Velocity Devices Inc.

The fire in your ATV

VDI Copperhead® GEN2 CDI Installation Instructions (Kawasaki)

Revision 2.2

Parts Included,
VDI Copperhead® GEN2 CDI:

- VDI Copperhead® GEN2 CDI and installed harness (1)
- #8 x ½" Self Drilling Screws (4)
- #4x4-40 x ¼" 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
- Drill and cable ties (if alternate installation is used)
- Philips screwdriver (#PH1) to install harness screws.

Supported Machines:

- 2002+ Kawasaki Prairie/KVF/Brute Force 650/700/750
- 2008 Kawasaki Teryx 750
- 2004+ Arctic Cat V2 650
- 2004+ Suzuki Twin Peaks 700
- 2004+ KFX700 / V-Force

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.
- 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 CDI 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® CDI 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 can be changed at any time, and does not require the engine to be off.
2) Status LED: The status LED serves as a system status and error indicator. Should the CDI detect an error, then the LED will flash the particular error code(s). See the "Error Code" section for more details. The machine's belt light (if present) will come on solid 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 idle. Once the engine is cranked, and the CDI 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 CDI 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 CDI AND VOID YOUR WARRANTY**.
4) Connectors: The 12 pin connector is reserved for a future Electronic Fuel Injection upgrade, and has no use at this time. The other connectors connect directly to the stock wiring harness when the factory CDI 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® CDI MAY OCCUR.

NOTE:
RE-JETTING IS TYPICALLY NOT REQUIRED, IF THE MACHINE IS PROPERLY JETTED BEFORE INSTALLATION.

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Installation:

Step 1:

Remove the seat to allow access to the factory CDI igniter on the utility machine. See Figure 1. The KFX-700 (V-Force) CDI is located on the right frame rail by the rear tire. The Teryx CDI is located under the driver's seat, inside the electrical box. See Figure 2. Disconnect the negative battery cable. Locate the stock CDI (located under the seat). Disconnect the connectors from the CDI, and remove the CDI.

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. The CDI is shipped assuming 5 degrees static timing, and increasing this with an offset key without compensating the maps may lead to engine damage.

Figure 1:

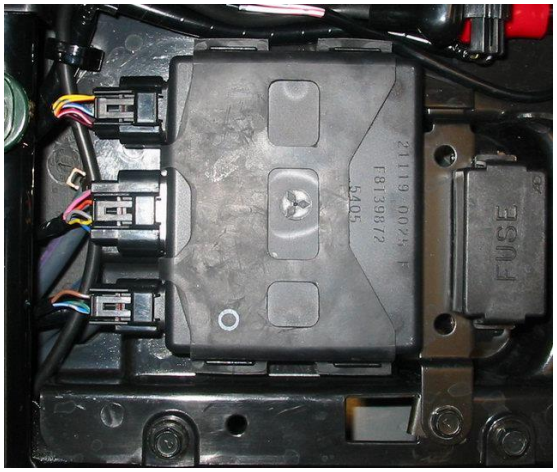
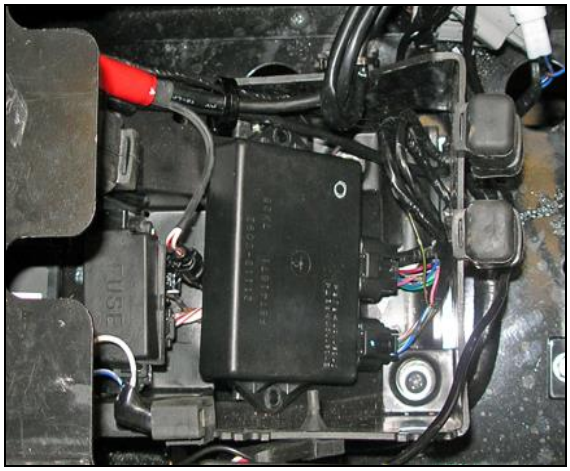


Figure 2:



Step 2:

Remove the two #4x4-40 screws from the DB44 connector at the front of the CDI. 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. Plug connectors from the Copperhead® CDI to their corresponding connector on the chassis wiring harness. The Copperhead® CDI will be mounted 90 degrees (1/4 turn) from the stock position in most applications. This will allow it to sit between the stock mounting tabs on the pan. See Figure 3 for the BF750i installation and Figure 4 for the Teryx installation. Test fit the unit, and mark the necessary mounting holes. The KFX-700 (V-Force) will require holes to be drilled in the frame to mount the CDI.

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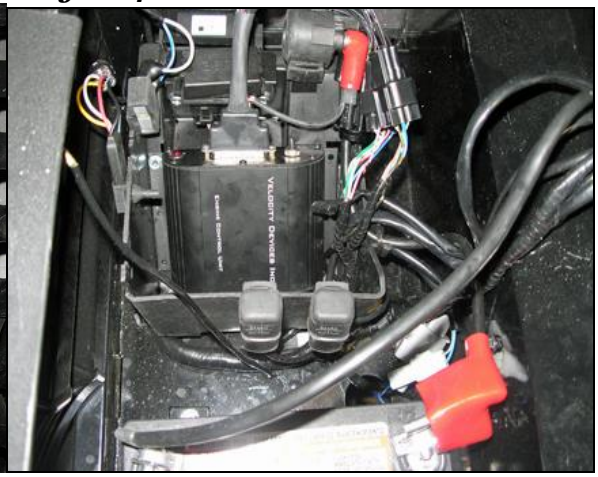
NOTE: *Certain models, such as the BF750, have very little room under the seat. Tuck the connectors under the frame rail before trying to mount the CDI. Ensure that the wires are not pinched. The length of the wiring harness will only allow the CDI to be mounted one way. On the BF750, only the top two mounting holes on the CDI in Figure 2 can be used.*

Figure 3:

Figure 4:



Step 3:

Fasten the Copperhead® CDI to the machine using the enclosed self-tapping screws. Before installing the self-drilling screws, ensure that they will not contact any wires or hoses under the mounting location. Alternatively, you can drill holes through the original mounting tabs, and use cable ties to hold the CDI in place. See Figures 5 and 6. Ensure the seat mounts will not pinch the wiring, when the seat is installed. You may need to use additional cable ties or electrical tape to ensure this will not happen.

NOTE: *Once the CDI is in place, the seat prevents excessive movement. It is not necessary (and might not be possible) to install all four (4) screws in some applications.*

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Figure 5:

Figure 6:

Step 4:

The Copperhead® CDI 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)

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Step 5:
Re-connect the negative battery cable, and re-install the seat.

Step 6:
Warm up the engine until the fan cycles. The Copperhead® will operate better when the idle mixture screws are set leaner than stock. The stock specification is turn both idle screws in all the way, and then back out 2 ¼ turns. Start with both screws set to 2 ¼ turns out, and slowly turn one in until the engine RPM starts to decrease. Turn it out ¼ turn from this position. Repeat with the second screw. Setting the screws as lean as possible (and still maintain decent idle) with eliminate stumbles and stalls when the throttle is jabbed, as well as lower your idle fuel consumption.

NOTE: RE-JETTING IS TYPICALLY NOT REQUIRED, IF THE MACHINE IS PROPERLY JETTED BEFORE INSTALLATION.

Once the engine is warm, take the machine for several full throttle runs. If the engine misses or backfires through the carburetors, then it is jetted lean. In the majority of the cases, you will only need to increase the main jet size, and not have to adjust the needles.

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

Step 7:
Go riding!

Typical Issues:
1) 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.)
2) If the engine stalls or stumbles when idling, or after jabbing the throttle from a dead stop, adjust the idle mixture screws.
3) If the engine runs poorly and backfires through the carburetor under full throttle acceleration, then the main jets are too lean, and they will need to be increased.
4) If the engine runs poorly and backfires through the exhaust under full throttle acceleration, then the main jets are too rich, and they will need to be decreased.

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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:

Map #1 (Original type configuration):
Timing: 5 degrees BTDC @ 1100 RPM to 28 degrees BTDC @ 5000 RPM
Revolution Limiter: 8500 RPM
Low Speed Retard: Enabled*
Restrict Reverse Speed: Enabled
Limp Mode: Enabled
*Disabled in the KFX-700 (V-Force) models

Map #2 (Optimized for 87 octane gasoline):
Timing: 5 degrees BTDC @ 1100 RPM to 34 degrees BTDC @ 5000 RPM
Revolution Limiter: 9200 RPM
Low Speed Retard: Disabled
Restrict Reverse Speed: Disabled
Limp Mode: Disabled

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

NOTE: The CDI fixes the timing advance at 5 degrees BDTC until 1500 RPM (regardless of what is programmed in the unit). Between 1500 RPM and 2000 RPM, the CDI will ramp up the timing to ensure the timing advance loaded in the maps is used at 2000 RPM. This prevents any stumbles and misses caused from stabbing the throttle from a dead stop.

NOTE: Map 2 was optimized for 87 octane by increasing the timing advance by 6 degrees above stock across the entire RPM range. If 91+ octane is utilized, then the timing can be increased to 9 degrees above stock.

Install the Copperhead® CDI, and turn on the key. If the CDI detects an error, it will turn on the belt light (if present) to indicate an error 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 1.5 times before the CDI will start firing the cylinders. This is required to properly synchronize the system.

Should the unit detect a data error in the onboard software, the CDI will not boot, and if possible, will display the error code.

Should the unit detect a data error in the onboard maps and configurations, it will display the particular error code, and default to a pre-programmed, stock type configuration, regardless of the position of the toggle switch.

The toggle switch on the unit is used to toggle between two programmed timing maps and configurations. It can be changed at any time.

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Should limp mode be activated, remove the belt case, and turn the belt switch back to “on”. Turning the key off and then on will reset the CDI.

Error Codes:

The unit status light serves as a diagnostic indicator. Should the CDI detect an error, it will turn on the belt light, 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).

First pulse organizes the error. Short pulse (error codes 0-7) are CDI errors.

NOTE:
Short pulse is 1/2 second, long pulse is 1 second
If the onboard software is corrupt, it is possible that error code #0 will not be displayed.

Error Code #:	Pulse Structure	Description	Outcome
0	S-S-S-S	Flash CRC error	CDI hangs, and engine will not start since software in CDI is questionable. Call tech support.
1	S-S-S-L	EEPROM CRC error	CDI ignores programmed maps and configurations, and defaults to stock type configuration. Reprogram the timing maps with the supplied USB memory interface.
2	S-S-L-S	Vehicle Down	Engine Stops
3	S-S-L-L	No speed sensor input	Power output is continuously restricted if low speed retard is enabled. No effect if low speed retard is disabled.
4	S-L-S-S	Engine Stop	Engine Stops. Move engine stop switch to "RUN".
5	S-L-S-L	Belt Switch	Engine rev limiter lowered to 3600 RPM if limp mode enabled, no effect if limp mode is disabled.
6	S-L-L-S	Kill Switch	Engine Stops
7	S-L-L-L	RESERVED	RESERVED

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Frequently Asked Questions / Troubleshooting:

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 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 CDI, and it's location near the exhaust pipes, the metal case gets hot.
S: None. The CDI is approximately the same temperature as the metal ATV frame below it.

Q: I have a hole shot module already installed. Do I have to remove it to use the Copperhead®?
A: No, the module can exist with the Copperhead®. Please note, the low speed retard feature will not work in the Copperhead® if the module is installed (enabled).
S: If you wish to re-enable the low speed retard, then the module will have to be removed, or have a bypass switch installed.

Q: I just drove through a waterhole and now the engine runs rough or has stalled.
A: Water vapor slows the burning time of the air/fuel mixture. The CDI cannot compensate for air density changes, and therefore cannot correct timing issues.
S: Avoid in jesting water or slow operation through deep water holes. Steam from the engine will effect operation.

Q: I backup up hard, put it into forward and pinned it. The engine died.
A: The engine flooded. This can be caused by improper jetting and/or dirty (or wet) air filter.
S: Ensure the jetting is correct for your elevation. Clean the air filter if dirty.

Q: I have the low speed retard enabled, and when I pin the throttle from a dead stop, my machine doesn't accelerate as nice. It seems to labor a bit at higher speeds. If I pin the throttle when the machine is already moving, it works fine.
A: The low speed retard prevents the timing from being advanced past 12 degrees until the wheel speed is faster than approximately 7 KPH or 5 MPH. This limits power output from the engine, and makes it safer for inexperienced riders. When you accelerate from a dead stop, the 12 degrees isn't enough timing advance to ensure a proper burn time for the higher RPMs. Excess fuel remains in the cylinder, and it takes a little time for the engine to clean out. Usually in stock configurations, the jetting is lean enough that this isn't very noticeable. If your machine has been re-jetted, it may be more pronounced.
S: Avoid stabbing the throttle from a dead stop. Start off slower. Alternatively, turn off the low speed retard utilizing the optional USB Memory Interface for maximum low-end power.

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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: We have designed the Copperhead® in such a way that you should never see starter kickback. If you have driven through a lot of water, and a lot of steam is coming off the engine, or have flooded the engine, on extremely rare occasions the ignition can be delayed enough that it may occur.

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.

Q: When I accelerate in forward, the engine stumbles and runs rough. I'm barely even moving.
A: You have reached the limp mode revolution limiter. A loose belt has tripped the belt switch. This prevents damage to the belt and belt case.
S: The belt cover must be removed, and the belt must be tightened. The belt switch must be turned to "on". If the limp mode has been turned off using the optional USB Memory Interface, then an error code will be displayed, but the RPMs will not be limited.

Q: What's up with the limp mode? Will my Copperhead® randomly trip like the stock unit?
A: Limp mode is supposed to be triggered by a loose and flopping belt. The original Mitsubishi CDI was improperly design, and voltage spikes on the belt wires (caused by the ignition, charging system starter, etc.) would cause the CDI to latch a "tripped belt", even though the switch never tripped. This would enable the limp mode, and restrict the RPMs. Our CDI continuously monitors the belt switch. The switch has to be tripped for a minimum amount of time before the limp mode is latched in. This prevents voltage spikes from tripping it.
S: To reset the limp mode, flip the belt switch back to "on" and then turn the key off and turn it back on.

Q: I find my machine gives me too much enjoyment now, and my significant other is upset that I spend so much time riding.
A: That is a common side effect.
S: You could share, but that would reduce your enjoyment time!

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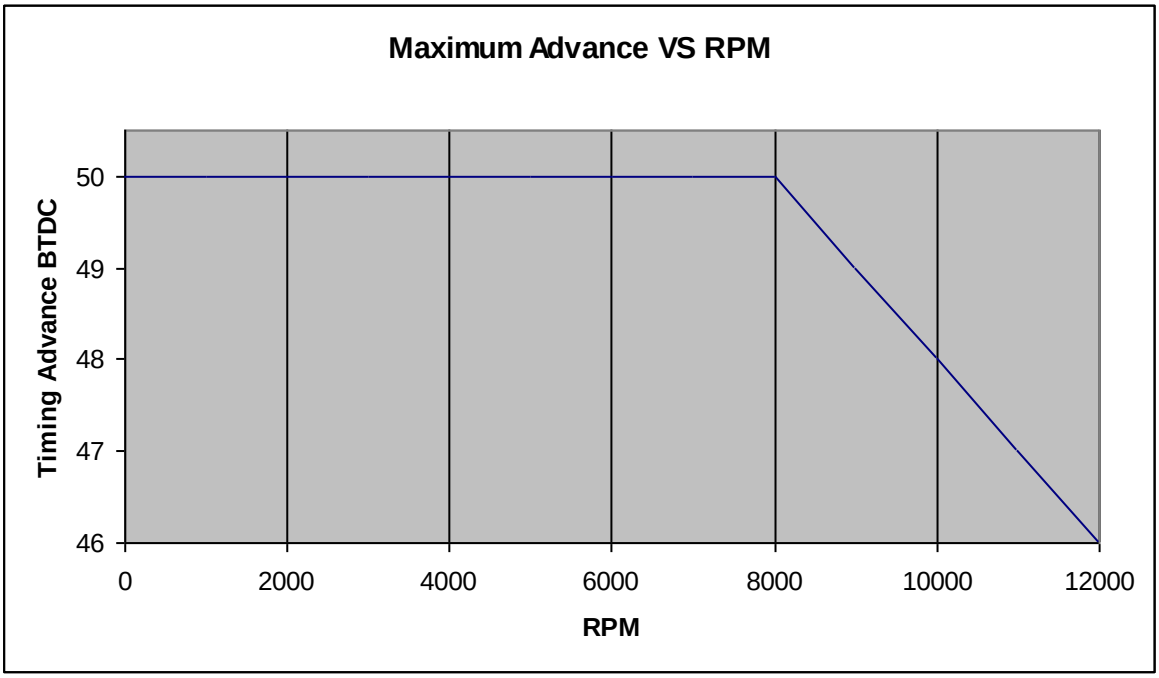
Specifications:

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
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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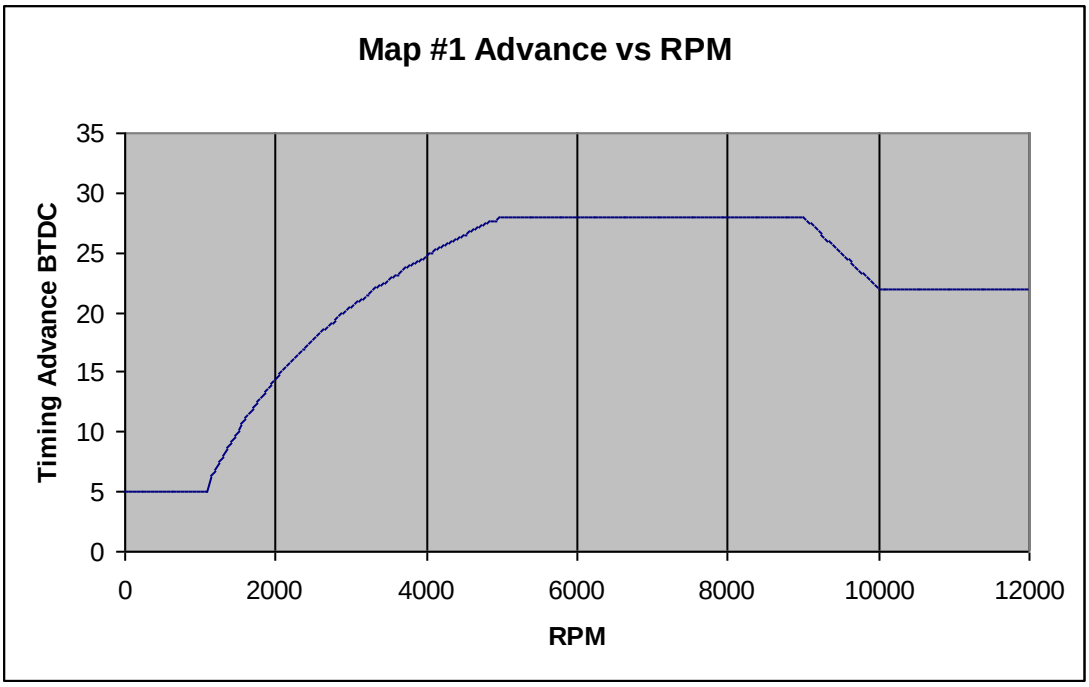

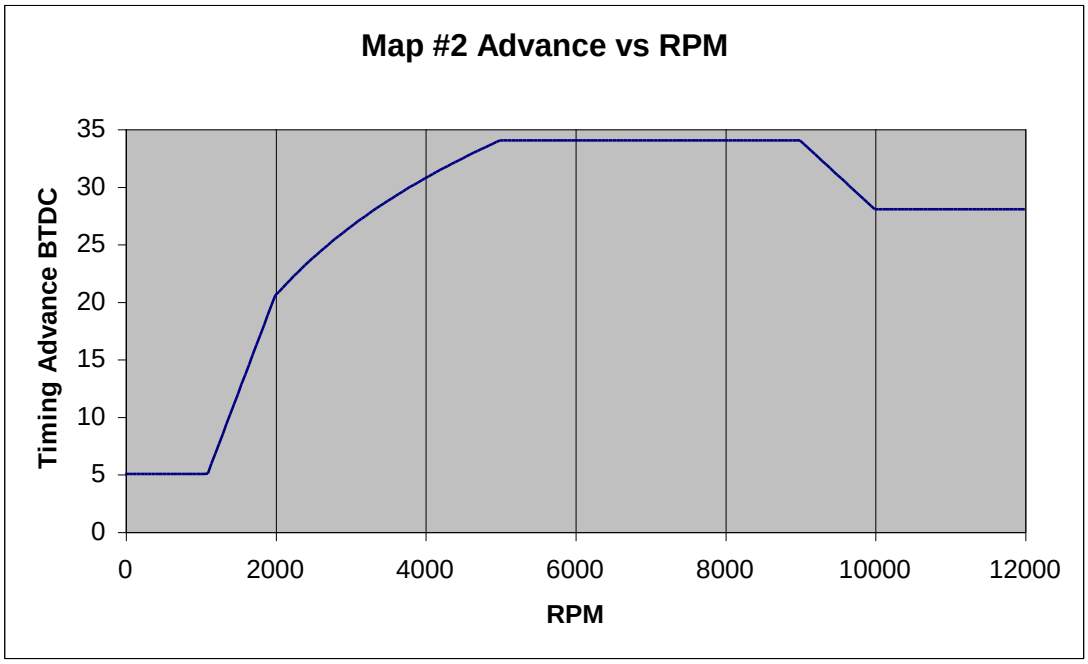

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The maple leaf found on the bottom of your Copperhead® CDI is a symbol of the pride we take in each and every unit we manufacture.

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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