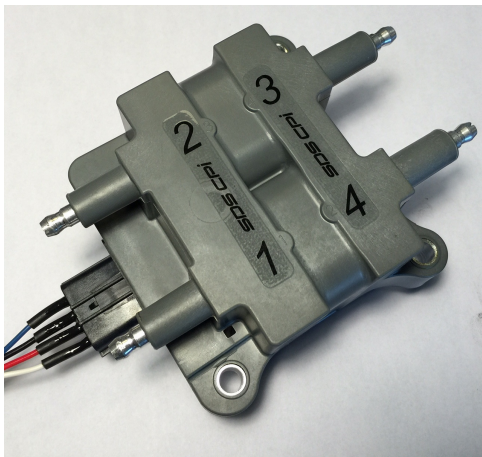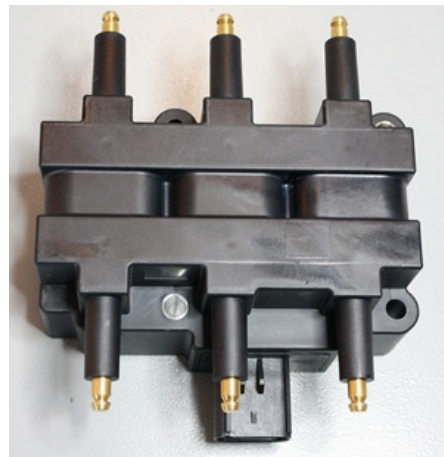# CPi   **April 18/20**

CoiL PACK IGNiTioN FOR AViATioN

Coil pack (4 cylinder)

Coil pack (6 cylinder)

For 4,6 and 8 cylinder 4 stroke applications.
Please read the entire manual before beginning installation.
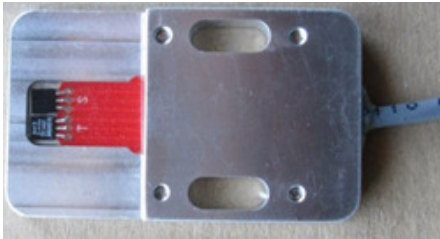
Software version 2.5 July 23/18

System Description

The CPi unit is a microprocessor based ignition unit designed to trigger the supplied waste-spark type coil packs. Engine spark timing is fully programmable for both RPM and load (manifold pressure or throttle position). Triggering is accomplished with magnets attached to the crankshaft and a Hall Effect sensor fitted to the engine case. As such, timing variations relating to gear lash or harmonics are eliminated.

Theory of Operation

A Hall Effect sensor is mounted near the crankshaft pulley sensing magnets mounted in the pulley. Two triggering magnets are used on 4 cylinder, three triggering magnets are used on 6 cylinder applications, 4 triggering magnets on an 8 cylinder. One sync magnet is also used to synchronize the computer with the engine so the computer knows which coil to fire first. As each magnet passes the Hall sensor, a pulse is sent to the CPi. The CPi determines the exact rpm and manifold pressure, sums the programmed spark retard values and calculates the appropriate delay for the specific conditions at that instant, then triggers each coil to fire at the precise time. Each coil fires two cylinders simultaneously, one cylinder on compression, the other on exhaust.

Once the system has been calibrated using a timing light by setting the MAG POS (MAGNET POSITION) value, the gauge mode will accurately display the actual ignition timing in degrees BTDC in real time. Programming can then be accomplished in the simplest possible terms to understand.
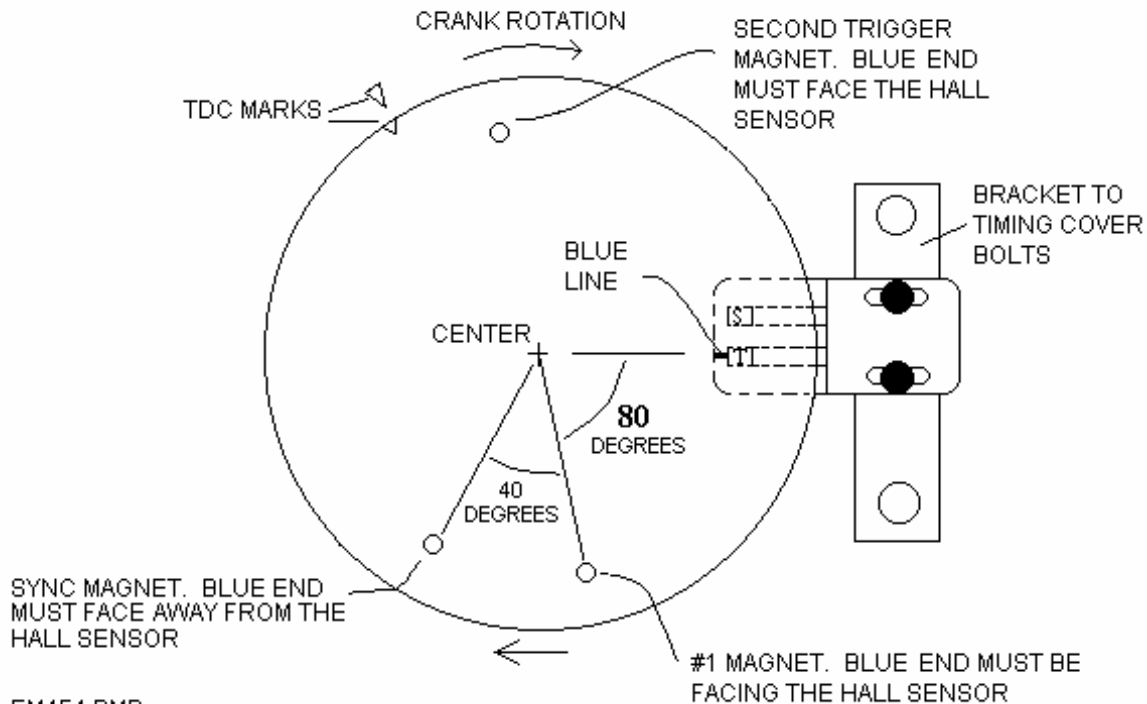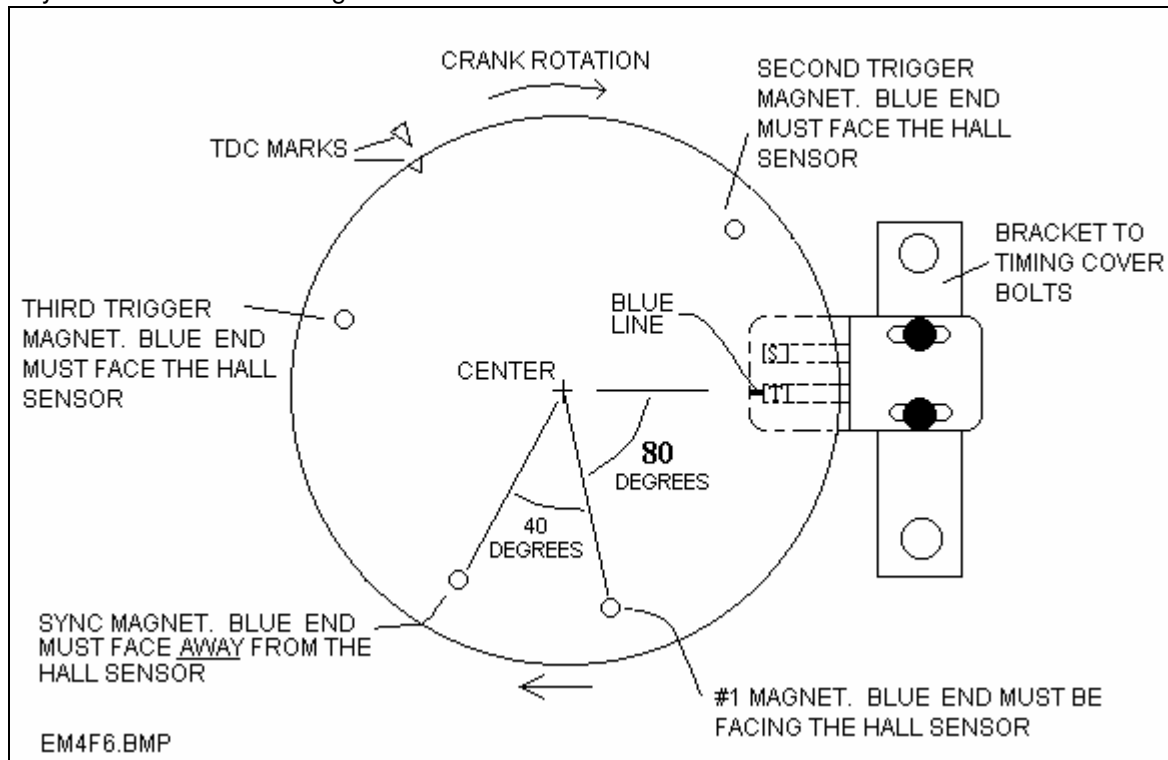
Hall sensor (adjustable type)   **Hall sensor (non-adjustable type)**
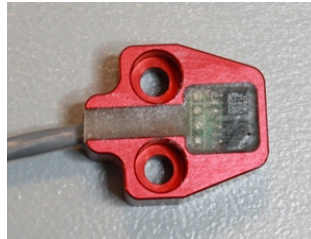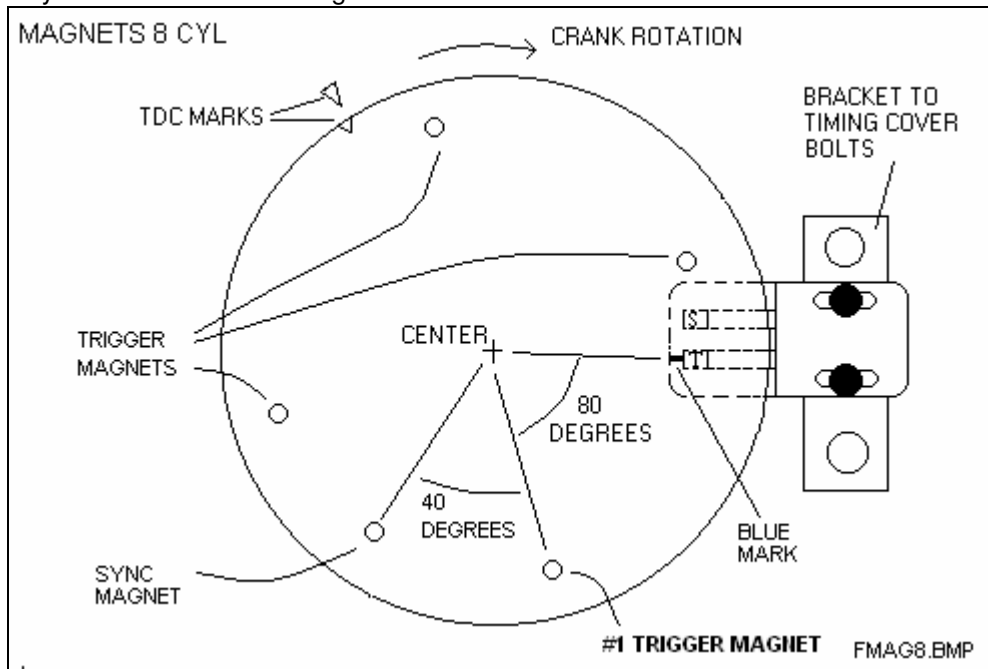
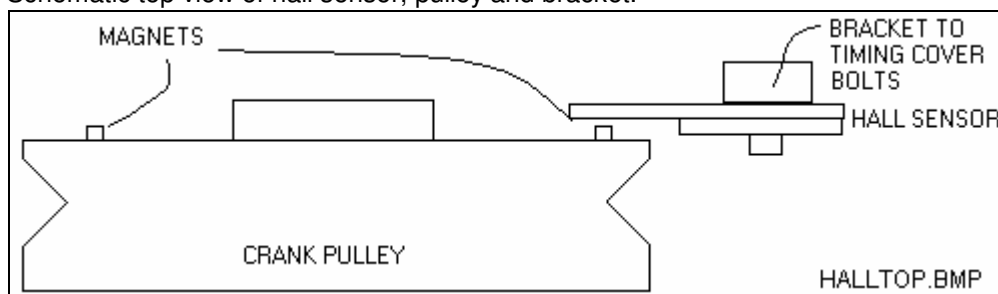

4 cylinder schematic drawing of hall sensor installation.

6 cylinder schematic drawing of hall sensor installation.

CRANK ROTATION

SECOND TRIGGER MAGNET. BLUE END MUST FACE THE HALL SENSOR

TDC MARKS

BRACKET TO TIMING COVER BOLTS

THIRD TRIGGER MAGNET. BLUE END MUST FACE THE HALL SENSOR

BLUE LINE

CENTER

[S]

[T]

80 DEGREES

40 DEGREES

SYNC MAGNET. BLUE END MUST FACE <u>AWAY</u> FROM THE HALL SENSOR

#1 MAGNET. BLUE END MUST BE FACING THE HALL SENSOR

EM4F6.BMP

8 cylinder schematic drawing of hall sensor installation.

MAGNETS 8 CYL

CRANK ROTATION

TDC MARKS

BRACKET TO TIMING COVER BOLTS

[S]

[T]

TRIGGER MAGNETS

CENTER

80 DEGREES

40 DEGREES

BLUE MARK

SYNC MAGNET

#1 TRIGGER MAGNET   FMAG8.BMP

Schematic top view of hall sensor, pulley and bracket.

MAGNETS

BRACKET TO TIMING COVER BOLTS

HALL SENSOR

CRANK PULLEY

HALLTOP.BMP

Hall sensor cable & pins

Hall sensor wires plug into the CPi connector as shown here on the bottom 4 middle pins.
Watch colors carefully, old style is shown first with grey cable. Second photo shown the newer Tefzel Cable.
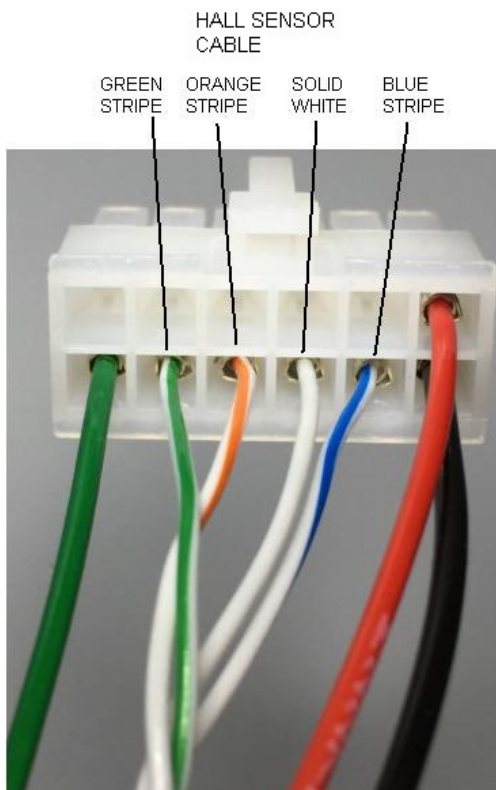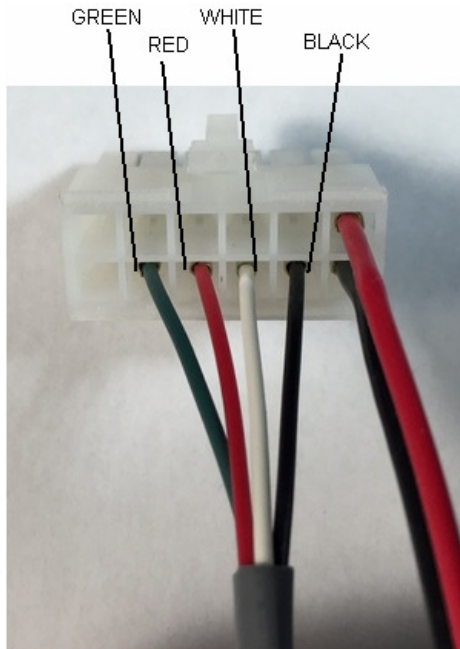
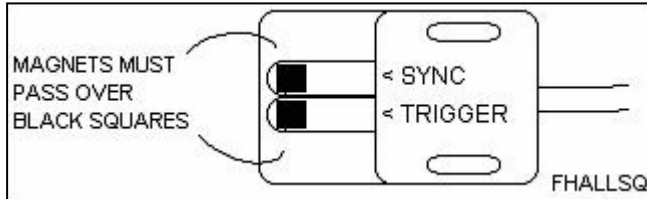

Tefzel cable

Aligning the Hall sensor and magnets
MAGNET SEEN WINDOW

Top line is used for checking trigger magnets.
Bottom line is used for checking the sync magnet.
When in this screen, the Status LED will also light when a magnet is over the sensor, and when the engine is running the Status light may flicker in this screen as magnets pass the sensor.

Important! Disconnect power to the coil pack to disable the spark while rotating the crankshaft.

Steps:

1. Best to rotate the crankshaft so that a trigger magnet is closest to the sensor.
2. Have the mounting bolts loosened slightly and slide the sensor in or out until the window shows TRIG YES. YES means the CPi is seeing the trigger magnet.
3. On adjustable sensors, slide the sensor back and forth and try to find the mid-point where the Trig shows YES.
4. Tighten the hall sensor mounting bolts. Check remaining trigger magnets and also the sync magnet. Non-adjustable Hall sensors don't require any alignment procedures.

Each magnet should be SEEN for at least 2 to 3 degrees of crank rotation.
Note: This window has no use once the engine is running, since the sampling rate of the programmer is only about twice per second.

Tach output, CPi power and ground wires
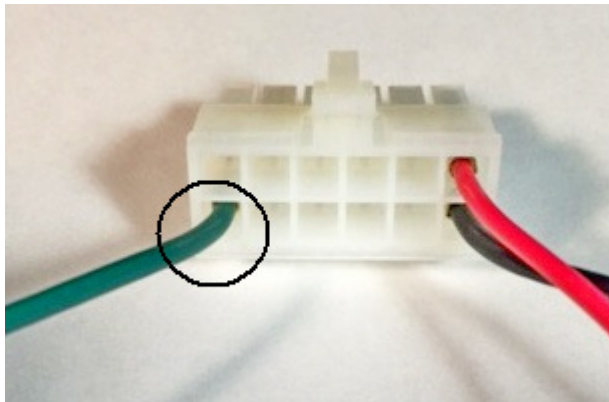
The Tach output wire (circled in photo) goes to the tachometer signal input. Tach output signal is 12V, 2 pulses per crank rev on 4 cyl. engines, 3 pulses on 6 cyl. and 4 pulses on 8 cyl.

Power, red wire in photo top right corner, goes to key switched fused 12 volts. Current draw is approximately 100mA or 0.1amps. A 1 or 3 amp fuse can be wired inline with the red wire if the power source has no fuse already.
Black wire in photo bottom right corner, goes to a known good ground such as chassis or Battery negative.

CPi signal cable connections 4cyl
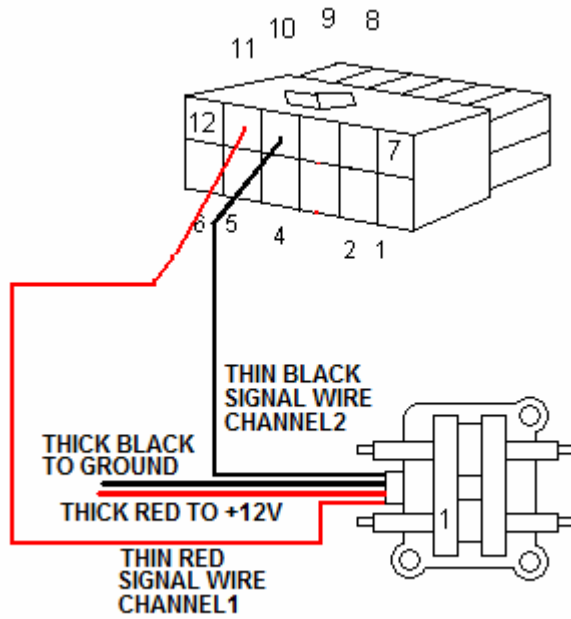
CPi signal cable connections 4cyl Twin spark plug per cylinder
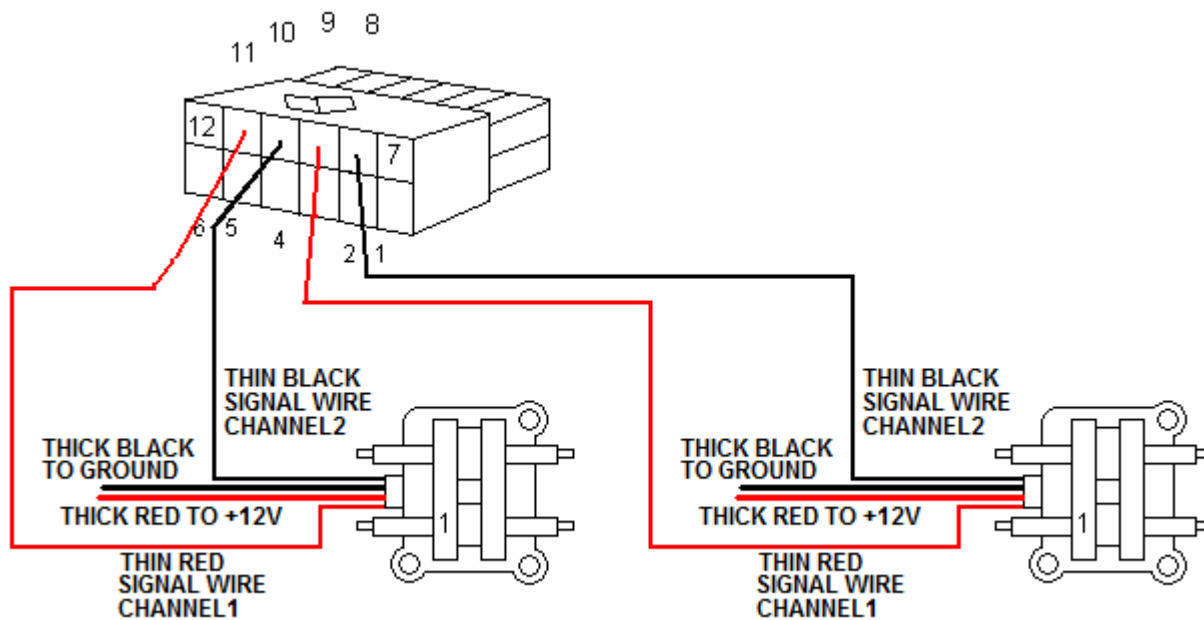
CPi ignition signal cable connections 6cylinder
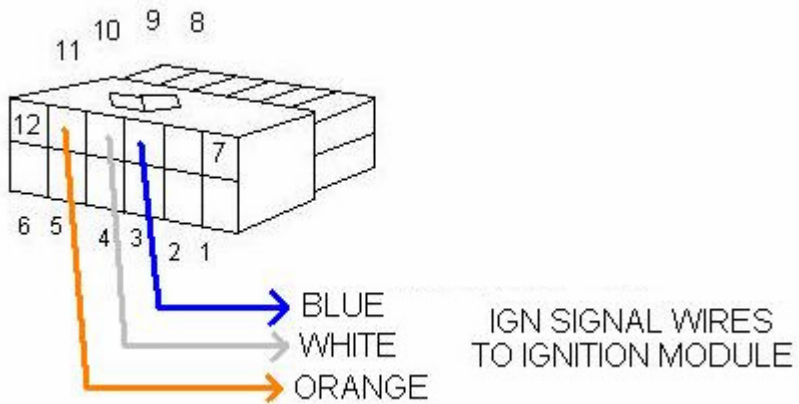
6 Cylinder coil pack

Long red connects to +12V power source, long black to ground.

CPi ignition signal cable connections 8 cylinder.
Chev, Dodge Pontiac, AMC, Lexus.

IGNITION SIGNAL
WIRES TO COIL PACKS

BLUE   WHITE   GRAY   ORANGE

BLACK TO GND
RED TO +12V
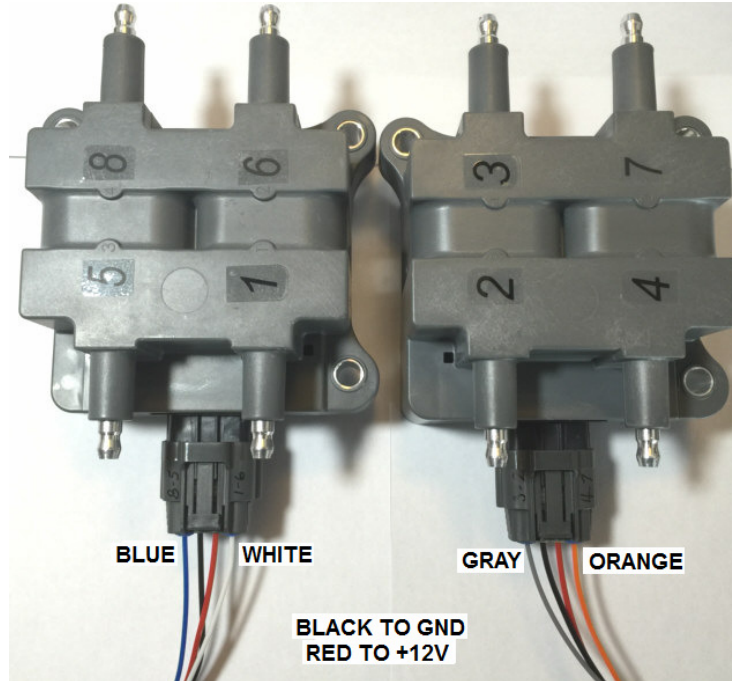
8 cylinder Ford Coil pack Wiring

IGNITION SIGNAL
WIRES TO COIL PACKS

FORD

BLUE   WHITE   GRAY   ORANGE

BLACK TO GND
RED TO +12V

PROGRAMMING THE CPi

MAGNET POSITION

```
MAG POS
        90°
```

Initial Setup - VERY IMPORTANT

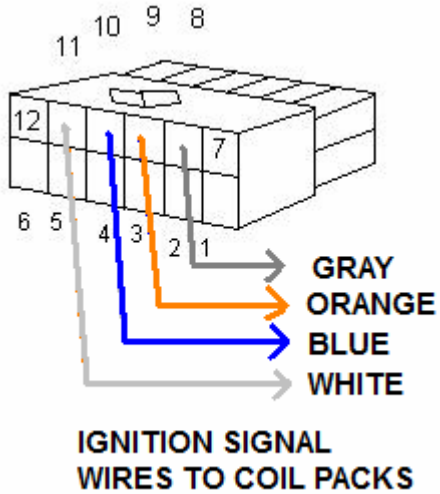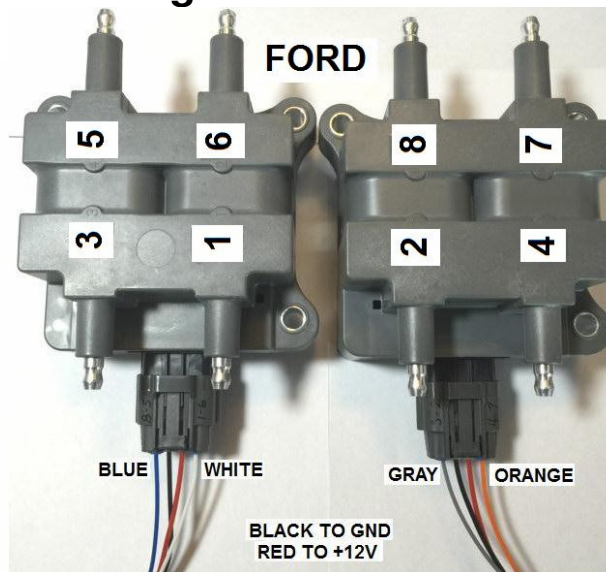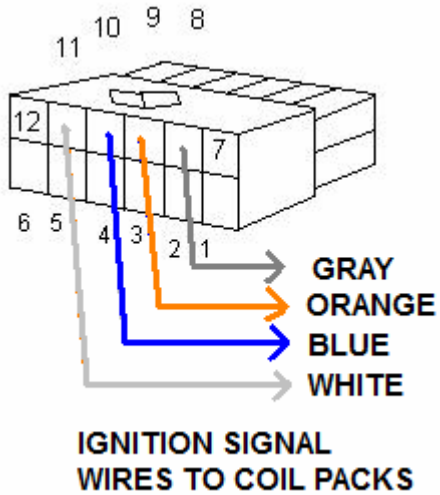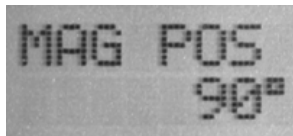This is how timing is calibrated. This step requires a timing light. The best timing light to use, is one that does not have a delay knob. Delay lights may not work properly with multi-spark ignitions or with multi-coil/waste spark ignitions. If you only have a delay type light set the delay to 0. The crank pulley and timing cover must have timing marks on them. The timing light inductive pickup clamp can also be connected onto the ground wire of the coil pack unit if clipping to the spark plug wires does not work well. Mag position is adjustable from 50 to 120.

This step should be performed as soon as the engine is fired up and idling. Ignition timing is meaningless without first setting the MAGNET POSITION parameter properly.
 Initially, use 90 on Continental O-200 engines. Use 100 on Continental IO-550 engines. Use 80 on Jabiru and Rotax 912 engines. Lycoming engines can skip this step. Magnet position is pre-set from the factory- 92 on single systems. Dual systems- 97 on CPI attached to top most Hall sensor, 88 on CPI attached to bottom most Hall sensor**. Make absolutely sure MAG POS settings are correct for each controller and Hall sensors are going to correct controller or ignition timing will be completely wrong. Poor running and engine damage can occur.**

STEP 1. Using the Programmer set the following parameters:

RPM IGNition 500 to a value of 5-10.
RPM IGNition 750 to a value of 10.
RPM IGNition 1000 to a value of 10.
RPM IGNition 1250 to a value of 10.
RPM IGNition 1500 to a value of 10.

If engine has a max rpm range of 4500, set RPM IGN 1100 thru 1500 to a value 10.
STEP 2. Make sure that all IGN RET-ADV/LOAD values below 30 inches are 0.
STEP 3. Start the engine and keep it running below 1500 rpm.
STEP 4. Connect a timing light.
STEP 5. Change the MAGNET POSITION value until the timing light reads 10 degrees BTDC.

Once the MAGNET POSITION is set, it does not have to be changed again- it is only to tell the ECU what the "distance" between the #1 MAGNET and Hall sensor is. Once the above 5 steps are completed, you can program any of the ignition values.

MAGNET POSITION may need to be adjusted if the Hall sensor is removed for engine repairs, so after it is installed again, then the above procedure should be completed, so the ignition timing is the same as before.

If you find you need to exceed the limits of mag pos then this means the magnets are mounted in the wrong locations and will need to be redone. Limits are 50 and 120 for this value.

## Gauge Mode Screen

```
RPM        0
  25"  10°
```

This screen is much like a dashboard, showing a live reading of engine RPM's, Manifold pressure (25 inches shown) and current amount of ignition timing on right side. Aircraft applications are in absolute inches mercury. Proper readings with a typical engine at idle should be around 8 to 12 inches with a prop installed.

Ignition Programming

Ignition timing requirements differ widely between various types of engines and fuels used so we can only offer general guidelines for ignition values. **SERIOUS ENGINE DAMAGE CAN OCCUR with improper values entered.** Excessively retarded timing can cause high exhaust gas temperatures while advanced timing can lead to pre-ignition and detonation. **Default values may not be correct for your engine!**

RPM IGNITION

RPM 2500
IGN 25°
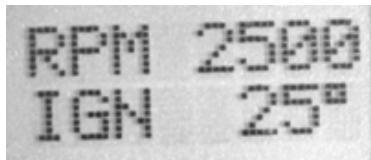
For example, if you want timing at 25 degrees BTDC at 2500 RPM go to RPM IGN 2500 and enter 25. Etc.

Most engines want total timing between 10 and 15 degrees BTDC at idle-. As RPM is increased, total timing is usually slowly increased up to around 1800 rpm where full rpm advance should be in. This figure is maintained right up to max rpm usually.

Here is a typical generic RPM only timing curve:

RPM	IGN
500	10
750	10
1000	10
1100	10
1200	12
1300	14
1400	16
1500	18
1600	20
1700	22
1800	24
1900	25
2000	25
2100	25
2200	25
2300	25
2400	25
2500	25
2600	25
2700	25
2800	25
2900	25
3000	25
3100	25
3200	25
3300	25
3400	25
3500	25
3600	25
3700	25
3800	25
3900	25
4000	25
4100	25
4200	25
4300	25
4400	25
4500	25

MP ADV RET
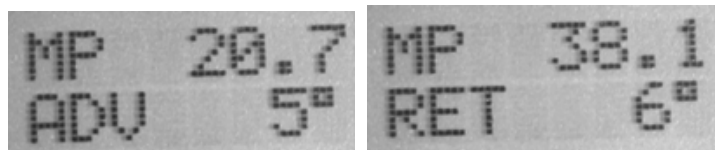
Manifold Pressure Advance/Retard.

These 64 settings allow programming of ignition retard or advance with reference to load on the engine. Load information is from the MAP (MP) sensor. RET refers to retard, and ADV refers to advance.

ADVance adds to your timing, usually at lower MAP to help fuel economy (left photo above).
RETard reduces timing, usually done at higher MAP to prevent detonation (right photo above).

ADVance will be added to RPM IGN, RETard will get subtracted from RPM IGN.

If too much retard is programmed, power output from the engine may be reduced significantly.
Advance may be useful to improve fuel economy. Advance can be programmed by pushing the -1 button.

Below are some example values for timing on Lycoming/ Continental engines. Some advance is used under low MAP to help fuel economy, and some retard at high MAP to help prevent detonation. The total timing column does not show all possible results. For instance the engine could be running at 2500 RPM with 28.9 inches MAP, so in this case, the total timing would be 25-4=21 degrees.

RPM	Value	MAP	Value	Ret/Adv	Total Timing
500	5-10	2.32	0	-	5-10
750	15	3.52	0	-	15
1000	20	4.72	0	-	20
1100	20	5.92	0	-	20
1200	20	7.12	0	-	20
1300	22	8.22	0	-	22
1400	23	9.42	0	-	23
1500	24	10.6	0	-	24
1600	25	11.5	0	-	25
1700	25	12.7	0	-	25
1800	25	13.9	0	-	24
1900	25	15.0	0	-	25
2000	25	16.2	0	-	25
2100	25	17.4	2	ADV	27
2200	25	18.6	2	ADV	27
2300	25	19.8	3	ADV	28
2400	25	20.7	3	ADV	28
2500	25	21.9	4	ADV	29
2600	25	23.0	3	ADV	28
2700	25	24.2	2	ADV	27
2800	25	25.4	0	-	25
2900	25	26.6	2	RET	23
3000	25	27.8	3	RET	22
3100	25	28.9	4	RET	21
3200	25	30.1	5	RET	20

Values for IGN RET-ADV/LOAD are limited to a maximum 25 degrees advance, and a maximum 25 degrees retard.

There are hundreds of possible timing curves available with the CPi to suit any engine, the previous examples are only hypothetical.

Optional Advance Switch

This option allows a dash mounted switch to activate the additional ignition advance timing programmed into this screen. The switch connections are one side to +12 volts, and the other side of the switch into pin12 via a blue wire.
Note, this cannot be used if Knock sensing is needed since both share the same input wire.
See Pin12 Function in Hidden Settings information. The proper function must be selected!

RUNUP(aka MAG CHECK)

Intended for aircraft with twin plug engines using a single Cpi to test operation of CPi coil pack(s).
4cylinder with single coil pack: Pressing the PLUS button will cut out spark on the coil pack.

4 cylinder using twin coil packs on 8 spark plug engines: Pressing the PLUS button will cut spark on the primary coil pack for 5 seconds. Pressing the MINUS button will cut spark on the secondary coil pack for 5 seconds.

6 and 8 cylinder: Pressing either plus or minus buttons on the keypad will cutout ignition completely.

On twin plug aircraft engines, when doing a runup test at low rpms like around 1000 rpm its best to have the ignition timing in the CPi unit programmed to 20 to 25 degrees. If timing is still at 10 degrees from doing timing light test, then increase the timing. Low timing of 10 or less will make the RPM's drop a lot when doing runup/mag check.

If the CPi is used alongside a magneto ignition, then you should program the timing at 1000 rpm and higher to match the magneto timing (commonly 25 degrees on most lycomings).
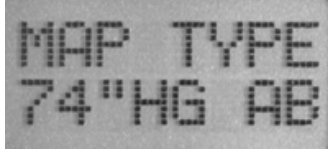For RPM Ignition 500, leave timing at 10 max, 750 RPM, 15 max.

Hidden settings.
These can be accessed by holding down the left arrow button when powering up the CPi unit.

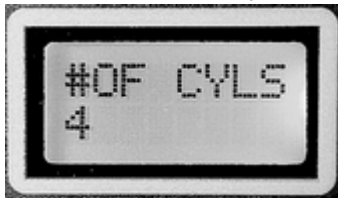Plus and minus buttons are used to change the settings.

Map Type

74" HG will be the aircraft setting. There are a variety of other settings for sensors which can be externally connected.

RPM Range

Allows selection of RPM range resolution. 4500, 9750 or 15,000 rpm can be selected.

Number of Cyls

Number of cylinders of the engine. 4,6 or 8.

Number of Coils

Multi or Single. Multi is used with coil pack or coil-on-plug. Single is for engines with only one ignition coil which use a distributor.

Coil Time

Adjusts the charge time or dwell of the coils in milliseconds. Default is 3.5mS. Increasing may help spark if running high boost on turbo/supercharged engines. Increasing dwell will increase current draw of the coil pack, and could cause the coil pack/ignition fuse to blow at high rpm. If experimenting with larger coiltime settings, rev the engine in neutral and monitor ignition current. One way to monitor current is to pull the coil pack fuse out and substitute your ammeter leads into the fuse socket. Fuse should be at least 50% greater amperage capacity than what you observe on the meter at redline.

Coil Test

This screen turns on coil test by pressing +1, turns off with –1. Remove all spark plug wires and place them close to ground so the spark can jump.
When turned ON, 1 coil will spark every 32.7 milliseconds. **Do not turn this ON when the plug wires are connected to the engines spark plugs, because fuel could ignite in the intake manifold**. See troubleshooting section.
This screen turns on coil test by pressing +1, turns off with –1. Remove all spark plug wires and place them close to ground so the spark can jump.

Config1 (no photo)

This value may control various functions in software. Factory set and locked. Change only if instructed to do so from the factory.

Pin12 Function

Used to select either Knock sensing or Ignition Advance Switch.
Press +1 to change the Pin12 function:
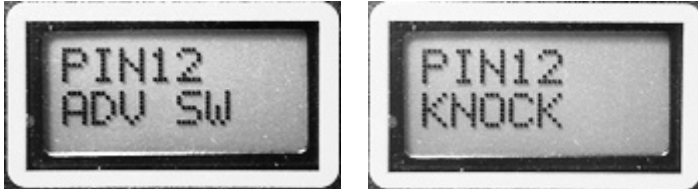
MAP CALI (no photo)

Offset value used at the factory to calibrate the MAP sensor.

Tach Output Signal

The CPI outputs a 12 volt tach signal. 4 cylinder units output 2 pulses per crank rev, 6 cylinder, 3 pulses, 8 cylinder, 4 pulses.

Troubleshooting

Testing the coil pack for spark (4 & 8cylinder) Caution high voltage!

The easiest test if the CPi unit is installed is to use the COILTEST function in the Hidden Settings area. This will send test signals out all channels of the CPi to the coil pack(s) connected.

Disconnect plug wires from engine spark plugs and place wires ends close to ground with a small gap to see the spark jump. You can also use spare spark plugs as shown in the photo, note how wires are connected in the photo.

Never test for spark by just removing the plug wires. Note how wire and plugs are connected in this photo.

Connect the black wire to ground and the red wire to +12 volts.

If the CPi unit is not connected and you just want to test the coil by itself then momentarily touch +12v momentarily to the input marked A or D on the black connector. A input fires one of the coils, D input fires the other coil. If you touch too long this may blow the fuse or pop the breaker.

Spark plugs

We recommend resistor type spark plugs only. Non resistor type may cause electrical interference.

Spark plug wires, **and Interference Problems**

Always use radio suppression type spark plug wires. NEVER use solid core wires.

Recommended wires:
Magnecor, MSD superconductor, NGK, OEM or factory carbon string, Accel 8.8 yellow.

Troubleshooting continued

Too much RPM drop when doing Runup(Mag check):
1. Program more ignition timing at 1000 RPM's and check all timing values in the RPM ranges where you are doing the mag check. If RPM ignition is still 10 at or above 1000 rpms then increase timing. See RUNUP section above. Most twin plug aircraft engines like Lycoming and Continental will drop a lot of rpm's unless you have 20 degrees or more for timing.
2. Check bottom spark plugs for oil or fuel fouling and change if necessary. Or swap bottom plugs with upper plugs and see if RPM drop decreases.
3. Unequal ignition timing in both cpi controllers if you have two cpi's. If used alongside a magneto timing may be different in the cpi from the magneto timing, so program the cpi as described in the Runup section above.

Will not start:

1. Check power and ground connections.
2. Check Hall sensor alignment.
3. No sync magnet being seen by the CPi unit. Check TRIG SYNC window and make sure all magnets are being seen.
4. Check # OF CYLS setting for 4,6,8 cylinder to make sure it is correct for the engine. This is in Hidden Settings so to access these you must hold down the left arrow button then power up the CPi.

Runs but no power

1. If you don't have a knock sensor installed set KNOCK RETARD to zero and KNOCK SENSE to 1.
2. Keep knock (yellow) wire away from spark plug wires.
3. Magnets positioned incorrectly, so timing is retarded too much. Check timing with a timing light (non-knob or non-delay type). See MAG POS.
4. RPM IGNITION values are too low.

RPM ERR message or engine miss:

1. Check alignment of Hall sensor over magnets. Loosen Hall sensor mounting bolts and try adjusting Hall sensor.
2. Check Hall sensor air gap. Should be close to .060".
3. Interference from plug wires.
4. Make sure that all CPi sensor wiring and Hall sensor cable is not close to spark plug wires or any high current/voltage wires.
5. Check spark plug gap, possibly too large. Reduce to confirm.

Coil pack fuse blows all the time:

1. Hall sensor and magnets not aligned.

I only received one magnet:

1. The magnets stick together really well. Separate them with your fingers.