

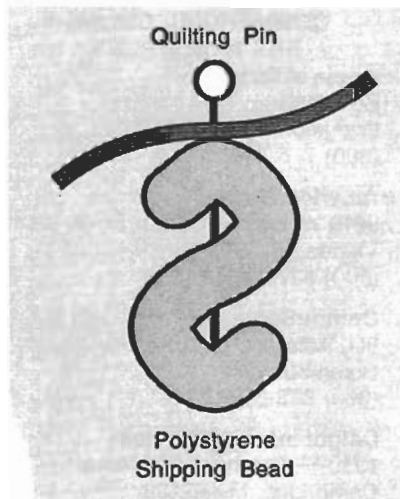
computer is rather primitive. A Motorola 6805 microcontroller and an EPROM are helped along by a simple multichannel A/D converter. A Triac drives the coil, a Darlington transistor drives the injectors, and a transistor drives the fuel pump.

A book that explains all this is *Bosch Fuel Injection and Engine Management* by Charles Probst. Other titles appear in the SAE Library.

Two major publishers of automotive books are *Robert Bentley* and *Chilton*. Also see *Automotive Industries* magazine.

### Servicing intermittents

Back to my horror story. My 1987 *Synchro* four-wheel drive van started showing an intermittent loss of power. Naturally, I did not suspect for an instant that all those 138,000 off-road desert miles I put on it had anything to do with the problem.



G. 3—A QUILTING PIN makes a safe st point along a stranded wire.

I found that cleaning up the air-  
c, checking the connectors, and  
apping the fuel filter did not help.  
ling it off on a 350-mile trip to my  
rest factory-authorized service  
er cost me an outrageous  
nt of money.  
zero improvement.

ll fairness, it is hard to fix an  
mittent problem when it  
it show up on demand. But as  
as I started treating this as an  
onic service problem, rather  
an automotive problem, the  
became obvious.  
t sent away for a shop man-

ual, something I should have done  
years ago. The *Robert Bentley* man-  
uals are really outstanding. Mean-  
while, I decided to make an effort to  
catch this intermittent in action  
while driving down the road.

So, I hooked up an oscilloscope.  
My first guess as to the source of  
the problem was the Hall-effect sen-  
sor, so I monitored the green wire  
from the sensor with a temporary  
test pin that I have shown in Fig. 3.  
The sensor output was continuous,  
even during a dropout.

Finally, a stroke of blind luck. I hit  
the computer with my fist and the  
engine died! It was something that I  
should have thought about long be-  
fore—something that the mechanic  
certainly should have tried.

Cleaning the connector didn't  
help, so I resoldered the computer.  
The culprit was a bad solder joint on  
a steel-lead power resistor. Aging  
and corrosion caused the failure.

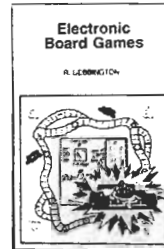
In hindsight, the tachometer  
would drop to zero during failure,  
with the engine obviously still stum-  
bling over. Because the tachometer  
is connected directly to the coil pri-  
mary, the problem had to be in the  
computer or wiring.

Interestingly, there is a new wiring  
harness/filter available that's sup-  
posed to eliminate the very same  
symptom that is apparently caused  
by the steel lead on that big comput-  
er resistor. Solder will not adhere to  
the steel lead. I suspect the man-  
ufacturer never found the real prob-  
lem and probably still does not have  
a clue.

All of this did get me thinking  
about servicing intermittent prob-  
lems in general. So, Fig. 4 is a set of  
my rules that should get you start-  
ed. The key points are (1) *always*  
have documentation on hand; (2) be  
*certain* you can cause the problem  
to show up; (3) divide-and-conquer  
by finding out where the problem is  
*not*; (4) attack probable causes first;  
(5) think logically, paying attention  
to *all* of the symptoms.

Yeah, there are fairly low-cost  
data loggers out there. But nobody  
has yet come up with a universal  
intermittent "flight recorder" that a  
car mechanic, a cardiologist, or an  
air conditioning repairman would  
fight over. There's opportunity there  
for the successful inventor.

## 3 NEW BOOKS for the Project Builder



Electronic Board Games

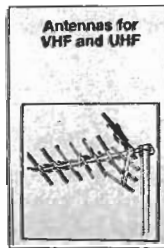
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