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VDI Copperhead® GEN2 CDI Installation Instructions (Suzuki)

Revision 2.2

Parts Included,
VDI Copperhead® GEN2 CDI:

- VDI Copperhead® GEN2 ECU and installed harness (1)
- #8 x ½" Self Drilling Screws (4)

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Time Required:

- Less than an hour.

Difficulty:

- 1/10

Tools Required:

- Robertson screwdriver (#2, red) to install mounting screws.
- Heavy Duty Velcro (Optional - to secure unit under seat).
- Drill and ¼" drill bit (Arctic Cat 700 installation only).

Supported Machines:

- 2005+ Suzuki King Quad 700 EFI
- 2008+ Suzuki King Quad 750 EFI
- 2006+ Arctic Cat 700 EFI

Introduction:

The Copperhead® GEN2 is the world's most advanced and expandable Capacitance Discharge Ignition (CDI). The Copperhead® CDI was designed around our DPM-550 Copperhead® core for ease of use and maximum flexibility while providing years of trouble free service. Each Copperhead® is shipped with a machine specific harness to be used right out of the box, and requires no additional configuration. Additional harnesses sold separately to allow for the unit to be installed on other supported models.

Several of the key features are:

- Plug and play installation allows for quick installation, with no wiring modifications to the machine.
- Dual timing maps and configurations. Have one map for inexperienced riders, and one performance map to unleash the power of your machine. Both maps are fully configurable via our optional USB Memory Interface
- Repetitive fire ignition delivers hotter spark with longer spark duration for maximum power and virtually eliminates misfires, while giving you easy starts and crisp throttle response.
- Using the performance map allows the machine to run cooler, produce more horsepower and more torque, while minimizing fuel consumption. Also, you'll benefit from better throttle response and eliminates the factory bottom end lag for wheel standing performance.
- Incorporates part throttle timing advance that increases the part throttle horsepower by over 40%!
- Replaceable harness allows for platform changes with a simple harness change and a firmware upgrade using our USB Memory Interface (sold separately). This may be the last ECU you'll ever need to buy!

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Overview:

The front panel contains the following items:

1) Toggle switch: The switch toggles between two user programmable maps. The Copperhead® ECU is shipped with a stock type configuration in map location #1, and a performance configuration in map location #2. See the "Operation" section for more details. The switch is only read when the key is turned on.
2) Status LED: The status LED serves as a system status and error indicator. Should the ECU detect an error, the LED will flash the particular error code(s). See the "Error Code" section for more details. The machine's EFI indicator will turn on to indicate that there is an error. Check the status LED for the error code. The status LED also functions as a reluctor pickup indicator. It will remain on when the engine is not running. Once the engine is cranked, and the ECU detects crankshaft pulses, the LED will turn off.
3) Interface connector: The interface connector is used to load new user programmed timing maps and configurations as well as re-program the ECU should new updates become available. **NOTE: THE INTERFACE CONNECTOR IS TO BE CONNECTED TO THE VELOCITY DEVICES INC. USB MEMORY INTERFACE ONLY. CONNECTING THIS PORT TO ANY OTHER DEVICE OR DIRECTLY TO A COMPUTER WILL DAMAGE THE ECU AND VOID YOUR WARRANTY**.
4) Connectors: The 34 pin connector connects directly to the stock wiring harness when the factory ECU is removed. There are six optional wires that can be used to control additional devices. See the "Installation" section for more details.

NOTE:
DO NOT TRY TO OPERATE THE MACHINE WITH A HIGH CURRENT BATTERY CHARGER CONNECTED. PERMANENT DAMAGE TO THE COPPERHEAD® ECU MAY OCCUR. IT IS ACCEPTABLE TO USE A BATTERY TENDER OR OTHER LOW CURRENT (2 AMPHERE) CHARGERS WITHOUT ISSUE.

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Installation:

Step 1:

Remove the seat to allow access to the factory ECU igniter. Before removing the stock ECU, follow the directions on Page 14 called "**Poor Power, Starting Issues, Stalls/Misses during Light Throttle**" to check if the Throttle Position Sensor is aligned properly. A misaligned TPS will cause hard starting, poor performance, and stalling.

Step 2:

Disconnect the negative battery cable. Locate the stock ECU (located under the seat). Disconnect the connector from the ECU, and remove the ECU.

NOTE: If your machine has had a timing offset key installed (aftermarket equipment), then the timing maps need to be adjusted using the optional USB Memory Interface. Increasing the timing with an offset key without compensating the maps may lead to engine damage.

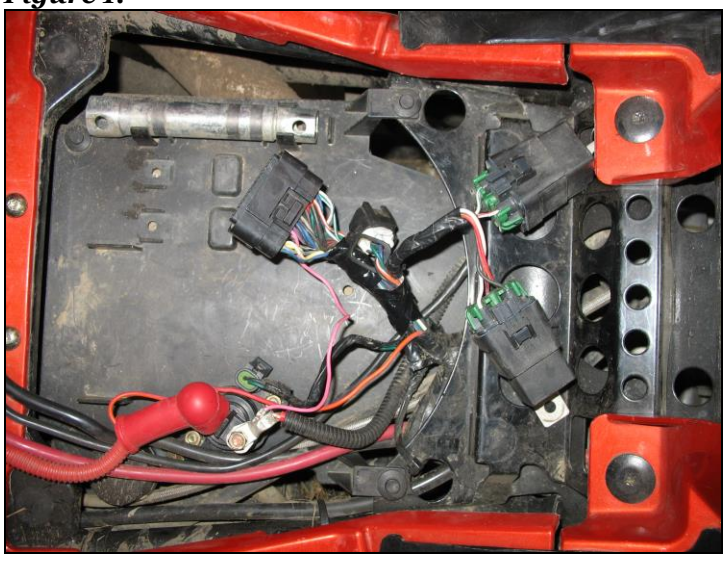
Step 3:

Remove the two #4x4-40 screws from the DB44 connector at the front of the ECU. The connector is filled with dielectric grease for water resistance after installation. Plug the Copperhead® wiring harness into the DB44 connector, and secure with the two #4x4-40 screws. The screws should be snug, but do not over tighten.

Step 4 *(Arctic Cat 700 EFI)*:

Remove the two plastic rivets from the relays. Cut the tape on the harness to give more free wire for the relays. Remove the pink starter wire from the bundle, and re-tape the remaining wires. See Figure 1.

Figure 1:



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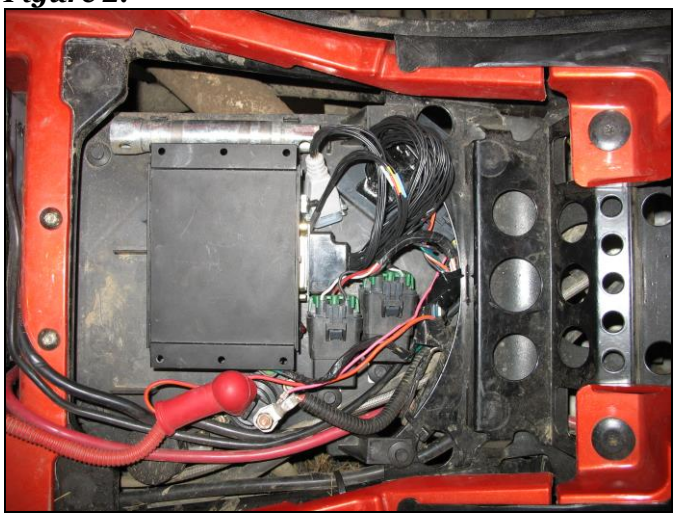
Plug the connector from the Copperhead® ECU into the connector on the chassis wiring harness. Drill two ¼" holes and relocate the two relays using the factory rivets. Tuck the ECU adaptor under the frame, and secure the ECU upside down to the pan with Velcro. It will mount in front of the factory ECU tabs, and they do not require removal. See Figure 2.

Figure 2:



Step 4 *(Suzuki King Quad 700 / 2008-2012 King Quad 750 EFI)*:

Remove the fuse block and fuel pump relay from the factory mounting tab (they just pull off). See Figure 3.

Figure 3:

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Depress the metal tab to remove the fuse block mounting bracket. See Figure 4. Secure the fuse block to the right side using the supplied self-taping screw. You will need to unplug the relay first to allow access to install the screw. See Figure 5.

Figure 4:

Figure 5:

Plug the connector from the Copperhead® ECU into the connector on the chassis wiring harness. Install the fuel pump relay on the other side of the factory mounting tab. Install relay back into fuse block. Secure the ECU upside down to the pan with Velcro. It will mount between the factory ECU tabs, and they do not require removal. See Figure 6.

Figure 6:

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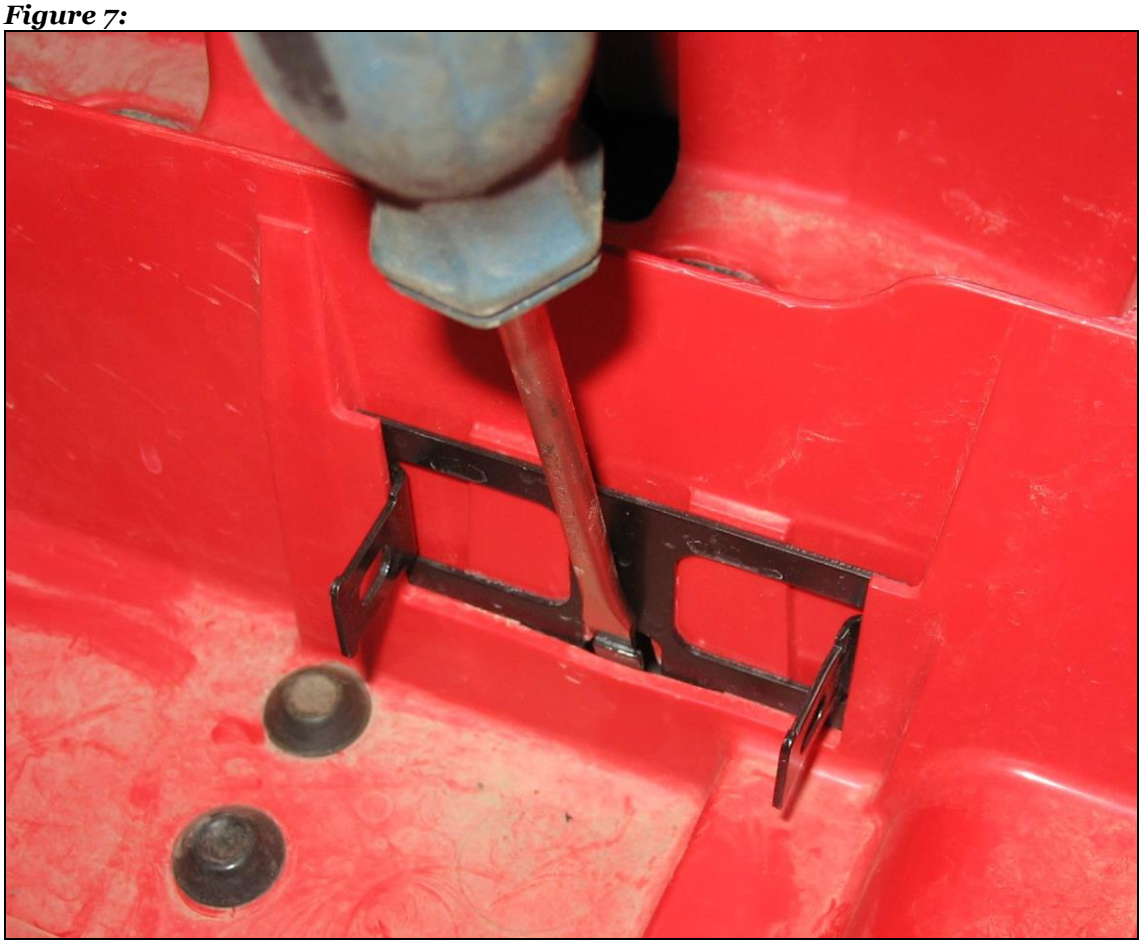
Step 4 *(2013+ Suzuki King Quad 750 EFI)*:

The factory fuse block must be raised to accommodate the extra height of the Copperhead® ECU. Remove the fuse block from the factory mounting tab (it just pulls off). Depress the metal tab to remove the fuse block mounting bracket. See Figure 7. Once the bracket has been released from the plastic, slide the fuse block back onto this bracket.

Figure 7:



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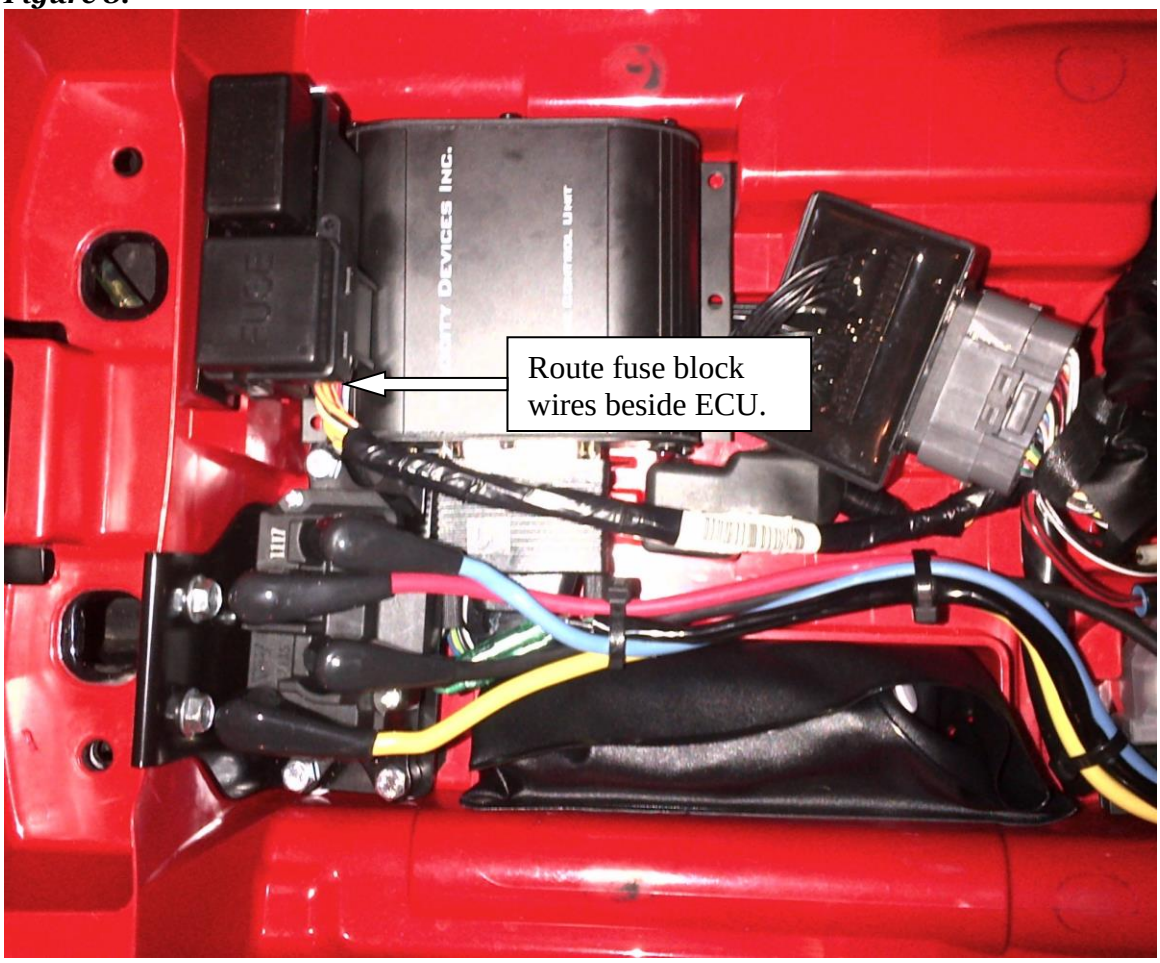
Plug the connector from the Copperhead® ECU into the connector on the chassis wiring harness. Mount the ECU 90-degrees rotation from the factory location, so that it is positioned under the edge of the fuse block. Slide the fuse block back into the factory mounting slot, and place it as far down as possible. Position the wires from the fuse block so they run parallel to the ECU, and not over the top. See Figure 8.

Figure 8:



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Step 5:

The Copperhead® ECU also has five (5) **optional** wires that are bundled together. Four wires are used to provide ground to a device when a certain RPM is reached (this is configured with the optional USB Memory Interface). Potential uses are shift lights, external controllers, NOS solenoid triggers. The white wire can be connected to an off the shelf tachometer that requires 1 pulse per revolution. The orange wire is a tether switch input that will kill the engine when connected to +12V.

Blue – Output #1 (grounds when triggered, 500mA MAX.)
Yellow – Output #2 (grounds when triggered, 500mA MAX.)
Green – Output #3 (grounds when triggered, 500mA MAX.)
Purple – Output #4 (grounds when triggered, 500mA MAX.)
Orange – Tether Switch (connect to +12V to kill engine)

There is also a tachometer wire that is connected to the harness. Tapping into this will give a tachometer output:
White – +12V Tachometer Output (1 pulse per revolution)

Step 6:

Re-connect the negative battery cable.

Step 7:

Due to variances between factory setups on the engines, the machine may exhibit high idle, stalling when stopping, poor hole shot performance and hard starting. Following this procedure will force the ECU to determine the optimum value for the machine it is installed on. Locate the orange tether wire in the bundle of loose wires held together with heat shrink.

To calibrate and use the optimum value:

1) Warm up the engine until the fan cycles, and then turn off the key.
2) Begin with the key off. Put the toggle switch to position #1. Put the transmission in neutral. Start the engine and warm it up until the fan cycles and then turn off the key.
3) Connect the orange tether input to the +12V battery terminal. Turn on the key, and once the ECU detects it connected for one second, it will turn on the status light, and start pulsing out a L-L-L-L (L = 1 second flash) error code to indicate it is waiting to/calibrating the step value. You can now disconnect the orange wire.
4) Start the engine.
5) The ECU will idle the engine until it reaches operating temperature (still flashing the L-L-L-L code). Once the engine is warmed up, the ECU will idle the engine down, and save the optimum value. The engine will then return to normal idle, and the status light will flash continuously at 1/4 second intervals to indicate it is done.
6) Next time the key is turned on, it will use this new value instead of the value stored in the "idle step" location of the map.

To clear the optimum value, and default back to the map value (only required should you not find the optimum value good):

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1) Begin with the key off. Put the toggle switch to position #1. Put the transmission in neutral.
2) Connect the orange tether input to the +12V battery terminal. Turn on the key, and once the ECU detects it connected for one second, it will turn on the status light, and start pulsing out a L-L-L-L (L = 1 second flash) error code to indicate it is waiting to/calibrating the step value. You can now disconnect the orange wire.
3) Turn off the key.
4) Next time the key is turned on; it will use the value from the map.

Step 8:

If you have an aftermarket muffler installed, the fuel maps will need to be modified for more fuel delivery, using our optional USB interface. We have a generic aftermarket map on our website which will work for most applications.

IF IN DOUBT, PLEASE CONTACT AN EXPERIENCED ENGINE BUILDER FOR ADVICE. PROLONGED OPERATION WITH A LEAN CONDITION CAN CAUSE SERIOUS ENGINE DAMAGE.

Step 9:

Go riding!

Typical Issues:

1) Worn/fouled spark plug will cause starting/operational issues. Replace if necessary.
2) Battery voltage should be above 12VDC when the engine is running. If it is 12VDC or lower, it indicates a problem with the battery or charging system.
3) Engine will not fire if the battery voltage drops below 11VDC. If the battery is low, and the engine isn't firing, use the recoil. Turn off any additional battery loads when starting (I.E. lights, hand warmers, etc.)
4) If the engine floods, pinning the throttle while cranking will turn off the fuel, and clean out the cylinder.
5) Turning the key on and instantly hitting the starter can cause the box to read a bad barometric reading, causing the machine to run poorly. If this does happen, just turn the key off and then back on to reset it. Wait a second after turning on the key (or engine kill switch power) before hitting the starter.
6) Due to difference in the engine synchronization when starting, the engine may crank over more than stock before firing. For the 2014+ unit, it will typically take 3-4 rotations to fire which is normal.

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Operation:

The Copperhead® was designed to be used right out of the box. No additional configuration is required. The unit is shipped with the following default configurations (***UNLESS OTHERWISE SPECIFIED WHEN ORDERED***):

Map #1 (Original type configuration):
Timing: 7 degrees BTDC @ 1300 RPM to 29 degrees BTDC @ 4000 RPM, with additional part throttle and altitude timing compensation.
Revolution Limiter: 6800 RPM
Differential Lock Low Speed Retard: Enabled
Restrict Reverse Speed: Enabled

Map #2 (Optimized for 87 octane gasoline):
Timing: 7 degrees BTDC @ 1300 RPM to 29 degrees BTDC @ 3000 RPM, with additional part throttle and altitude timing compensation.
Revolution Limiter: 7500 RPM
Differential Lock Low Speed Retard: Disabled
Restrict Reverse Speed: Disabled

Both maps and configurations can be changed using USB Memory Interface (available separately).

NOTE: Map 2 was optimized for 87 octane. If 91+ octane is utilized, then the timing can be increased an additional 2 degrees.

Install the Copperhead® ECU, and turn on the key. If the ECU detects an error, it will turn on the EFI indicator. The status light with flash to indicate the detected error (see the "Error Code" section for more details).
NOTE: The engine must rotate a minimum of 2 times before the ECU will start firing the cylinders. This is required to properly synchronize the system.

The toggle switch on the unit is used to toggle between two programmed timing maps and configurations. The ECU will only read the switch when the key is turned on.

If the engine floods, fully depress the throttle and crank the engine. It will clean out the excess fuel. Should the engine become substantially flooded, the stock ECU may be required to get the engine restarted due to a limitation of the Multi-Spark Discharge ignition not being able to light an excessively rich condition.

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Error Codes:

The unit status light serves as a diagnostic indicator. Should the ECU detect an error, it will turn on the EFI indicator, and display an error code on the status light.

Error codes are displayed by first turning off the indicator lights for 1 second. Each error code is displayed, with ¼ second blank between each code. The process is repeated (including the 1 second blank).

NOTE:
Short pulse is 1/2 second, long pulse is 1 second

Error Code #:	Pulse Structure	Description	Outcome
0	S-S-S-S	Barometer reading error	Engine will start, but operation will be poor. Cycle power, wait a second and then crank the engine.
1	S-S-S-L	EEPROM CRC error	Engine will not start due to questionable data. Reload configurations with USB interface.
2	S-S-L-S	RESERVED	RESERVED
3	S-S-L-L	RESERVED	RESERVED
4	S-L-S-S	RESERVED	RESERVED
5	S-L-S-L	RESERVED	RESERVED
6	S-L-L-S	Kill Switch	Engine stops when triggered.
7	S-L-L-L	Voltage Error	Engine may run, but battery voltage is low, or overcharging
8	L-S-S-S	Throttle Position Sensor Error	Defaults to 0% throttle, and engine will still run, but will experience poor throttle response and possible lean stalls. This can be caused by a faulty or miss-adjusted TPS sensor. Follow the adjustment procedure in the "Stalls/Misses/Sputters during Light Throttle" section below to adjust the sensor.
9	L-S-S-L	Engine Coolant Sensor Error	Defaults to 80 Degrees Celsius, and engine will still run.
10	L-S-L-S	Intake Air Temperature Error	Defaults to 40 Degrees Celsius, and engine will still run.
11	L-S-L-L	Manifold Absolute Air Pressure Sensor Error	Defaults to 100 kPa, and engine will still run.
12	L-L-S-S	High Temperature	Engine will run.
13	L-L-S-L	Crank Position Sensor Error	Engine won't start.
14	L-L-L-S	No Injector/Fuel Pump Power	Engine won't start.
15	L-L-L-L	ISC Calibrating	See Step #6, above.

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Frequently Asked Questions

Below are typical questions that are asked. They are organized as Q for question, A for answer, and S for solution.

Q: The engine is cold, and is cranking a little slower than normal, and won't fire. If I use the recoil starter, it fires up fine. Why?
A: The Copperhead® requires a minimum of 11VDC to start the engine. If the battery is drained, it will drop below 11VDC when cranking, which is insufficient to generate spark.
S: Charge the battery if low, replace if necessary, or use the recoil in these circumstances. Minimize battery loads by turning off lights, hand warmers, etc.

Q: The CDI seems to be hot, is this normal?
A: Yes, between the operation of the ECU, and it's location near the exhaust pipes, the metal case gets hot.
S: None. The ECU is approximately the same temperature as the metal ATV frame below it.

Q: I've flooded the engine. How do I get it going again?
S: Fully depress the throttle, and crank the engine. It will turn off the fuel and allow for the engine to clear the flood condition. In extremely flooded conditions, it may be required to re-install the factory ECU to get the engine to start. This is due to a limitation of the multi-spark discharge the Copperhead uses.

Q: Do I need to give it some gas to start?
A: No. Unless the engine is partially flooded, never use the throttle when cranking. The ECU uses a fixed starting curve to derive the starting fuel. It will not compensate for air pressure changes caused from opening the throttle.
S: None.

Q: What is starter kickback caused from?
A: Starter kickback is caused by pre-ignition. That is, the cylinder fired before the piston reached top dead center. This causes the engine to spin backwards, and forces the starter into the engine.
S: Sometimes if the engine is partially flooded, the engine may kick back when starting.

Q: When I accelerate in reverse, the engine stumbles and runs rough.
A: You have reached the reverse revolution limiter.
S: To enable full reverse power, hold the reverse override button. Alternatively, turn off the reverse power limiter utilizing the optional USB Memory Interface.

Q: When I accelerate in forward, and am going pretty fast, the engine stumbles and runs rough.
A: You have reached the revolution limiter.
S: You have reached the maximum safe operation speed of the engine. If your engine has had modifications that can support higher RPMs, then the revolution limiter can be raised using the optional USB Memory Interface. NOTE: Increasing the revolution limiter on engines that have not had the proper modifications can lead to fatal engine damage.

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Troubleshooting:

High Idle:

The idle speed is set by a combination of the throttle blade position as well as the ISC (Idle Speed Control) valve. If your throttle cable has no slack in it, then it will allow more air around the throttle blades, which will increase the idle speed. When you first start to press on the throttle, the tip of the throttle should move 1/8"-1/4" before you feel resistance from the throttle cable. If you have not already done so, follow the directions in step 6, above.

To adjust the slack:

1) Pull the rubber boot back by the thumb throttle.
2) Loosen the jam nut, and turn the other collar to give the cable the appropriate slack.
3) Tighten the jam nut, and slide the rubber boot back.

The Copperhead ECU typically idles 100 RPM higher than the stock ECU, but you shouldn't be having issue changing gears.

Bogs/Soft Launch:

The Copperhead ECU has the acceleration enrichment tuned to make the majority of machines operating perfectly with no modification. If you your machine has heavy/large tires, or is heavier than normal, then you may encounter a rich bog off the line. If your machine is lighter, or has light clutching, then you may encounter a lean flat spot off the line. Both conditions can be fixed using our USB Memory Interface (sold separately).

Note:
It is normal to have a ½-1 second hesitation when you snap the throttle in high range. This is due to the single cylinder engine, with tall gearing in high range. This won't be apparent in low range. It shouldn't have any rich bogs though.

Poor / Lack of Noticeable Power Gains:

If you are not seeing large power gains, it is typically caused by either a slipping belt, or dirty clutching. The clutch rollers can become caked with mud/dust and belt residue, which prevents the clutch from giving you proper gear ratios. Inspecting the belt and cleaning the clutch will eliminate this. Also see "Stalls/Misses/Sputters", below.

Note:
Many aftermarket belts don't have the compounds for long life, and tend to wear faster than the stock belt. It is not uncommon for a stock belt to last the lifetime of the machine, but only get 600 miles out of an aftermarket one. A worn or slipping belt will decrease performance.

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Poor Power, Starting Issues and Stalls/Misses during Light Throttle:

If you are experiencing any odd behavior that occurs during light throttle or hard acceleration, it can be caused by a miss-adjusted Throttle Position Sensor (TPS). The ECU relies on the TPS for acceleration enrichment as well as part throttle fuel compensation. If it is getting a wrong reading, it can substantially effect operation.

Checking the TPS:

1) Re-install the factory ECU.
2) Find the diagnostic connector near the ECU (it is usually white, with a black dust cap). It will have six (6) positions, but only four (4) positions will have wires inserted. Connect the two terminals together with a piece of wire or a paper clip. See Figure 7.
3) Turn on the key, and observe the speedometer pod. The display will show "–C00" or "–E00" (depending on your machine). If the dash is centered on the C or E, then it is adjusted properly. If it is either high or low on the C or E, then you'll need to adjust the TPS. See Figure 9.

Adjusting the TPS (2019+ KQ750 is non-adjustable):

1) Loosen the two screws on the TPS (located on the left side of the throttle body). See Figure 8.
2) Rotate the sensor until the speedometer pod displays either "–C00" or "–E00".
3) Tighten the two screws.

Figure 7:

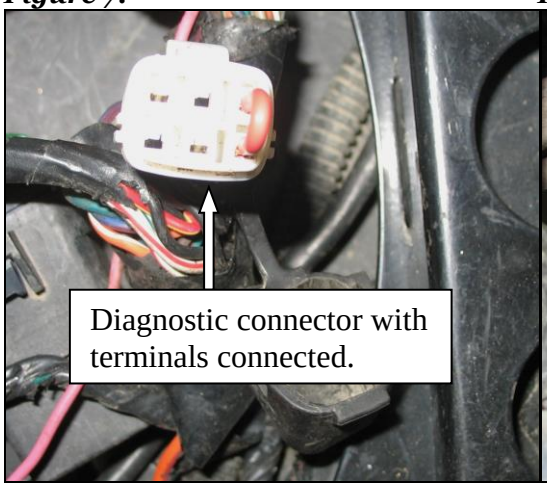


Figure 8:

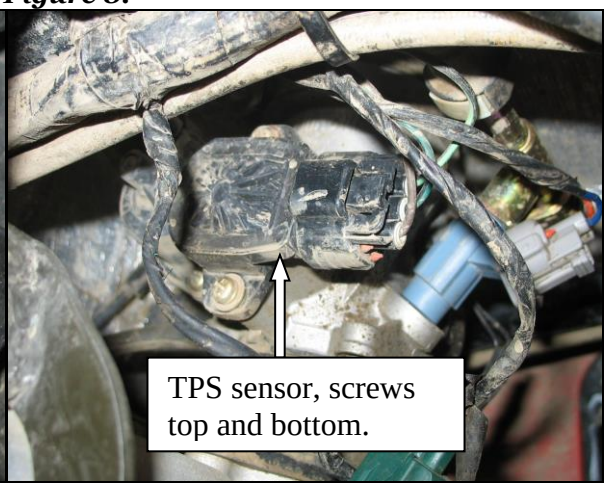
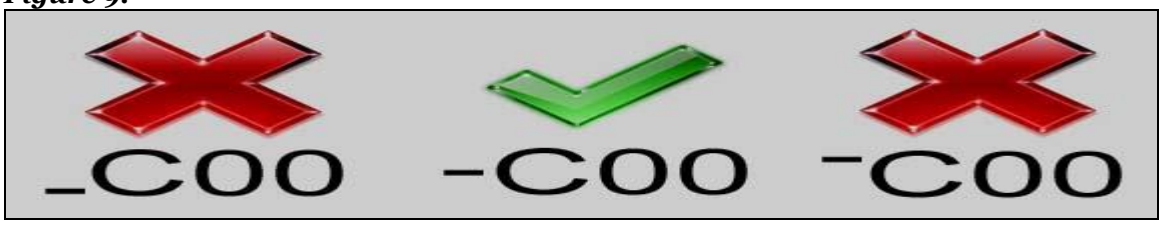


Figure 9:



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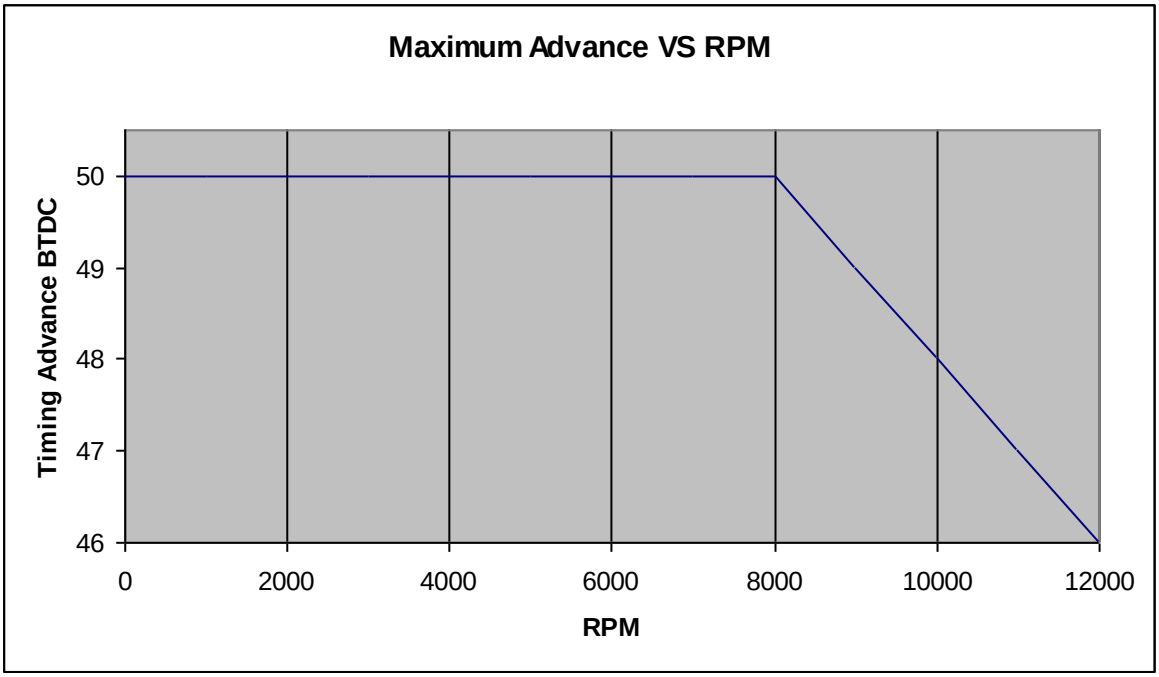
Specifications:

Subject to change without notice.

Dimensions (without wiring harness) (LxWXH):	145mm x 115mm x 42mm
Weight:	500 grams
Input Voltage:	9VDC to 15 VDC **(minimum of 11 VDC required to start)**
Input Current (engine not running):	330mA RMS @ 25°C
Input Current (engine running):	1.7A RMS @ 25°C
Input Current (key off):	No Current Draw
Output Voltage (to coil):	+/- 175 V Peak
Output Energy (per coil):	14.5 mJ
Firing Technique:	Multi-Spark Discharge
Firing Duration:	15 degrees
Maximum Operating Temperature:	-55°C to +100°C
Maximum engine speed:	12000 RPM
Maximum advance:	50 degrees BTDC @ 8000 RPM, with software roll off to 46 degrees BTDC@ 12000 RPM



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Facsimile: (403) 668-7471
Webpage: www.velocitydevices.com
Email: tech@velocitydevices.com

Velocity Devices Inc.

The fire in your ATV

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The maple leaf found on the bottom of your Copperhead® CDI is a symbol of the pride we take in each and every unit we manufacture.

Every unit is assembled, tested and packaged locally by one of our trained technicians, or approved ISO9001 registered manufacturing firms.

Should have any questions or concerns with this product, contact us immediately, and one of our courteous representatives will deal with your concerns in a prompt fashion.

We appreciate your business, and hope you enjoy your purchase.

Email: *tech@velocitydevices.com*

Telephone: *1.403.668.7470*

Or regular mail:
Velocity Devices Inc.
Attn: Concerns Dept.
P.O. Box 47052
RPO Creekside
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T3P 0B9