shipments outside of the U.S.A.). All warranty work outside of the U.S.A. must include prepayment of return shipping. Customs, duties or tariffs are not covered by this warranty. If the equipment is found to be defective but is due to customer misuse (as described in warranty) P. A.Ignition Co., Inc. will notify the customer and if the customer wants the defective equipment returned P. A.Ignition Co., Inc. will return the equipment C.O.D. freight. If the equipment is found to be in operational order when returned to the factory P. A.Ignition Co., Inc. will return the module with a $15.00 service charge plus freight and C.O.D. Charges.

Any module returned under the warranty must include the trigger plate, note of explanation of failure and be accompanied by a dated bill of sale.

P. A.Ignition Co., Inc. warranty obligations are limited to those set forth herein and no other obligations, expressed or implied, are assumed by P. A. Ignitions Co., Inc.

Some states do not allow the exclusions or limitations of incidental or consequential damages, or allow limitations on how long an implied warranty lasts, so the above limitations or exclusions may no apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

POWER ARC IGNITIONS
A GIFT FROM ABOVE

POWER ARC DS OWNER'S MANUAL

ADJUSTABLE SINGLE FIRE ELECTRONIC IGNITION SYSTEM FOR HARLEY-DAVIDSON MOTORCYCLES

- **SINGLE OR DOUBLE FIRE OPERATION**
- **ADJUSTABLE ADVANCE CURVE**
- **EXTREME SPARK STABILITY**
- **MULTI-SPARK CAPABILITY**
- **STREET LEGAL (CARB #D-351)**
- **COIL SATURATION CONTROL**
- **RETARD CONTROL WIRE**
- **ADJUSTABLE REV LIMITER**
- **LED STATIC TIMING INDICATOR**
- **CORRECTED TACHOMETER OUTPUT**

POWER ARC IGNITIONS CO., INC.
2518 N. E. 102 AVE.
ANKENY, IA 50021
(515) 964-7608

http://www.powerarc.com

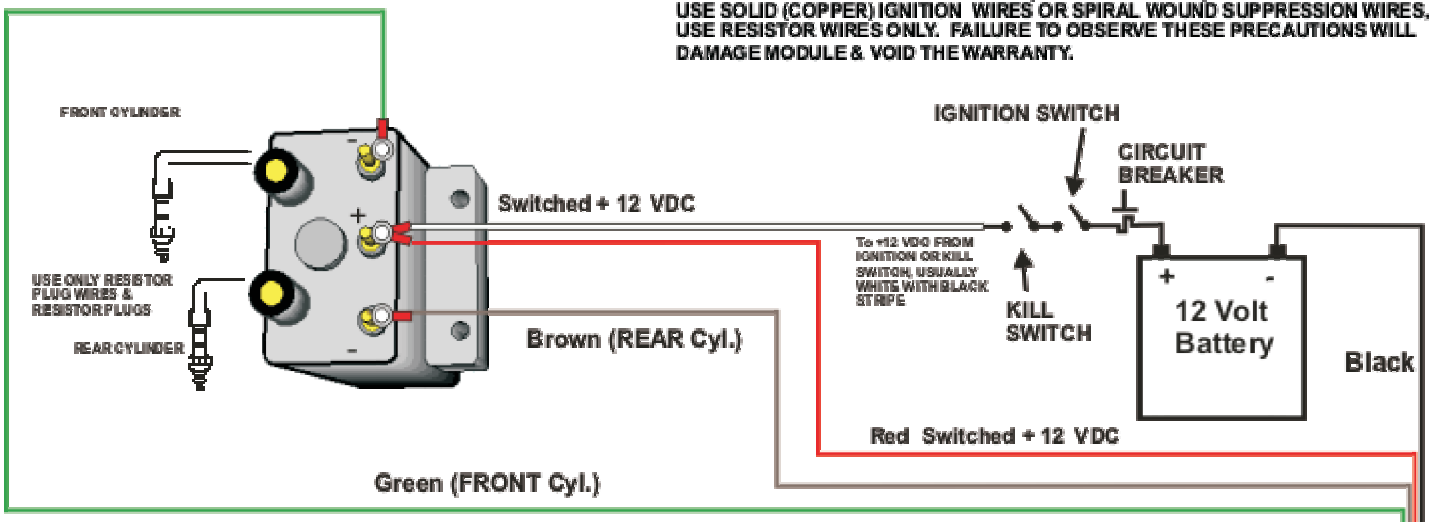
PATENT #4,951,629 OTHER PATENTS PENDING

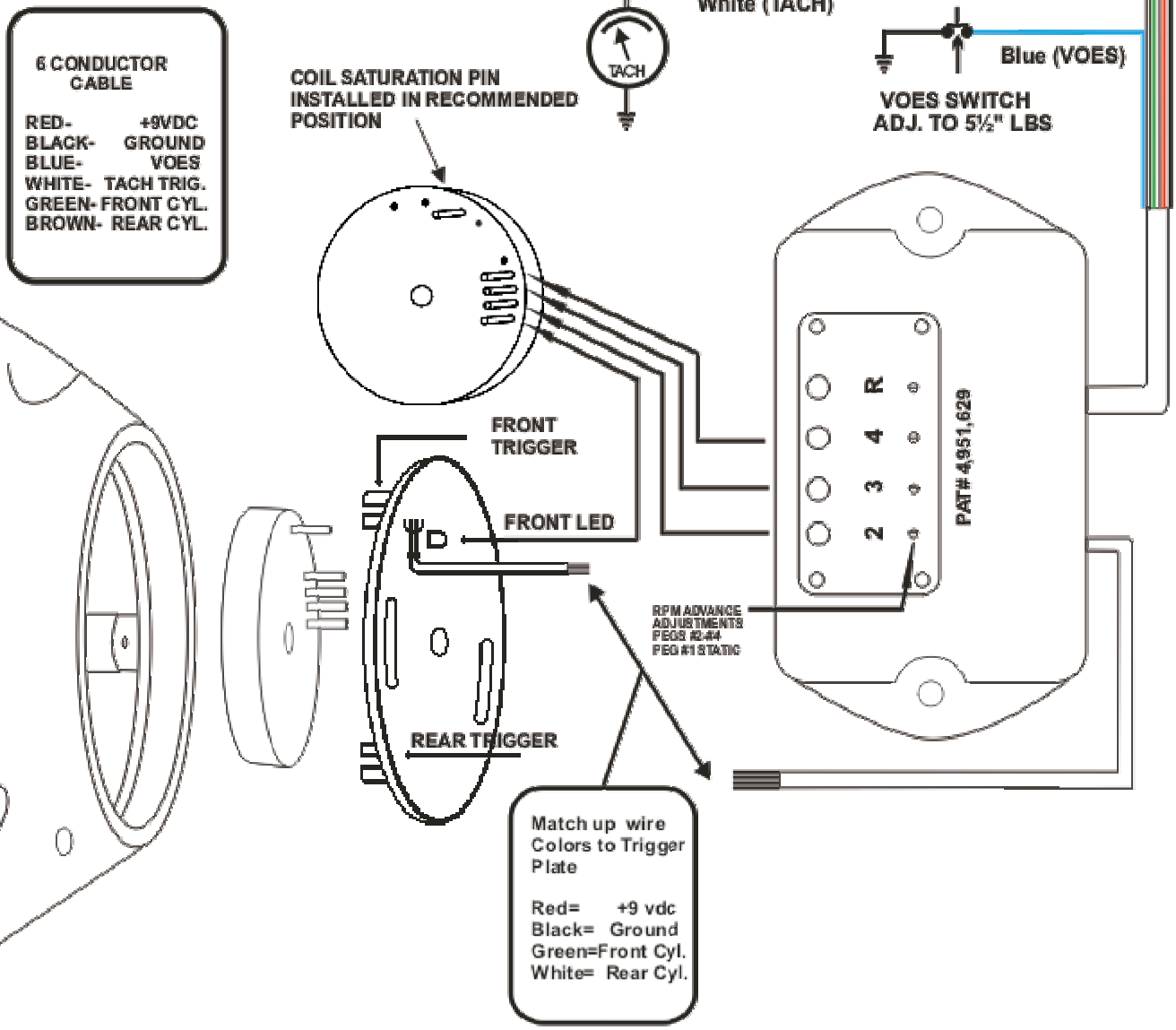
IGNITION WIRING DIAGRAM

TO USE A DUAL FIRE COIL
SEE COIL HOOKUP SECTION

WARNING

DO NOT TOUCH COIL OUTPUT WIRES (GREEN & BROWN) TO +12 VDC. DO NOT USE SOLID (COPPER) IGNITION WIRES OR SPIRAL WOUND SUPPRESSION WIRES, USE RESISTOR WIRES ONLY. FAILURE TO OBSERVE THESE PRECAUTIONS WILL DAMAGE MODULE & VOID THE WARRANTY.





INSTALLATION INSTRUCTIONS

WARNING: DO NOT TOUCH COIL OUTPUT WIRES (GREEN & BROWN) TO +12 VDC. DO NOT USE SOLID CORE SPARK PLUG IGNITION WIRES OR SPIRAL WOUND SUPPRESSION SPARK PLUG WIRES, USE RESISTOR WIRES ONLY. FAILURE TO OBSERVE THESE PRECAUTIONS WILL DAMAGE MODULE & VOID THE WARRANTY.

Locate a desirable position for location of the ignition module. Use screws to hold the module in place. Make sure the ignition key is turned off & remove ground at battery. Connect ignition system wires as indicated in wiring diagram. The HD stock wiring system uses a white wire for +12 VDC coming from the kill switch, this wire hooks to the +12 VDC of the coils and the #18 red wire of the module. Do not allow wiring to come into direct contact with high heat areas or to touch any moving parts of the motorcycle. When routing the wiring attempt to keep the wires as far as possible from the spark plug wires. When tightening down the factory wire retainer do not allow it to cut into the trigger plate wires, the retainer may have to be bent. Hook up the ground last after all other wiring is complete. Attaching the ground directly to the battery post is advisable. Wrap wiring with electrical tape and place heat shrink tubing around connections. If you're planning to use the mechanical simulator leave enough wire (4" to 6") to allow for placement of the trigger plate onto the simulator.

If you do not have a VOES switch or do not wish to use it, cut and strip the blue and black wires and crimp them into the supplied blue ring connector and connect to battery negative. **MODULE WILL NOT FULLY ADVANCE IF THIS IS NOT DONE.** The blue wire may be hooked to the stock VOES vacuum switch in heavy load situations, such as heavy dressers, or trailering. In most applications ground the blue wire. Do not hook tachometer output of module (white wire) to the coil, hook white wire to trigger input of tachometer. If you do not have a tachometer insulate the end of the wire and do not use. Install the trigger rotor using the supplied screw, lock washer and flat washer. Make sure to align the trigger rotor with the alignment slot on the end of the camshaft.

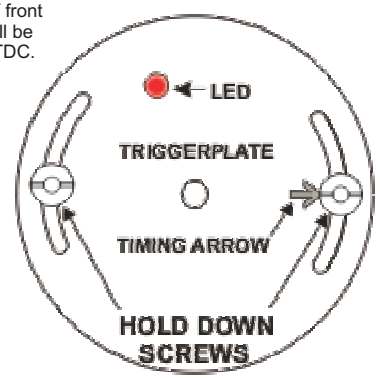
Pull the trigger plate control wire through the factory ignition systems access hole, solder each connection and place heat shrink tubing around each solder joint. Make sure to match up wire colors. Place heat shrink tubing around or wrap electrical tape around all four connections.

TOP DEAD CENTER TIMING METHOD:

Turn the engine over to the TDC mark of the compression stroke on the fly wheel. With the power on (+12 VDC), rotate the trigger plate all the way clockwise. Next, rotate the trigger plate (CCW) counterclockwise until the red LED static timing light on the #1 (front cylinder) trigger just begins to light. Lock down the trigger plate hold down screws. Recheck engine TDC mark to make sure no movement has occurred. Peg #1 will be set at approximately 8° BTDC. Additional adjustments may be made to meet your engines specific requirements.

QUICK TIME METHOD:

Place timing arrow as shown in drawing so that it points to dead center of the front hold down screw. The timing will be set at approximately 8° BTDC. If pointed approximately 1/16" below (clockwise) of dead center of front hold down screw. Timing will be set at approximately. 12° BTDC. In the case of a sportster everything is rotated 90° clockwise with LED facing forward and hold down screws in the vertical position.



MODULE IS PRE-SET FOR HIGH PERFORMANCE (MULTI-SPARK) OPERATION

IMPORTANT: The ignition has the ability to consume more fuel when set in the multi-spark mode. It **may be** necessary to enlarge the fuel line size to the carburetor when used for off road racing.

IT IS NOT IMPORTANT WHERE ADJUSTERS ARE DO THE FOLLOWING

1. With the ignition switch turned off adjust the #2 peg Rpm adj. 15 turns counter clockwise. The #2 LED (light) will never activate when module is set in multi-spark mode.

2. With the ignition on, turn the #3 peg Rpm adj. Clockwise until the LED light turns on. Then turn CCW until the LED just goes out & add 1/4 turn more CCW past that point. The #3 peg LED (light) should be adjusted so it is off when initially turned on & while the starter is engaged. As soon as the engine starts the LED should light indicating advance.

3. Start the engine and increase idle to 2100 RPM's or use a simulator and set peg #4 LED to light at the desired Rpm.

4. Using the simulator set the rev. limit adj. to the desired Rpm..

Multi-Spark

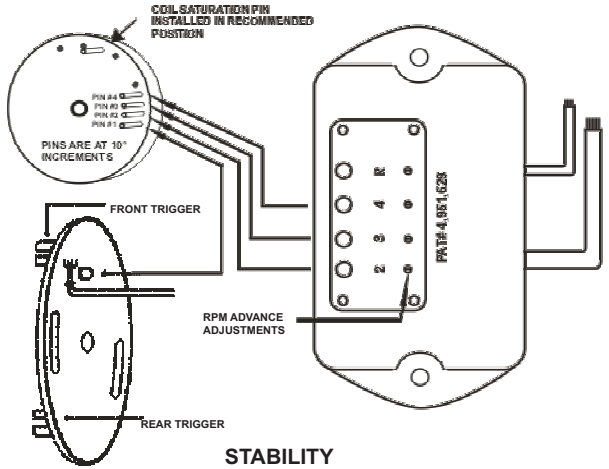
During the intake cycle fuel is delivered via a carburetor or injection system and intake manifold into a combustion cylinder. Both of these delivery systems supply fuel to the cylinder in a droplet form, especially at lower rpm ranges. As the fuel is compressed turbulence in a circular fashion is created due to existing head designs. As the primary spark is discharged the concussion of the explosion combined with superheating of the combustion chamber turns the droplets of fuel into a hot vaporous gas. The flame front due to the rolling turbulence created by the heads moves away from the point of ignition to the face of the piston and to the outer cylinder walls. As the piston nears the top of the compression stroke the unburned vaporous gas is circulated over the spark plug, and a fuel roll stall occurs. At this point a second spark is discharged obtaining a secondary burn of the fuel that in a single spark ignition system would be trapped in the upper portions of the head and during the expansion portion of the power stroke would be unburned and then be cycled out during the exhaust cycle as emissions.

With the extreme stability of an optically triggered ignition system in a Multi-Spark mode the ability to add more fuel is possible to achieve higher horsepower outputs but there are considerations to look at when doing this

1) The extreme stability of a optically triggered ignition system has the ability to allow the engine to accelerate as much as 30% quicker requiring greater fuel flow to the carburetor. This coupled with enlarged jetting of the carburetor or increased fuel to the injectors means you must maintain a sufficient supply line from the fuel tank to the delivery system by use of an enlarged petcock and supply line or a fuel pump. An example would be that at higher rpm's you may use all the gas in the float bowl of your carburetor and create a lean run situation damaging the engine if fuel supply is not maintained.

2) If you have a sufficient fuel flow in a single spark mode you have enough to operate in the Multi-Spark mode without engine damage because you are burning residual fuel, even though your plugs may show a lean burn. This will normally show an increase in fuel economy, horse power and a reduction of emissions output. You could increase the fuel for more horsepower but you should be careful not to over fuel, because if the fuel is not burned by the secondary spark it is exhausted as burning fuel through you exhaust system increasing heat and reducing horsepower output because of an improper air/fuel mixture. This also results in increased emissions output which is unnecessary.

BASIC OPERATION



STABILITY

Most electronic ignitions used to date sense crank angle by using a Hall Effect pickup, which is a magnetic type sensor. This type of sensor is inheritantly unstable & is effected by metal mass, motion & heat. The Hall Effect sensor is unstable causing engine inefficiencies & wear, due to internal vibration caused by unstable firing of the spark plug. An example of this instability would be the movement seen of the TDC timing mark on the flywheel when using a timing light. The use of a magnetic type sensor can be off a much as ±7° giving an overall deviation of 14°. With an optical sensor you are breaking a light beam and light beams do not deviate! This extreme stability allows the engine to accelerate at a much greater speed, reduces engine wear, allows for smoother operation & transfer of power.

PROGRAMMABILITY

The Power Arc DS Ignition has 5 pins passing through an optical sensor, which are counted. The first pin to pass through the optical sensor (#5 pin) is the coil saturation control pin & controls the amount of time the coil is on (dwell). See COIL SATURATION CONTROL section for more detailed information. The next pin to pass through the sensor is the (#4 pin) & is the most advanced point and the last (#1 pin) is your static timing. The pins have a 10° crank spread between each. When the engine is started the control circuitry counts pins 4, 3, 2, 1 and fires the spark plug when pin #1 is counted. As the engine speed is increased to 500 rpm's (starter over ride) the control circuitry counts pins 4, 3, 2 and fires when pin #2 is counted. As the pins have a 10° crank angle separation the engine is advanced 10° above the static timing. When the engine achieves 1500 rpm's the control circuit counts pins 4 & 3 then firing when the #3 pin is counted, advancing the engine timing 10° more or 20° total over static. When the engine reaches 2100 rpm's the spark plug is fired when the #4 pin is counted giving 30° total advance over static timing. If static timing is set at 5° BTDC you would see an advance to 15° at 600 rpm's, 25° at 1500 rpm's and 35° at 2100 rpm's. The points at which each step of curve is achieved is altered by the adjusters on the top of the module.

COIL SATURATION

(DWELL TIME)

Coil saturation or dwell time is the period of time the coil is turned on charging the primary windings of the coil. The primary windings of the coil must be charged enough to deliver a good spark to the spark plug at high rpm's but not turned on or saturated so long as to cause the coil to over heat.

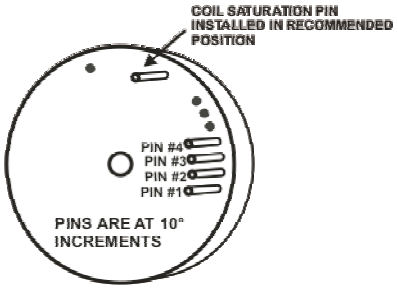
This over heating due to excessive coil saturation time causes several problems.

1. Reduction or weakening of spark output due to a mismatch between the primary and secondary windings when heated. This mismatch occurs due to the fact that you have a dramatic shift in the resistance of the secondary windings verses the primary windings. When the coil is heated especially due to over saturation, the resistance of the primary windings rises minimally due to having only 60 ft. of #24 gauge wire but the secondary resistance rises dramatically due to having approximately 7000 ft. of 42 gauge wire. This causes the mismatch between the primary & secondary windings, reducing the output of the coils.

2. Coil failure due to high voltage break down in the secondary windings, because of weakening of high voltage isolation barriers between the secondary windings.

3. The large difference between running temperature and off temperature of the coil, causes expansion and contraction of epoxy encapsulated coils. This combined with the vibration of the motorcycle and improper epoxy choices for heat dissipation causes stress cracking & breakdown of isolation barriers in the secondary of the coil & weakening of the primary terminal lug areas.

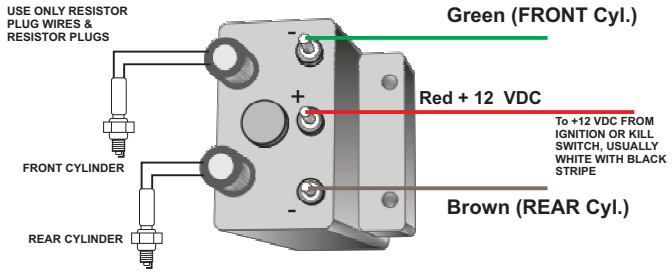
4. The longer the coils are saturated the more stress that is put on your ignition power supply lines (breaker, ignition switch & kill switch). With some ignitions on the market the coils are saturated for 270° of crank angle or about 75% of the time. During this period a single fire coil at 3 ohms is drawing 4 amps for 50% of the time and for 25% of the time both coils are on making the current draw 8 amps.



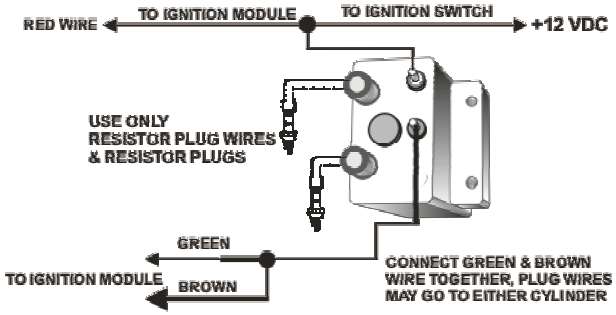
NOTE: The coil saturation pin should be left in the recommended position. This will run the coils cooler, maintaining peek output should you experience a power reduction in the upper rpm range you may wish to extend the saturation time by moving the coil saturation pin counter clockwise 1 hole at a time. This reduction of power can occur due to higher compression ratios, high rpm's or high fuel flows. Run as much saturation to achieve proformance but not so much as to heat the coils excessively.

COIL HOOKUP DRAWINGS

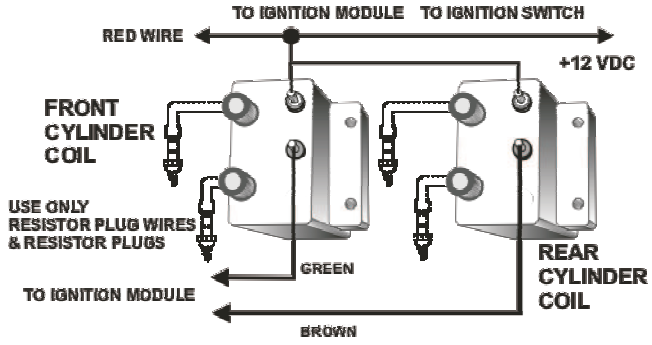
POWER ARC SF SINGLE FIRE COIL



1 Plug per Cylinder 12 VDC 3 Ohms Dual Fire Coil



Two Plugs per Cylinder 12 VDC 3 Ohms Single Firel



COIL HOOKUP GUIDELINES

1. USE ONLY RESISTOR PLUGS & RESISTOR PLUG WIRES EVEN WHEN GROUNDING OUTPUTS ON TWO OUTPUT COILS FOR SINGLE OUTPUT USE.
2. DO NOT TOUCH THE GREEN OR COIL OUTPUT WIRES TO +12 VDC.
3. A TOTAL OF 2.8 OHMS IS THE MINIMUM ALLOWABLE COIL RESISTANCE.
4. DO NOT HOOK UP COILS WITH POWER (12 VDC) APPLIED TO THE COILS & IGNITION MODULE.
5. BE SURE THE COIL USED DOES NOT REQUIRE A BALLAST RESISTOR, IF IT DOES, IT MUST BE USED.
6. MAKE SURE NOT TO RUN WIRING NEAR HIGH HEAT AREAS OF THE MOTORCYCLE, SUCH AS THE EXHAUST STSTEM.
7. USE ONLY NEW OR KNOWN TO BE GOOD COILS.

TROUBLE SHOOTING GUIDE

Voltage Test:

Load system by turning on lights & ignition. With negative terminal of volt meter attached to ground of module, check the voltage at the + (positive) of the battery & note. Then check the voltage at the + (positive) of the coils & note. Compare the two and there should be no more than 1 volt difference. If they show more than 1 volt difference check battery, ignition breaker, ignition switch & kill switch for high resistance opens. (COMMON PROBLEM STOCK WIRING TO SMALL)

NOTE: Perform above test first, no matter what the symptoms may be.

Problem: Only front or rear cylinder will fire.
- Bad coil, spark plug, or spark plug wire.
- No +12 VDC to coil + leads
- Module trigger wire not connected to coil
- Blockage of Front or Rear trigger on Plate (clean with alcohol)
- Pinched or shorted green or brown coil trigger wire

Problem: Hard Starting or wants to start when starter button released
- Weak or undersized battery, VOLTAGE DROP (SEE TOP OF PAGE)
- Poor connections in ign. circuit to coils (breaker, ign. & kill switches)
- Spark plug gap to large
- Improper coil chose

Problem: Erratic operation, tach bounce
- Solid or spiral core spark plug wires being used
- Pins on rotor rusted or blocked by debris
- High resistance connection on ground loop from ignition module
- Blockage of triggers on trigger plate

Problem: Green LED on module lights but trigger plate LED static timing LED does not
- Black - (ground) to trigger plate has been touched to + (positive), ground black wire on trigger plate side to frame & retest

Problem: Trigger Plate LED stays lighted
- Blockage of trigger pickup on trigger plate (clean with alcohol)
- Defective Trigger Plate

Problem: Kicks back when starting, runs similar to stock ignition
- Static timing too advanced (see quick time method)
- Voltage drop to ignition (see test at top of page)
- #2, #3 or #4 LED activates while engine is being started

Problem: #4 LED on module will not light
- Blue VOES wire on module not grounded
- Defective VOES switch

Problem: Tail pipes blue, hollow sound in pipes, runs sluggish
- Trigger plate timing wrong, too far retarded (see quick time method)

Problem: Plugs fire, occasional back fire, wont start
- Timing 180° out, reverse brown & green wires (see quick time method)

Problem: Pinging when leaving the line
- Timing to far advanced (see quick time method)

Problem: Pinging in the midrange
- Pins in rotor located in the wrong position (too much advance)
- #4 advance pin coming in to soon, raise advance point
- Hookup VOES switch & retry, especially when heavily loaded

BEFORE RETURNING ANY MODULE OR TRIGGER PLATE INSPECT THE 4 & 6 CONDUCTOR CABLES ON MODULE & 4 CONDUCTOR CABLE ON TRIGGER PLATE FOR ABRASION, CUTS OR CRUSHING AS THIS IS A COMMON CAUSE OF FAILURE.

NOTE: Any module returned under warranty must include the trigger plate, note of explanation of failure & be accompanied by a dated bill of sale. If out of warranty a $25.00 Charge to cover testing, shipping & handling should accompany the return and COD charge will be added.