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Peripheral Interface Controller Transistorized Ignition Module (PICTIM) Circuit Parts Kit

What is it?

This product is a collaborative effort between S/S Machine & Engineering LLC and Outpost Enterprises, LTD - two of the largest providers of ignition modules for model engine enthusiast and builders. Our goal was to create one physical ignition module that:

- can run on 6 to 12 volts (battery and coil)
- is efficient and minimizes battery consumption
- has a built-in automatic safety shutoff
- is easier to install (little to no "dwell" consideration)
- is microprocessor controlled (programmable)

Being programmable allows us to support multiple functionality with the on-board jumper or change of the microchip (PIC). Current PIC offerings:

- the DELUXE chip (included) performs both single spark, and multiple spark modes:
    - BASIC mode, which provides one spark per power stroke, for most low to mid RPM engines
    - BUZZ mode, which can provide up to 50 sparks on each power stroke, ideal for slower hit & miss or low compression engines

Possible future PIC offerings:
- an ADVANCE chip, automatic ignition advance timing for higher performance engines
- a rev limiter, to prevent an engine from RPM red-lining
- a "skip" chip, to fire on every other flywheel revolution (allow flywheel mounting of magnet/Hall sensor on 4 cycle engines)

The PIC integrated circuit is an amazing device. For all intents and purposes, it IS a complete computer in itself, with CPU, ALU (arithmetic/logic unit), BIOS, RAM, and ROM. The programs are written on PC's, compiled, then downloaded onto the PIC.

Disclaimer:

This kit is not difficult to assemble, but should be assembled by someone who is proficient at soldering PCB's (printed circuit boards) using a small pencil soldering iron not more than 30 watts in power. The PCB is a quality product made here in the USA, and the remaining components are manufactured by quality name brand suppliers, and they WILL be good when you receive them. Since there are lots of ways to destroy electronic components - overheating during soldering, wrong connections, short circuits, static electricity, magnetic fields, etc., so please take care while soldering, but if you do damage a component, e-mail us and we can quote you the price for a replacement.

PCB Assembly Notes: (these notes do NOT contain the dual mode jumper install)

Please read these instructions in their entirety before proceeding! Use a small diameter (.032"-.060") rosin core solder and a small pencil iron of around 20-30 watts with a nice clean conical or pyramidal shaped tip. Excess heat can kill electronic components, so make each connection quick then get the iron off. The longer the iron is in contact, the more heat that can conduct into the component. Some builders find it easier to solder by cutting the leads to within 1/32" after inserting the component into the board.

We find it easier to install the lower profile components first. This keeps the larger components from "getting in the way". However, feel free to install the components in any order you wish. Be aware that orientation is critical for most parts except the

resistors and the small capacitors. For heat-sensitive parts, grip the lead between the component and the board with a heavy pattern tweezer or alligator clip as each lead is soldered. This helps prevent the heat from conducting up the lead into the component, which could damage it.

Diodes D1-D4: These are heat sensitive, so solder them quickly. Align the banded end as indicated on the PCB. See Diagram 7. Be aware that the Zener diode (D4) looks similar to the 1N4148 diodes (D2 & D3), but it is slightly longer.

Resistors R1-R6 and Capacator C2: The resistors and capacitors C1 and C2 are not harmed by normal soldering heat and the use of a heat sink is not required. Orientation does not matter. Since C1 is tall, install it later.

The PIC socket: Make sure the notch end of the socket is aligned with the notch diagram on the PCB.

LED D5: The Light Emitting Diode is mounted directly on the board and a heat sink can't be used. These are heat sensitive also, so solder it quickly. It is polarized, so be sure the short lead (negative) is inserted in the "square" hole. If the leads are identical, the negative lead generally has the larger plate inside.

The Blue Terminal Blocks are not required, but they make wire hookup much easier. Solder the terminal blocks so that the openings for the wires are on the outer edge of the board. Experienced builders may wish to eliminate the terminal blocks and solder the external connections directly to the board, as this is usually a more secure connection.

Capacitors C3 and C4: These are cylindrical in shape, and are polarized. Make sure the shorter, negative lead is positioned in the "negative" hole as indicated on the PCB. See Diagram 7.

Transistors T1 & T2: Position the smaller transistor so its flat side is aligned with the flat side of the symbol on the PCB. **Use a heat sink!**

Capacitor C1: Finish up by soldering the large poly capacitor. It is not polarized, so orientation does not matter.

Component Checklist & Placement Chart

X	PCB Label	Component	Notes
__	D1	1N5817 Diode	Larger, black & white
__	D2	1N4148 Diode	Smaller, orange & black
__	D3	1N4148 Diode	"
__	D4	1N5231B 5.1v, .5w Zener Diode	Medium size, orange & black
__	R1	1K Ohm 1/8 Watt Resistor 5%	Brown-Black-Red-Gold
__	R2	51K Ohm 1/8 Watt Resistor 5%	Green-Brown-Orange-Gold
__	R3	1K Ohm 1/8 Watt Resistor 5%	Brown-Black-Red-Gold
__	R4	200 Ohm 1/8 Watt Resistor 5%	Red-Black-Brown-Gold (may appear light blue w/dark blue bands)
__	R5	10K Ohm 1/8 Watt Resistor 5%	Brown-Black-Orange-Gold
__	R6	360 Ohm 1/8 Watt Resistor 5%	Orange-Blue-Brown-Gold (may be 1K Ohm instead)
__	C2	.1uF 104K K5M Capacitor	Small, ceramic
__	PIC	PIC IC Socket	Align dot or notch on socket with notch on PCB diagram
__	D5	Red Light Emitting Diode	Polarized, make sure short lead is placed in the "square" hole
__	Hall/Points	4 Position Screw Terminal Block	Make sure wire connectors are facing the outside edge
__	Coil/Batt	4 Position Screw Terminal Block	"
__	C3	100uF Capacitor	Medium sized, electrolytic (polarized)
__	C4	330uF Capacitor	Large, electrolytic (polarized)
__	T1	KSC815YTA NPN Transistor	Align flat side of transistor with PCB diagram
__	T2	FGI 3040G2 IGBT (large transistor)	Align metallic back along PCB edge
__	C1	.1uF 104K Capacitor 400v	Large, poly

Trim the component leads on the bottom of the board as close as possible with diagonal cutters. Carefully check the circuit traces and especially between component solder pads under magnification to make sure there are no solder bridges across them.

Make sure you are fully discharged of any static electricity, then carefully insert the PIC chip into the socket, again, making sure the notch end of the chip is aligned with the notch end of the socket.

PICTIM Module Installation Notes:

Wiring: Place the ignition module, coil and battery as close to the engine as possible to reduce current losses in the connecting

wires. Battery and coil wire should be from #20 to #22 gauge - a medium size stranded wire that will carry 4 amps of current. Ideally, use red for +, black for -, and yellow or white for the coil leads. The wiring distance and wire size from the points or Hall sensor (whichever you use) to the PCB can be small -- wire as small as #28 a foot long has been successfully used.

Points: If you use conventional points, you don't need a capacitor across them. You can use a tiny micro-switch instead of conventional points and the contacts will not burn because the current through the contacts is very low and there is no arcing. Again, no condenser is used. Connect to the PCB as per Diagram 3. If using the BUZZCOIL PIC, unlike with conventional ignition, the plug will fire when the points are closed instead of when they open. The LED on the board will be of help in setting the timing. If you use standard ignition points where one contact is grounded to the engine frame (normal practice), connect a ground wire from the engine frame to the "minus" or "G" of the "Hall or Points" block as shown in Diagram 3. DO NOT use the engine mounting bolts for your ground connection.

Hall Sensor: Most builders like the Hall Effect setup and use it on most of their engines. There are no mechanical contacts at all and therefore no adjustments once set and no wear ever. Connect the Hall sensor to the PCB as per Diagram 2. By trial, determine which pole (south) of the magnet activates the Hall sensor and mark it. Drill a shallow pocket in the side of the cam gear for the magnet so it will be flush with the gear surface and the marked side up. JB Weld can be used for this. If the cam gear is iron or steel (magnetic), you will need to separate the magnet from the iron by about 3/32" or so with a non-magnetic spacer material such as aluminum, brass or plastic. If there is room, drill or mill a ¼" or 5/16" diameter pocket for the plug and mount the magnet in the plug. The Hall sensor should be mounted so that it will be within about 1/32" of the magnet when it passes by. The printed side of the Hall sensor faces the magnet as per Diagram 5. If you mount the sensor on an arm that pivots around the cam shaft, you will have adjustable spark advance and retard. For the BUZZCOIL PIC, the larger the circle the magnet is mounted in relation to the camshaft center, the shorter the time the coil will be energized (dwell). Too short a time may cause a weak spark or no spark at all. For info on correct dwell angles, see:
http://www.model-engine-plans.com/partskits/ignitionsystems/howtobuildtransistors.htm#dwell.

Dwell is NOT a factor/concern for the BASIC and ADVANCE PIC as the coil is energized only when the magnet has passed the Hall and just at the moment it is out of range (the moment when the LED goes from on to off).

The T2 transistor should never get more than luke warm in use. If it gets really warm, try attaching an aluminum plate heat sink to the backside of it to help dissipate heat. Although there is a built-in safety shut-off to prevent over-energizing of the main circuit and coil, ALWAYS DISCONNECT POWER TO THE CIRCUIT WHEN THE ENGINE IS NOT RUNNING.

VERY IMPORTANT - Hall Effect sensors and Micro Switches do not have electrical ground contact with the engine frame. If you are using one of these for ignition, provide a ground wire from the engine frame to the "G" position of the "Hall or Points" screw block (see Diagram 2) on the PCB. Without a ground, the Hall sensor and possibly the circuit board will be destroyed by the coil high voltage (common ground, 3-wire coils).

Coil: Any of our coils, or coils with similar specifications, should work fine. Note that the final IGBT transistor switches the coil on the negative lead, so any coils with exposed ground (like our red ATV coil) should be isolated from the engine frame, or you will short and burn up your coil. *Always place the coil as far away from the PICTIM as possible to avoid electro-magnetic interference/ erratic PICTIM behavior*. Sometimes, metal shielding around the PICTIM is required to deflect this interference.

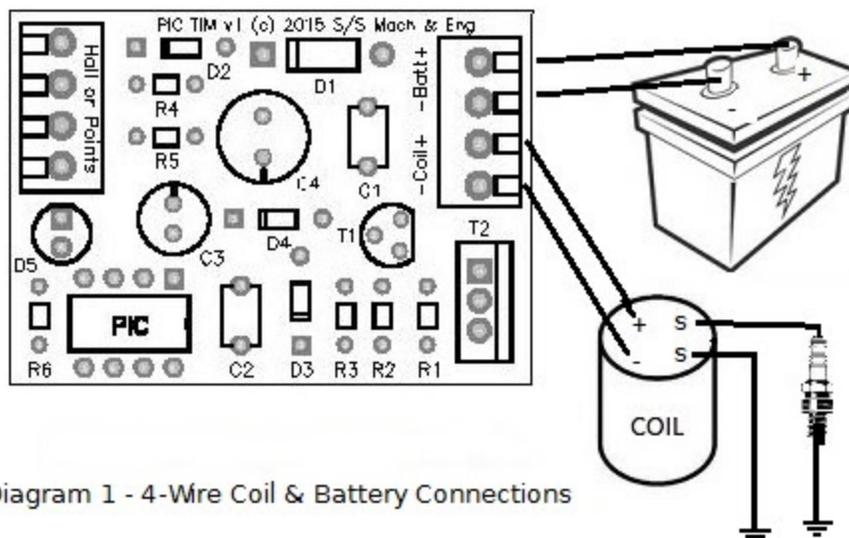Do NOT exceed 12 volts. If using a 6 volt coil, do not exceed 6 volts to the PICTIM.

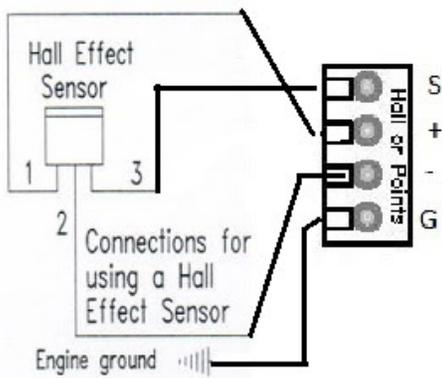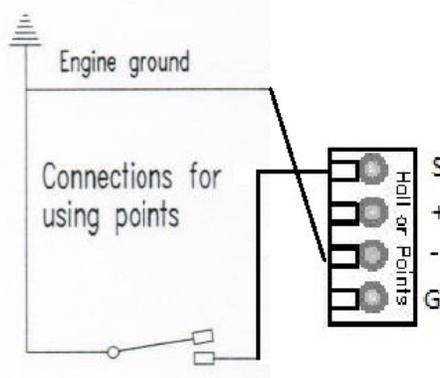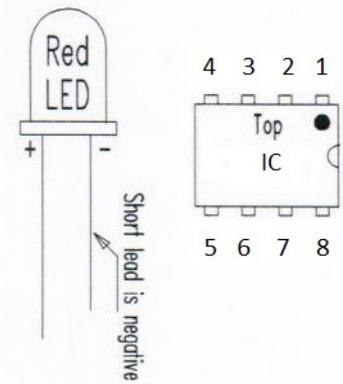Diagram 1 - 4-Wire Coil & Battery Connections

Diagram 2

Hall Effect Sensor

1 3
2

Connections for using a Hall Effect Sensor

Engine ground

Hall or Points
S
+
-
G

Diagram 3

Engine ground

Connections for using points

Hall or Points
S
+
-
G

Diagram 4

Red LED
+ -

Short lead is negative

4 3 2 1
Top
IC
5 6 7 8

Diagram 5

Bevel indicates active magnetic sensing side

N S
Magnet

Hall

1 2 3

(Optional Hall Effect Sensor)

Diagram 6

Cathode   Anode
1N
xxxx

Orientation of Diodes

Diagram 7

Polarity band showing the negative lead

Negative Lead: Shorter

Positive Lead: Longer
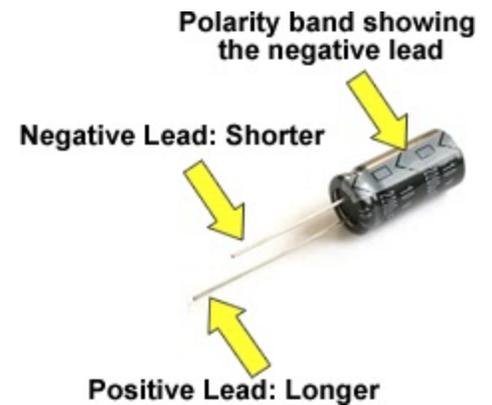

Many of the old hit-n-miss engines used spark saver switches. They extend running time between battery charges. The spark saver switch is mounted so that when the exhaust valve is being held open and the engine is coasting, the switch (Hall Sensor) is open and preventing a spark. You can mount the spark saver magnet on a brass post affixed to the exhaust valve push rod. Mount the Hall sensor stationary so the sensor is only "on" when the valve is closed.

Spark Saver
Hall
1 3
2

Ignition
Hall
1 3
2

Engine Ground

Hall or Points
S
+
-
G
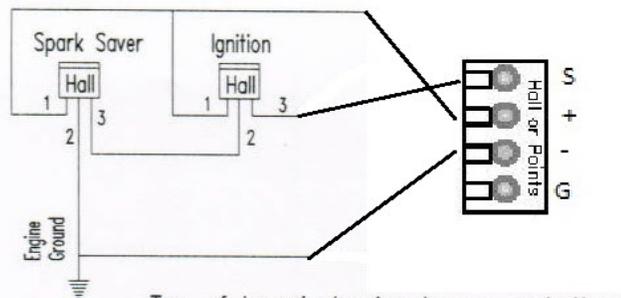
Top of board showing traces on bottom

Spark Saver Using (1) Hall Effect Sensors
(Use two optional Hall Effect Kits)

+

Spark Saver
Hall
1 3
2

Signal

Engine Ground

Ignition (points)

Hall or Points
S
+
-
G
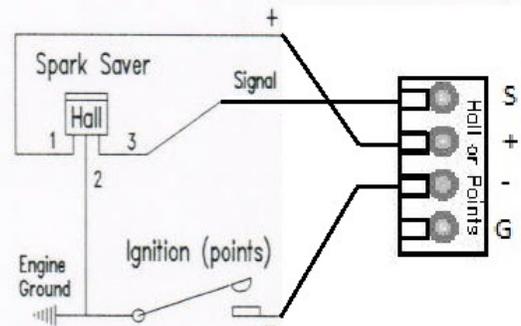
Top of board showing traces on bottom

Spark Saver Using (1) Hall Effect Sensor & (1) Micro-Switch or Conventional Points Set

(Use one optional Hall Effect Kit)

PICTIM Operation Notes:

Power applied to the PICTIM should range between 6 and 12 volts. Voltage applied should be dependent upon the coil connected to it, i.e. if the coil requires 6 volts, then run the PICTIM on 6 volts. If the coil requires 12 volts, then run the PICTIM with 12 volts.

The PICTIM built-in safety shut off will cut off power to the coil and the majority of the PICTIM circuitry, however, the PIC IC itself will always remain on and consume some, although minimal, battery power. For this reason we recommend installing an on/off ignition switch between the battery and the PICTIM in your ignition circuit.

The jumper located next to the LED determines operation mode. To change modes, disconnect power from the PICTIM before changing the jumper. Note that pin 4 of the PIC chip is intentionally NOT inserted in the IC socket. Make sure this chip leg does not touch the diode legs, or anything!

The "Basic" PIC operation (jumper OFF):

When the Hall sensor is activated (or points/micro-switch close), the LED will light. The LED will remain on until the Hall sensor no longer detects the magnet (or points/micro-switch open). At the moment the LED goes from ON to OFF, the PICTIM will send current to the coil for 2 ms, then stop. The cycle then repeats. Unlike the TIM6 and BuzzCoil ignition modules, the coil is NOT energized when the LED is on, but ONLY during the transition from ON to OFF.

When the LED is on, think of it as a cocked hammer on a firearm. The gun hasn't fired, but is set to fire when the trigger is pulled, and in the case of the "Basic" PIC, the trigger is pulled when the LED turns off. Since the coil is energized for only 2 ms during each cycle, there are no "dwell" concerns. "Dwell" is the duration of time the switch is on during each cycle. For basic ignition modules like the TIM6 ignition, too little or too much will adversely affect the operation of the engine and/or ignition system. For the PICTIM and "Basic" PIC, simply physically adjust the Hall/magnets (points/micro-switch) to fire the plug when the LED state goes from ON to OFF, and you're all set.

The "Buzz" PIC operation (jumper ON):

In a nutshell, the coil and LED are activated for the duration of the Hall activation (or points/micro-switch closed) BUT power to the coil will automatically time out after 50 consecutive sparks, or when the LED goes off, whichever comes first. While the LED is on, the coil is energized for 2 ms, then cut for 3 ms, then energized for 2 ms, then rest again for 3 ms. This repeats a max of 50 times. If your engine won't fire after 50 sparks, I think you have a carburetor problem!

The beauty of this setup is that the spark plug will fire multiple times when starting or running at very low RPM's, better insuring combustion, but as the engine accelerates, fewer sparks per cycle will occur, and if "dwell" is minimal, will fire only once at high RPM, thus minimizing battery consumption.

So, for the Buzz PIC, "dwell" can be a factor, but is much diminished from that of the TIM-6. Too little dwell is not a factor because the coil will be energized at least once for at least 2 ms on each cycle. Too much dwell is much less of a factor because the Buzz PIC will automatically shut off the coil after 250 ms (2ms on + 3ms off x 50). However, dwell can be adjusted for optimum engine efficiency and minimal battery consumption. For more information on dwell, see:

http://www.model-engine-plans.com/partskits/ignitionsystems/howtobuildtransistors.htm#dwell