



The fire in your ATV

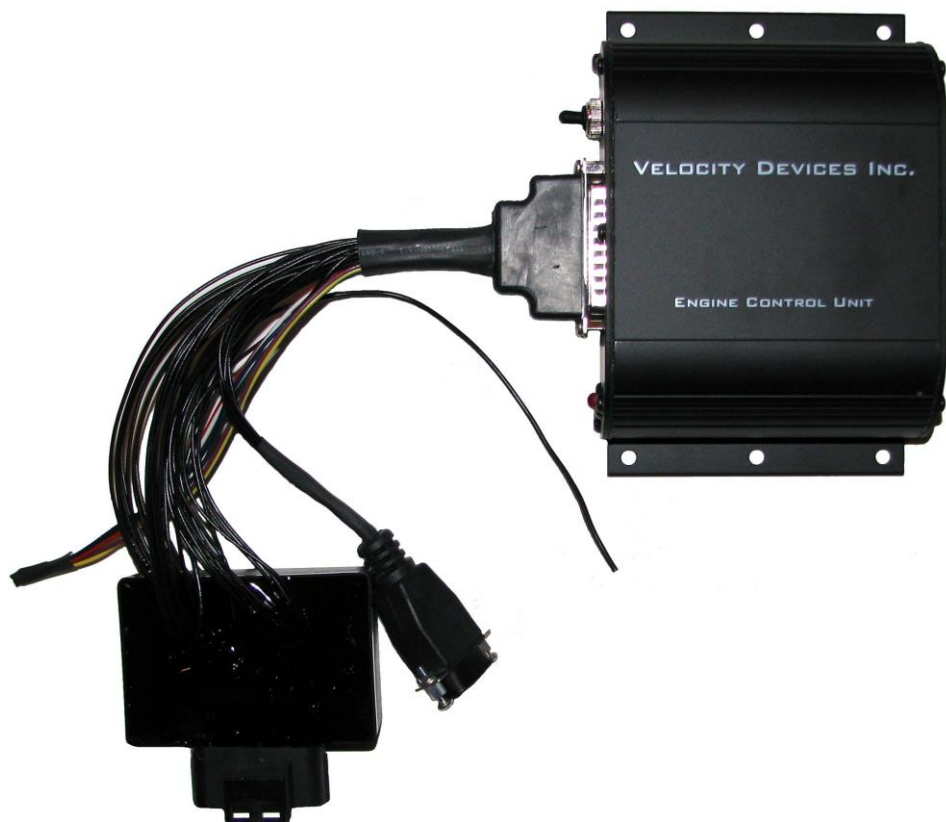
VDI Copperhead® GEN2 CDI Installation Instructions (Suzuki 450)

Revision 1.3

Parts Included,

VDI Copperhead® GEN2 CDI:

- VDI Copperhead® GEN2 ECU and installed harness (1)
- #8 x 1/2" Self Drilling Screws (4)
- #4x4-40 x 1/4" Machine Screw (2), located in the DB44 connector



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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 (to secure unit under seat)
- Philips screwdriver (#PH1) to install harness screws.

Supported Machines:

- 2006+ Suzuki King Quad 450 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.
- Additional speed limiter input allows to add a speed limiter for commercial applications.
- Incorporates part throttle timing advance that increases the part throttle horsepower by over 20%!
- 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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Use of Velocity Devices Inc. products may make your ATV operate in a manor, which the original manufacturer had not designed for. VELOCITY DEVICES INC., SHAREHOLDERS AND EMPLOYEES SHALL NOT BE LIABLE FOR ANY DAMAGES (WHETHER CONSEQUENTIAL, INCIDENTAL OR OTHERWISE) FROM THE USE OF VELOCITY DEVICES INC. PRODUCTS. EXCEPT, AS SET FORTH IN THIS LIMITED WARRANTY, VELOCITY DEVICES INC. MAKES NO OTHER WARRANTIES, EITHER EXPRESS OR IMPLIED.

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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 retractor 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 26 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 BATTERY CHARGER CONNECTED. PERMANENT DAMAGE TO THE COPPERHEAD® ECU MAY OCCUR.

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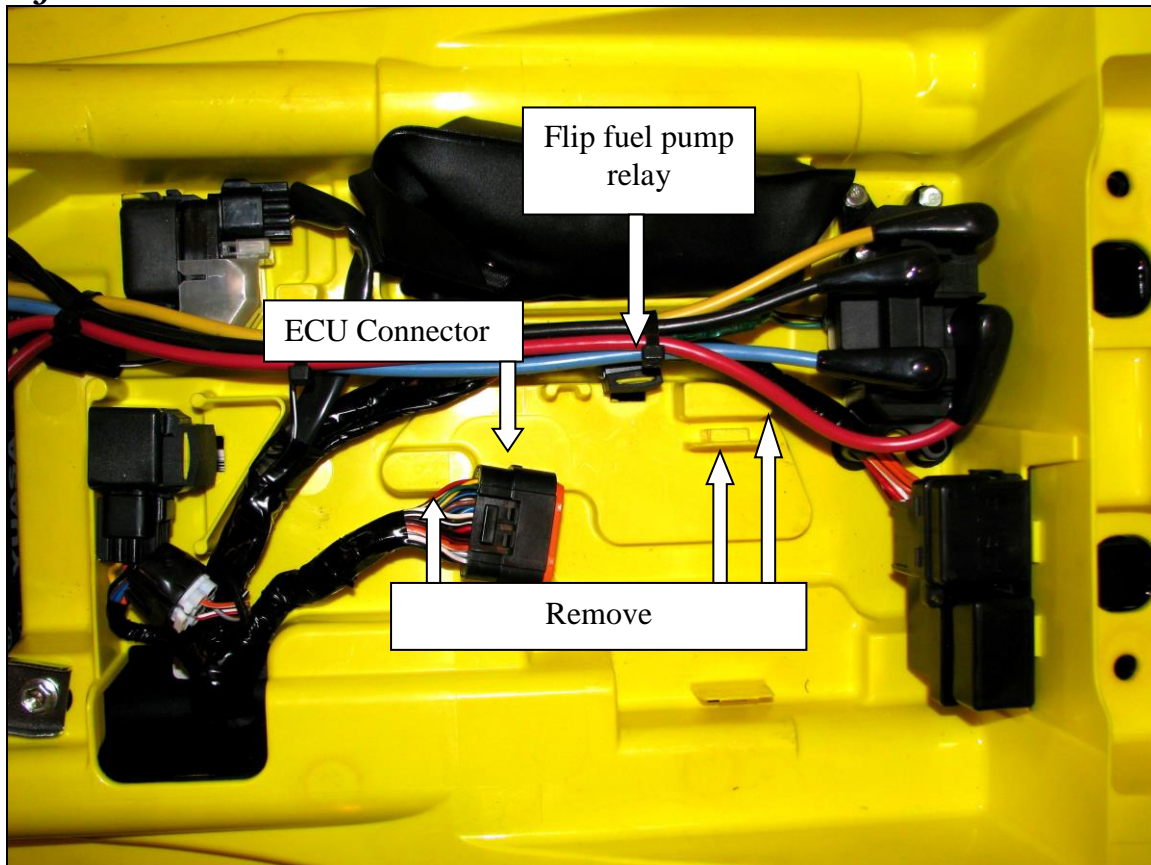
Installation:

Step 1:

Remove the seat to allow access to the factory ECU igniter. Before removing the unit, follow the directions for “Stalls/Misses/Sputters under Part Throttle” in the troubleshooting section to ensure the factory Throttle Position Sensor (TPS) is properly centered. Disconnect the negative battery cable. Locate the stock ECU (located under the seat). Disconnect the connector from the ECU, and remove the ECU. Pop the fuel pump relay off the tab, and reverse to move it out of the way. The three (3) plastic tabs will need to be removed to make room of the new ECU. See Figure 1.

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.*

Figure 1:



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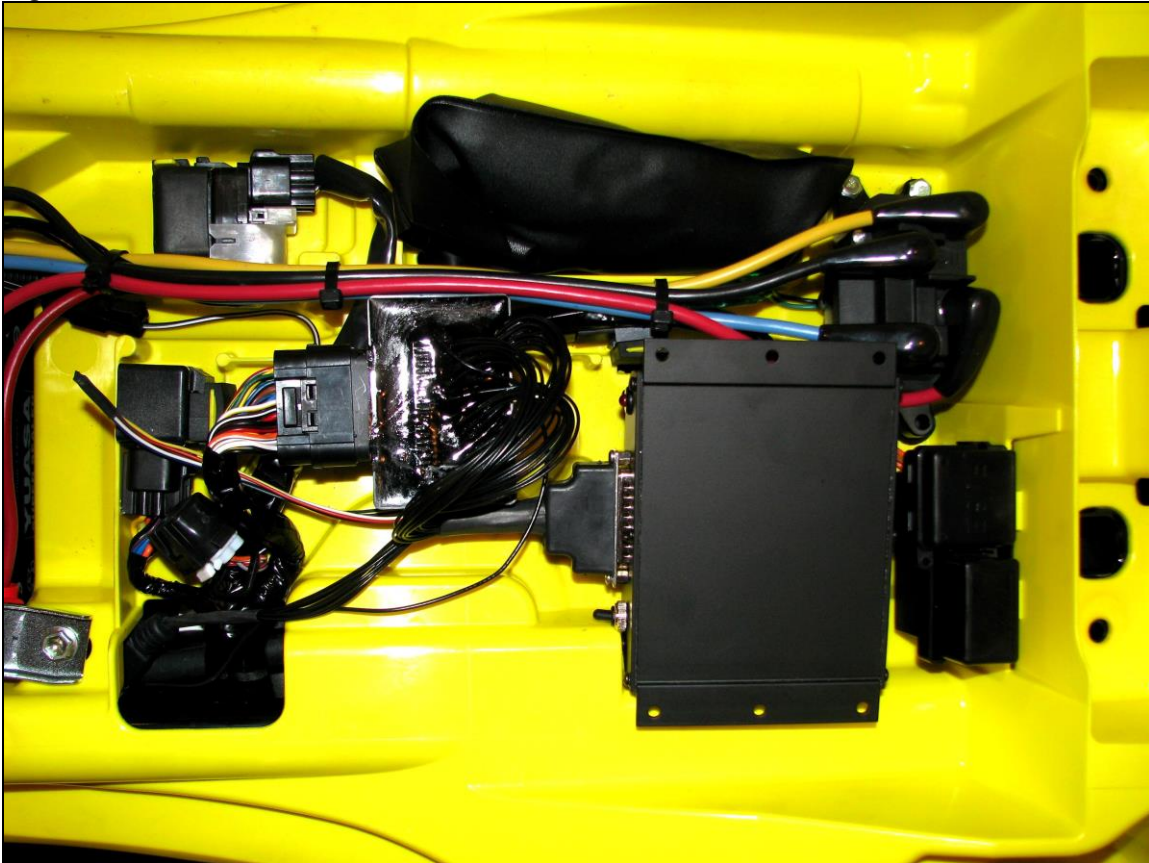
Step 2:

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 3:

Plug the connector from the Copperhead® ECU into the connector on the chassis wiring harness. Due to space constraints, installation is easiest by securing the ECU upside down to the pan with Velcro. See Figure 2.

Figure 2:



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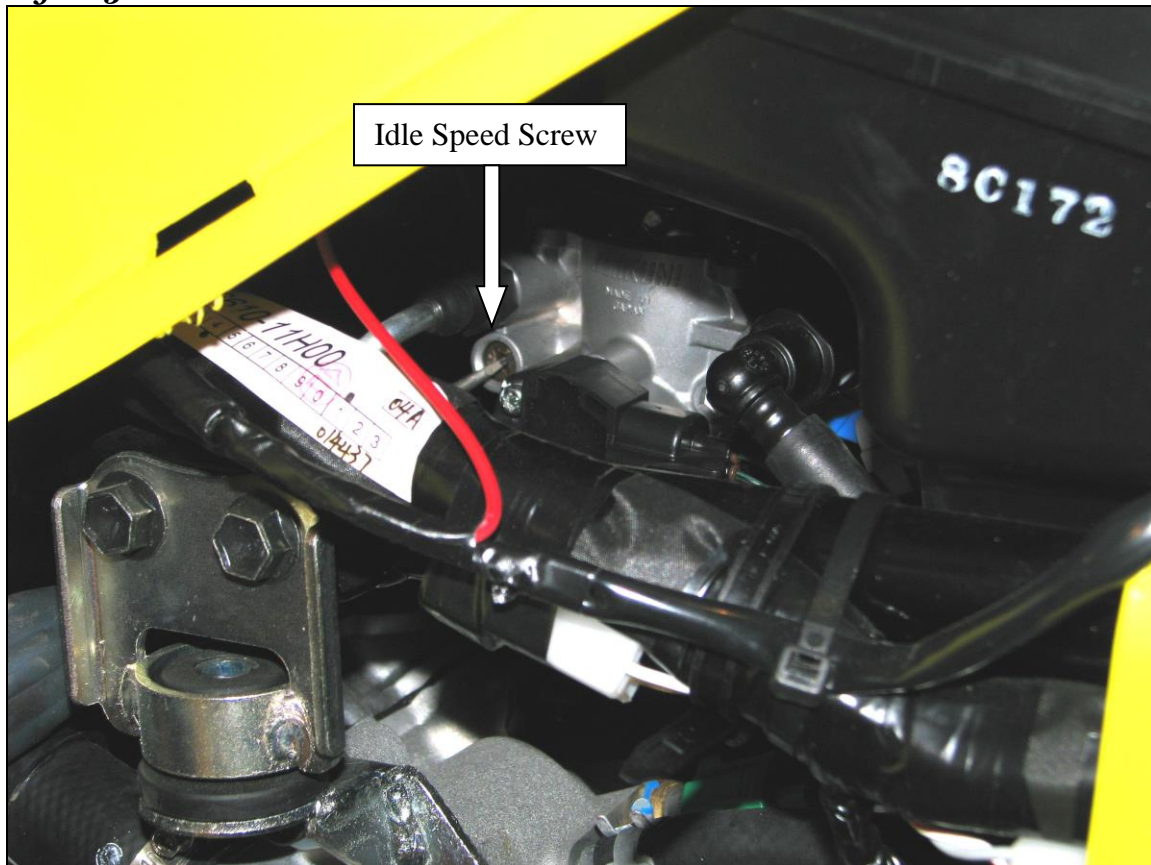
Step 4:

Re-connect the negative battery cable, and re-install the seat.

Step 5:

The Copperhead® ECU has a more efficient burn than the factory ECU. The idle speed will most likely be too high once the engine is warm. Start the engine, and get it up to operating temperature. Turn the idle speed screw on the left side of the throttle body clockwise to slow the idle speed. The idle speed should be between 1400-1500 RPM (below the clutch engagement). See Figure 3.

Figure 3:



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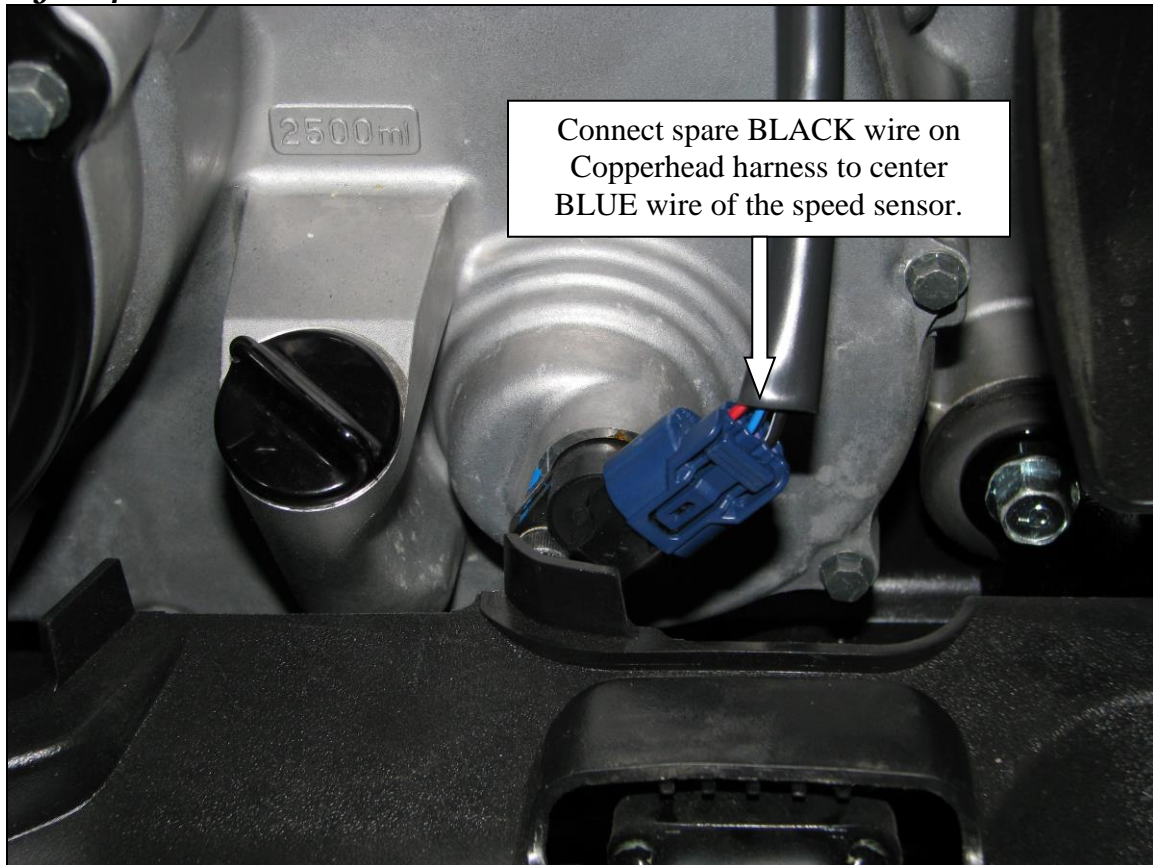


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Step 6 (Optional):

The Copperhead® ECU has an optional speed sensor input. When the ECU is configured to use a speed limiter, the forward/reverse speed is limited to 30KPH/19MPH. Once enabled, the speed limiter cannot be disabled and the ECU will need to be sent back to Velocity Devices Inc. for the limiter to be disabled. See Figure 4.

Figure 4:



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Step 7:

The Copperhead® ECU also has six (6) **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.)
White – +12V Tachometer Output (1 pulse per revolution)
Orange – Tether Switch (connect to +12V to kill engine)

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.

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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: 8000 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: 8000 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 will 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 1/4 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	RESERVED	RESERVED
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.
14	L-L-L-L	RESERVED	RESERVED

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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 idle speed screw. See Step 4.

Bogs/Soft Launch:

The Copperhead ECU has the acceleration enrichment tuned to make the majority of machines operating perfectly with no modification. If 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 1/2-1 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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Stalls/Misses/Sputters 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 5.
- 3) Turn on the key, and observe the speedometer pod. The display will show “-Coo”. If the dash is centered on the C, then it is adjusted properly. If it is either high or low on the C, then you’ll need to adjust the TPS.

Adjusting the TPS:

- 1) Loosen the two screws on the TPS (located on the left side of the throttle body). See Figure 6.
- 2) Rotate the sensor until the speedometer pod displays either “-Coo”.
- 3) Tighten the two screws.

Figure 5:

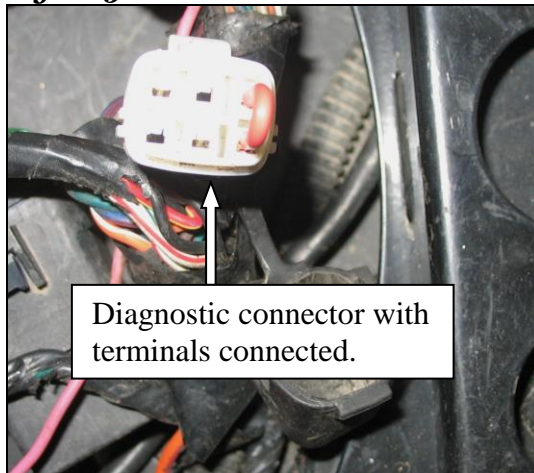
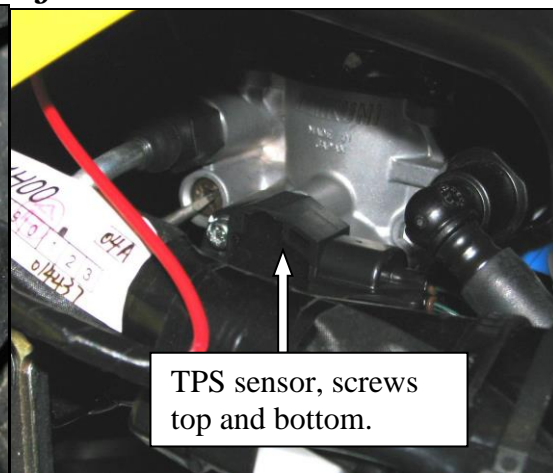


Figure 6:



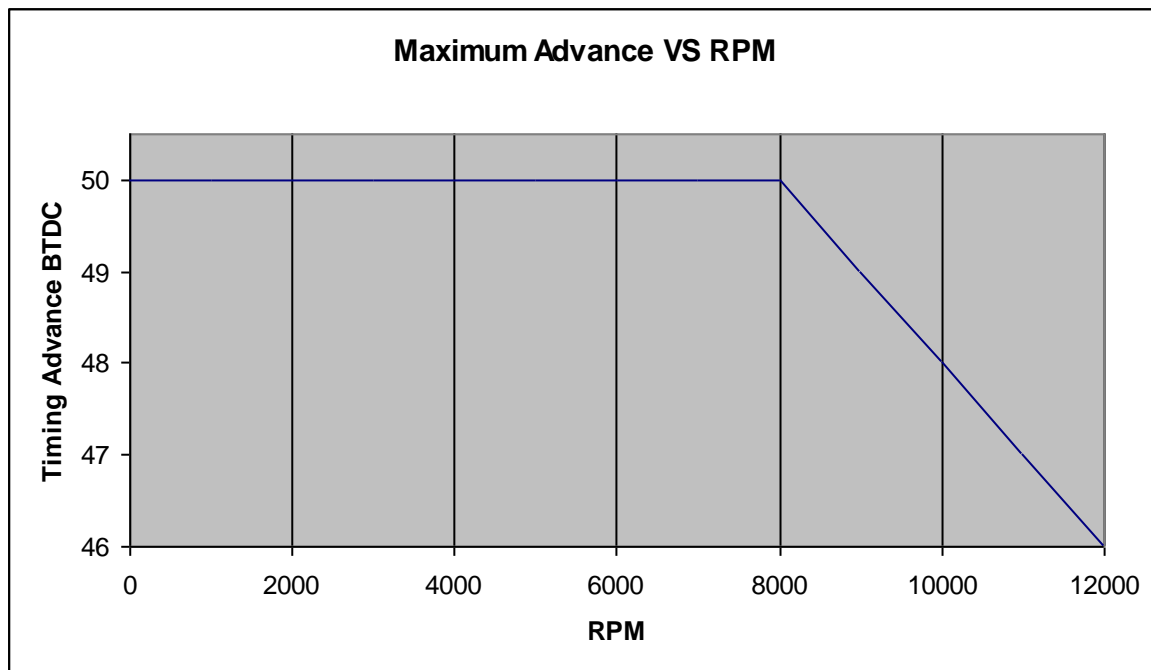


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Specifications:

Subject to change without notice.

Dimensions (without wiring harness) (LxWXH):	145mm x 115mm x 42mm
Weight:	500 grams
Input Voltage:	9 VDC 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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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.

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