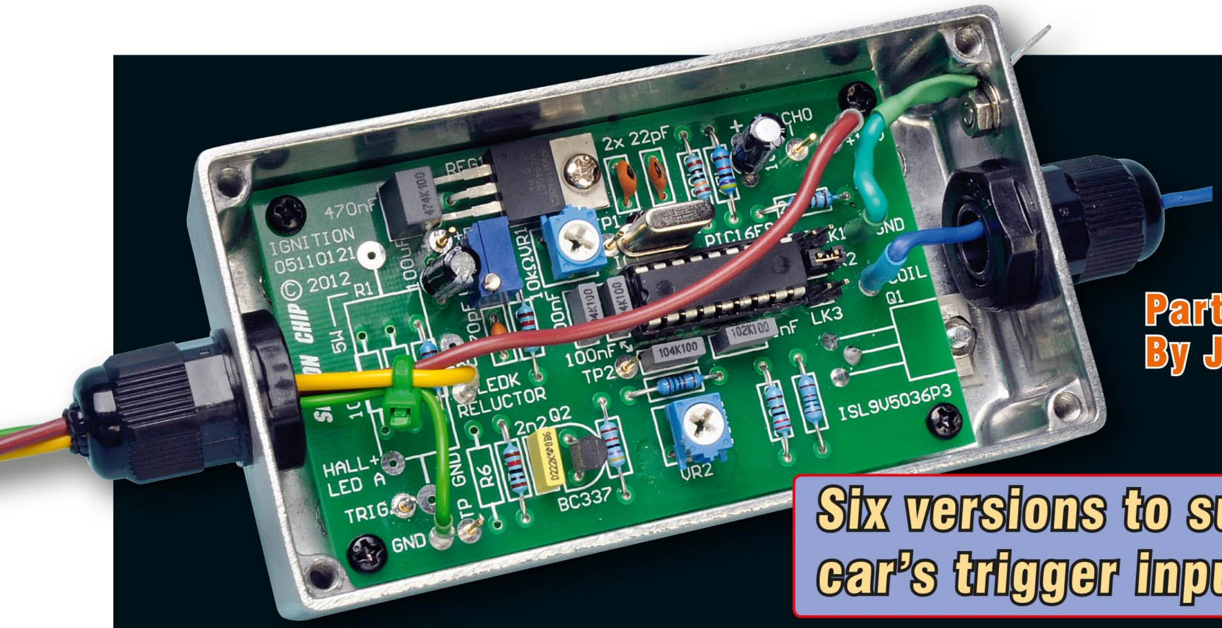


Part 2:
By John Clarke

Six versions to suit your car's trigger input

High-Energy Electronic Ignition System

In Part 1 last month, we introduced our new *High-Energy Electronic Ignition System* and described its operation. In this article, we give the assembly details for six different versions, to suit your car's trigger input, including an ECU/coil tester version.

THE ELECTRONIC IGNITION IS built on a PCB coded 05110121 and measuring 89 × 53mm. This is housed in a 111 × 60 × 30mm diecast aluminium case to give a rugged assembly. Two cable glands, one at either end of the case, provide the cable entry and exit points for the power supply, coil switching and input trigger leads.

The first step is to check the PCB for any defects. You then have to decide which version you are going to build. There are six different versions and it's important to choose the version that suits your car's trigger sensor. For example, if your car has a distributor with a reluctor pick-up, use the layout shown in Fig.5. If it has a Hall Effect or Lumenition trigger, follow the layout of Fig.6.

Similarly, if you are using an existing 5V trigger signal from your car's ECU (electronic control unit), build the layout shown in Fig.10. This is also the version to build if you intend using the unit purely as a coil tester.

Note that the same PCB is used for each version. It's just a matter of installing the relevant input trigger parts to suit your car.

Mounting the parts

Begin the assembly by installing PC stakes at the external wiring points, test points TP1, TP2 and TP GND and at the +5V point (near REG1). The three 2-way pin headers for links LK1-LK3 can then be fitted, followed by the resistors. Table 1 shows the resistor colour codes, but you should also check each one using a digital multimeter before soldering it in place.

Follow with the IC socket, making sure it is oriented correctly, but don't install the PIC micro yet. The capacitors can then go in (orient the two electrolytics as shown), then install crystal X1 and the trimpots. Note that the Reluctor version has an extra trimpot (VR3). This is a multi-turn trimpot and it must be installed with its adjusting screw in the position shown.

Regulator REG1 and transistor Q2 (in the Reluctor version) can then go in. Be sure to fasten REG1's tab to the PCB using an M3 × 10mm machine screw and nut before soldering its leads.

IGBT mounting details

Fig.11 shows the mounting details for IGBT transistor Q1. It's secured to the base of the case, with its leads bent at right angles and passing up through the underside of the PCB.

For the time being, simply bend Q1's leads upwards through 90° and

Where to buy kits

Jaycar and Altronics have full kits (including the case) available for the High Energy Electronic Ignition System. The Jaycar kit is Cat. KC-5513 while the Altronics kit is Cat. K4030

PCBs: a PCB for the High Energy Electronic Ignition System is available from the *EPE PCB Service*.

test fit it to the PCB – but don't solder its leads yet. Its tab mounting hole must be clear of the edge of the PCB, as shown in the diagrams.

That done, fit the PCB assembly inside the case and slide it to the left as far it will go, to leave room for Q1. The mounting hole positions for the PCB and Q1's tab can then be marked inside the case, after which the PCB can be removed and the holes drilled to 3mm (hint: use a small pilot drill first).

Deburr these holes using an oversize drill. In particular, Q1's mounting hole must be slightly countersunk inside the case to completely remove any sharp edges. The transistor's mounting area should also be carefully smoothed using fine emery paper. These measures are necessary to prevent the insulating washers which go between Q1's metal tab and the case from being punctured by metal swarf or by a high-voltage arc during operation.

Having drilled the base, the next step is to mark out and drill holes in the case for the two cable glands. These holes are centrally located at either end and should be carefully reamed to size so that the cable glands are an exact fit.

You will also have to drill a 3mm hole for the earth connection in one end of the case. This goes in the end adjacent to the GND connection on the PCB – see photos.

Installing the PCB

Once the case has been drilled, fit 6.3mm tapped nylon stand-offs to the PCB's corner mounting holes using M3 × 5mm machine screws. That done, the next step is to fasten Q1 in place. As shown in Fig.10, its metal tab is insulated from the case using two TO-220 silicone washers and an insulating bush and it's secured using an M3 × 10mm screw and nut.

Do this screw up finger-tight, then install the PCB in the case with Q1's leads passing up through their respective

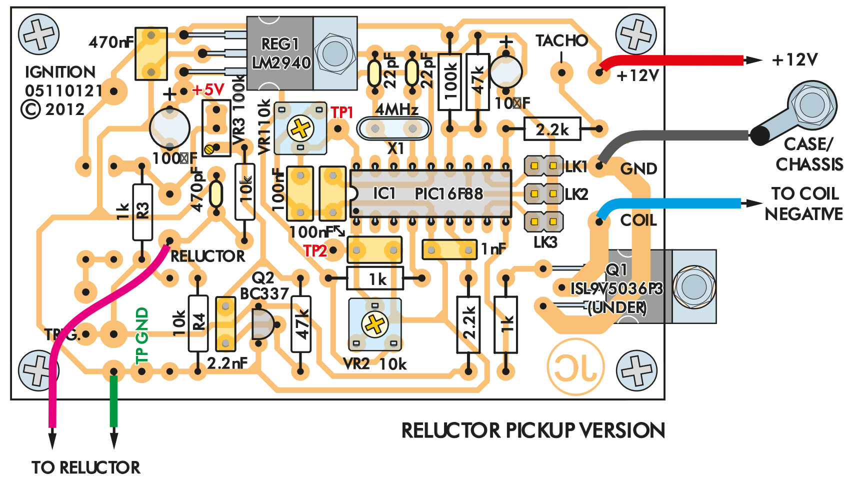


Fig.5: follow this PCB layout diagram if your car's distributor has a reluctor pick-up. Note that Q1 mounts under the PCB and is secured to the bottom of the case using an M3 × 10mm machine screw and nut – see Fig.11.

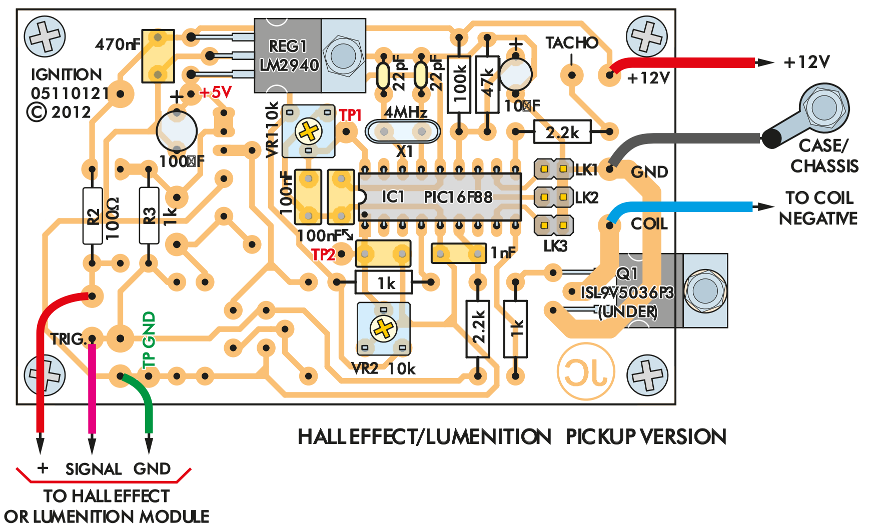


Fig.6: this is the layout to follow if the distributor uses a Hall Effect device or a Lumenition module. Take care with component orientation.

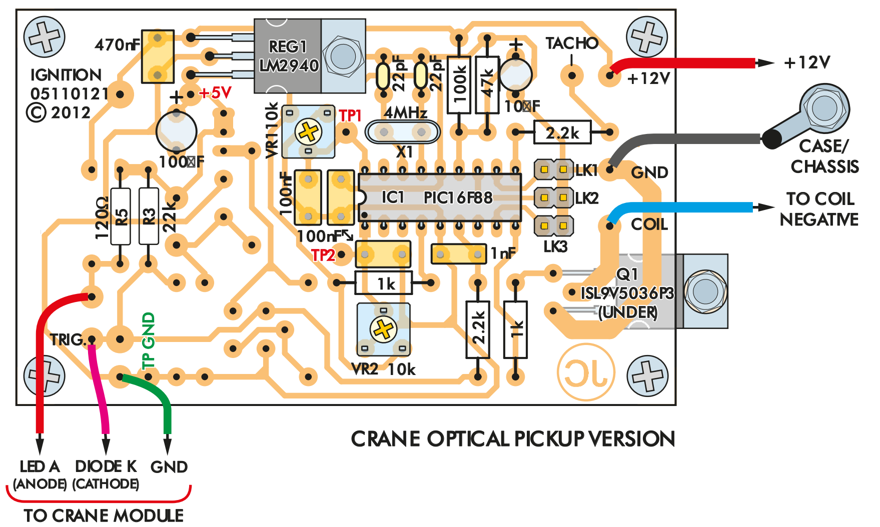


Fig.7: build this version of the ignition if your distributor has been fitted with a Crane optical pick-up.

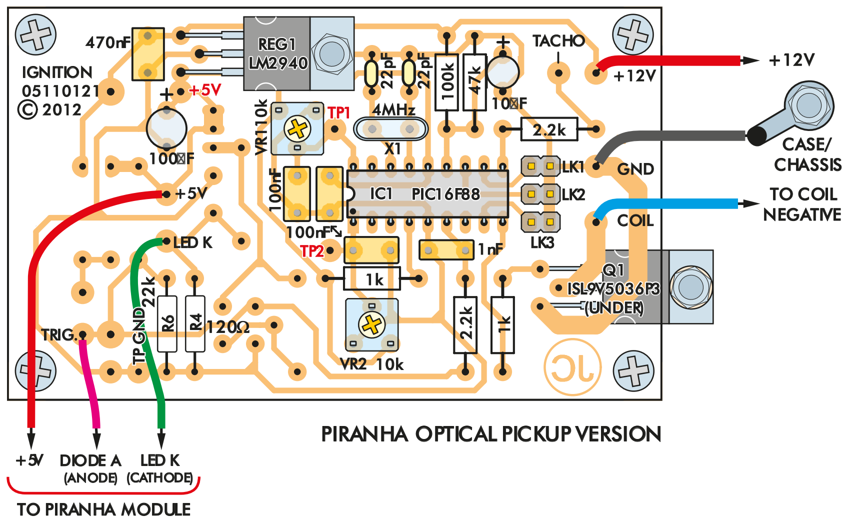


Fig.8: the Piranha optical pickup version is similar to the Crane version but note the different locations for the 22kΩ and 120Ω resistors.

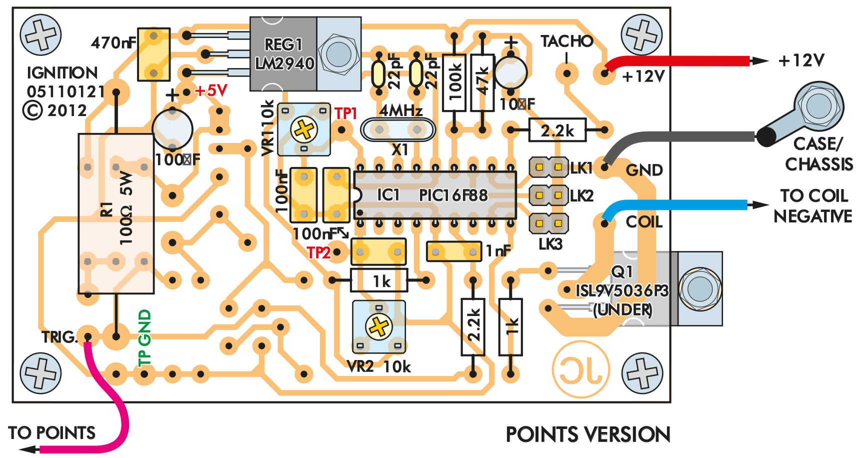


Fig.9: this is the Points version. Secure the 100Ω 5W resistor (R1) to the PCB using neutral-cure silicone, to prevent it from vibrating and fracturing its leads and/or solder joints.

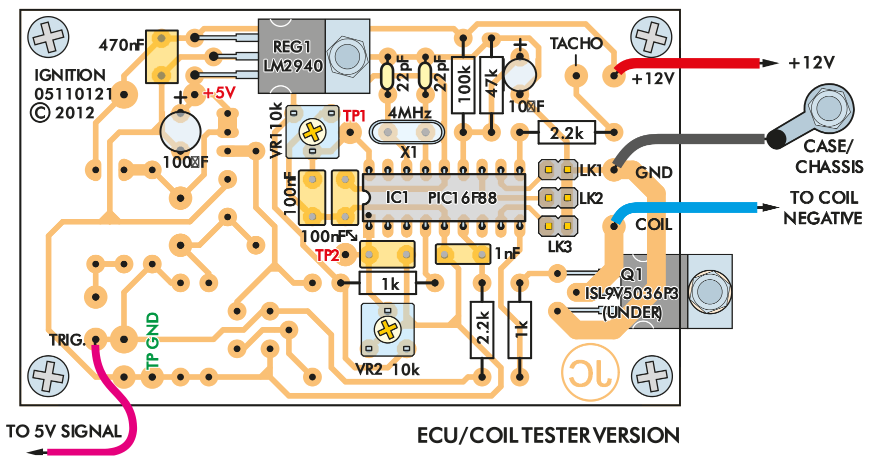


Fig.10: the ECU (engine management) trigger version requires no additional input conditioning circuitry. In this case, the ECU trigger signal goes straight to pin 6 of IC1 via a 2.2kΩ resistor. Build this version also if you only intend using the unit as a coil tester, in which case the 5V trigger input isn't needed.

mounting holes. The PCB can now be secured in place using four more M3 × 5mm machine screws, after which you can firmly tighten Q1's mounting screw (make sure the tab remains centred on the insulating washers).

Finally, use your multimeter to confirm that Q1's tab is indeed isolated from the metal case (you should get an open-circuit reading), then solder its leads to the pads on top of the PCB.

External wiring

All that remains now is to run the external wiring. You will need to run leads through the cable glands and solder them to the relevant PC stakes for the power, coil and input trigger connections. **Note that the coil wire is the only wire that's fed through that righthand cable gland (important to prevent interference due to high-voltage switching glitches; eg, by capacitive coupling into the power and trigger leads).**

The remaining leads (with the exception of the earth lead) must all be run through the other cable gland, at the trigger input end of the case.

As shown in the photos, we fitted heatshrink tubing over the PC stake connections, to prevent the wires from breaking. **So before soldering each lead, fit about 6mm of 3mm-diameter heatshrink tubing over it, then slide it over the PC stake and shrink it down after the lead has been soldered.**

The earth connection from the PCB goes to a solder eyelet lug that's secured to the case using an M3 × 10mm screw, nut and star washer. This same screw also secures a quick connect lug on the outside of the case (see photo).

Initial checks and adjustments

Now for an initial smoke test – apply power to the unit (between +12V and GND) and use your DMM to check the voltage between the +5V PC stake and GND. It should measure between 4.85V and 5.25V. If so, switch off and insert the programmed PIC (IC1) into its socket, making sure it goes in the right way around.

You can now do some more tests by connecting the car's ignition coil between the +12V and COIL leads. The unit should be powered from a 12V car battery (or motorcycle battery), with the case connected to battery negative. The coil's HT (high tension) output should be fitted with a paper clip (or similar) which is then positioned so that it can spark back to the coil's negative terminal over about a 5mm gap.

Before connecting the +12V supply, set the dwell trimpot (VR1) fully anticlockwise and install a jumper on LK2 to enable the spark test mode. That done, apply power and slowly adjust VR1 clockwise. The sparks should start and gradually increase in energy with increased dwell. Stop adjusting VR1 when the spark energy reaches its maximum.

This sets the dwell period to suit your ignition coil. Note that, during the spark test procedure, the spark frequency can be changed using VR2.

Note also that when accelerating, the rapid change in the time between successive firings can cause the dwell to reduce. That's because the micro determines when the coil is to be switched on, based on the previous period between plug firings. During acceleration, this period reduces for each successive firing.

To counteract this reduction in dwell, the software dwell calculation also takes into account the rate of change in the period between firings. This ensures that the initial set dwell period is maintained under normal acceleration. However, you may need to set the dwell to slightly longer than 'optimal' (by adjusting VR1 clockwise) to ensure sufficient dwell during heavy acceleration.

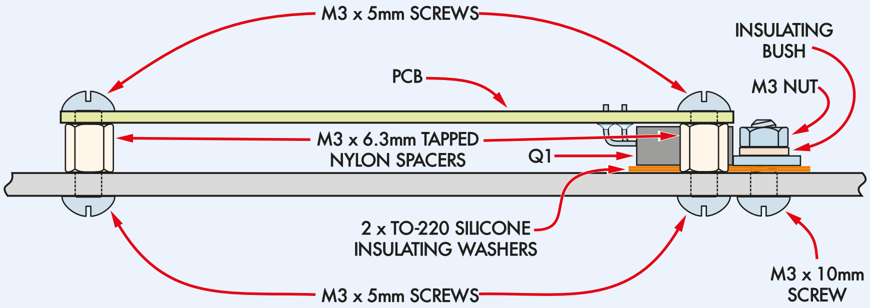


Fig.11: the PCB and IGBT (Q1) mounting details. Note that Q1's metal tab must be insulated from the case using two TO-220 silicone washers and an insulating bush. After mounting, use a multimeter (set to a low-ohms range) to confirm that the tab is properly isolated; it must not be shorted to the case.

That completes the dwell adjustment procedure. **Link LK2 should now be removed, so that all three 2-pin headers (LK1-LK3) are open.**

Installation

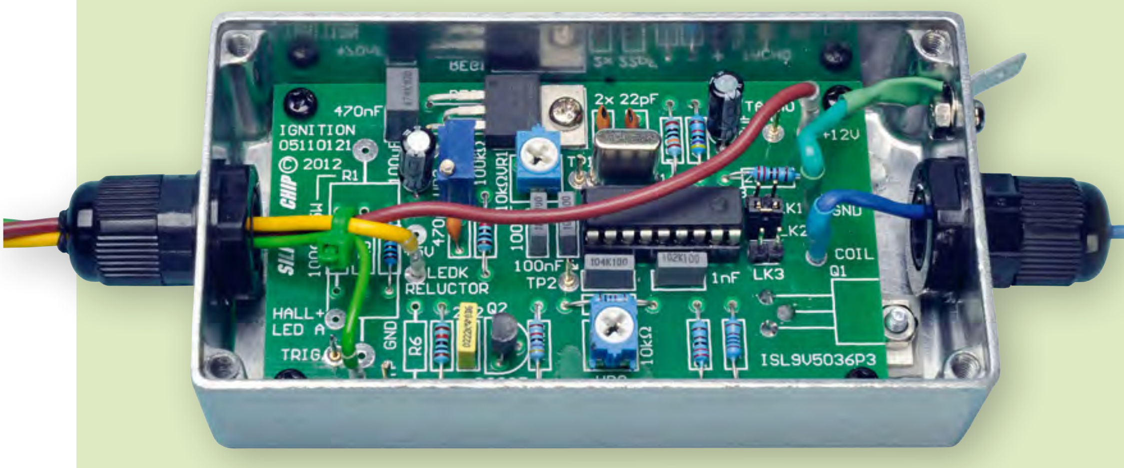
The *Electronic Ignition* box should be installed in the engine bay close to the distributor. Make sure that it's well away from the exhaust manifold and the catalytic converter (if fitted), so that it doesn't overheat.

Use brackets and screws to secure the box to the chassis. That done, wire the positive supply lead to the +12V ignition supply, the negative earth lead to the car chassis (if necessary) and the trigger inputs to the trigger unit in the distributor. The coil lead goes to the coil negative, replacing the existing switched negative lead.

If you are using the Reluctor circuit, connect the Reluctor trigger unit, adjust VR3 fully anti-clockwise and measure the voltage at the trigger test point (TP TRIG). If the voltage is close

Table 2: Capacitor Codes

Value	µF Value	IEC Code	EIA Code
470nF	0.47µF	470n	474
100nF	0.1µF	100n	104
1nF	0.001µF	1n	102
22pF	NA	22p	22



This is the view inside the completed unit (Reluctor pick-up version shown). Be sure to build it for good reliability by fitting heatshrink over the solder joints on the PC stakes and by fitting a cable tie to the leads as shown. Note that the lead to the coil negative is the only one that exits through the righthand cable gland.

Table 1: Resistor Colour Codes

❏	No.	Value	4-Band Code (1%)	5-Band Code (1%)
❏	1	100kΩ	brown black yellow brown	brown black black orange brown
❏	1	47kΩ	yellow violet orange brown	yellow violet black red brown
❏	2	2.2kΩ	red red red brown	red red black brown brown
❏	2	1kΩ	brown black red brown	brown black black brown brown

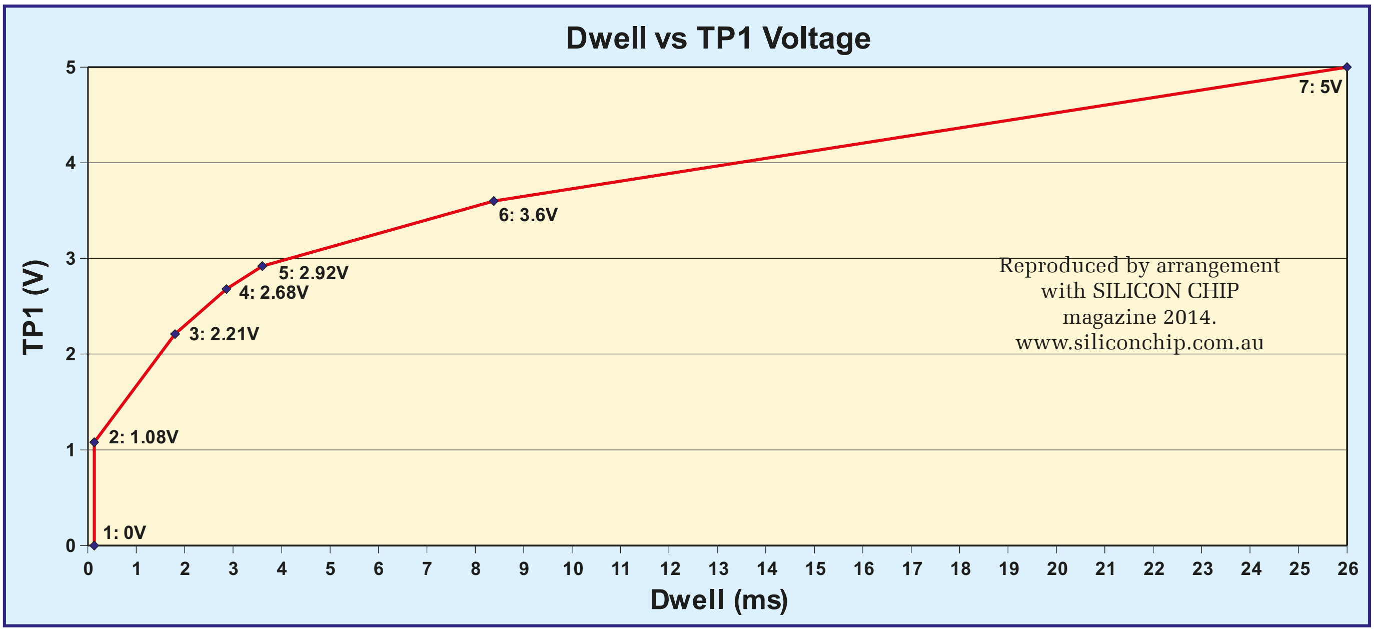


Fig.13: you can check the dwell setting by measuring the voltage at test point TP1 and then reading the dwell period (in milliseconds) off this graph. The dwell is adjusted using trimpot VR1 to give maximum spark energy, as described in the text (see initial checks and adjustments).

to zero, wind VR3 clockwise several turns until the voltage goes to +5V, then wind it another two turns clockwise and leave VR3 at that setting.

Now check that LK1-LK3 are all open (ie, no jumpers installed), then try to start the engine. If it doesn't start, try the invert mode by installing LK3.

If you have a Reluctor pick-up, it's important that the engine fires on the leading edge of the trigger signal. That edge should coincide with the leading edge of each tooth on the Reluctor ring as the distributor shaft rotates, otherwise the timing will usually be so far out that the car won't start. In that case, you can either swap the Reluctor leads or install LK3 as described above.

The quick-connect terminal at the right-hand end of the case provides a convenient connection point for the earth lead.

Once the engine starts, adjust the debounce trimpot (VR2) for best results. This adjustment should be set as low as possible (ie, set VR2 anticlockwise as far as possible). An increased debounce period will be required if the engine runs erratically and it's just a matter of adjusting VR2 clockwise until smooth running is obtained.

If that doesn't do the trick, then the follow mode may be necessary. This is selected using LK1 and will typically be required for badly worn points or worn distributor shaft cam lobes and/or shaft bearings.

Note that, in the absence of trigger signals, the coil switches off after 1s for debounce settings of 2ms and less, or after 10s for debounce periods greater than 2ms. The debounce setting can be measured by connecting a multimeter between TP2 and TP GND. As stated, VR2 sets the debounce period and the calibration is 1ms per 1V.

Ignition coil

For most installations, it's usually best to keep the original ignition coil and ballast resistor (if one is used). If you intend using a different coil, make sure it is suitable, especially if you intend setting the debounce period so that there's a 10s delay before the coil switches off in the absence of trigger signals. In that case, it's important that the coil is able to cope with the continuous current that will flow through it for this period without overheating.

A ballast resistor will prevent excessive current flow through coils that have a low resistance (ie, below 3Ω).

Connecting a tachometer

Finally, the Tacho output (top-right of the PCB) should be suitable for driving most digital tachometers. However, an impulse tachometer will require a signal voltage that's derived from the negative side of the coil. If that doesn't work, try operating the ignition unit in 'follow' mode by installing a jumper across LK1.