Digifant Ignition Basics, 1992-96 Eurovan

Or, what to look for if your 5 Cylinder Eurovan won't start due to "no spark"

The story:
In the spring of 2007, I started to have "hard starting" issues with my 93 (built 10/92) 49-state 5 speed Eurovan. Once started, it would run fine. Then it quit starting – no spark. Mechanics traced the problem to the ECM, which was replaced. The van ran for two weeks, then the "no spark" problem came back, which I fixed by putting the original ECM back. This lasted for two weeks, then the problem re-occurred. The camping season was over, so I left it until February 2008 before starting the diagnosis again.

Further (and more exhaustive) testing turned up a bad ground in the ECM harness, which I repaired. I still had both ECMs, but neither would work. The ECM was replaced again, and everything seemed fine – from April to mid-August . Then the hard starting came back again. More testing revealed a weak / intermittent Hall Sender, I replaced that and everything works 100% now (End of September). Throughout all of this, several members on the list were very helpful, so it only seems fair to help some one else by documenting what I learned.

Application:
My Van is a 49 state/ Canada 1993 model EV "Weekender", built October 1992, with five-speed transmission and AAF engine, originally sold in Wisconsin. Other variations:

- California models have a different ECM with different wiring, and some differences in sensors.
- Automatics have different ECMs, with a wire to the Transmission Controller.
- Vehicles built January 1993 and after have a Closed Throttle switch; previous models have a CO Potentiometer.
- For the ACU engine, from September, 1995 (January, 1995 for Winnebago conversions) the ECM wiring is significantly different.

Basics of how the Digifant Ignition / Fuel Injection works:

Three critical items for ignition get battery voltage when the key is on:

- the Camshaft Position Sensor, switched by the ECM
- the Coil, switched by the key
- the ECM, switched by the key and though the ECM relay (Relay position #3, often with "30" printed on the relay)

These must also have good grounds. The Coil has a brown ground wire, the CPS has a brown wire with a white stripe. The ECM has four grounds (see the listing further down)

A good ground is no more the 1.5 ohm resistance, preferably less than 1 ohm. When I was finished cleaning up my grounds, they were all under 0.5 ohm. The same applies when checking for a good connection from one end of a wire to the other.

What is supposed to happen:

- When you turn on the ignition, the coil gets 12v though the key, the ECM gets 12v through the Ignition relay, and the CPS gets 12v through the ECM.
- As the engine turns over, the CPS sends a 12v pulse to the ECM.
- The ECM takes this information, modifies it based on input from other sensors, and switches 12v to ground from the coil pack. Timing of this grounding is the ignition timing.
- The Coil sends a spark (much more than 12v) to the distributor. (Note: The Coil pack has a primary and secondary side: however replacements are sold as both parts integrated together, and I think most shade-tree mechanics would just replace both at once).

Simple stuff to check first if your van cranks but won't start:

- You should hear the fuel pump run briefly when you turn on the ignition (after it has been off for at least a couple minutes).
- Got gas? (this sounds silly, but I have seen it happen).
- Check for spark at the spark plugs.
- Check for good tune-up parts (distributor cap, rotor, spark plugs and wires)

Fuses & Relays (pull down the small tray right by the driver's door, under the dash)

- Check Fuses 15 and 18 (Fuel and ECM Relay)
- ECM relay (for AAF engine - third from left, second row up, often has "30" written on it) - you should feel it click when you turn the key to on.
- Fuel Pump Relay (for AAF engine - bottom row, right hand end) - you should feel it click when you turn the key to on.

Ignition System Tests:
The Bentley manual says that the following tests should be performed with the Cold Start Valve connector removed and the Fuel Rail connector removed. Otherwise fuel will be injected into the motor while cranking during testing, and will get pumped out as (potentially explosive) vapors. Plus, it will condense in the cold engine and wash down into the oil. That being said, I did my tests with these connected and lived to tell the tale.

This is the order I would recommend doing the tests, from what I gather the most common fault is tested for first, and so on in order:

1 – Start with the coil, located in front of and below the battery.
Coil packs are said to be common failure items on these vans.
Checking for power to the coil:

- Disconnect the three-wire connector from the ECM to coil pack.
- Look for battery voltage from terminal 3 (black wire) going to ground on terminal 1 (brown wire) with the ignition on.
- If no voltage, check for voltage to the negative terminal on the battery (or other known good ground). Check that the brown wire has a good ground. If everything checks out and there is no voltage to the coil, you may have a defective ignition switch.

Checking for signal to the coil:

- Disconnect the three-wire connector from the ECM to coil pack.
- Connect an LED 12v tester or 12v LED between Terminal 2 (Green/Black) and Terminal 3 (Brown)
- Turn the ignition on, LED should light up, stay lit for a few seconds, then go out.
- Crank the motor, LED should flicker (quite obviously). The flickers are the trigger signal: if you get the trigger signal the problem is most likely either the coil or the HT system (plug wires, distributor cap, spark plugs: not on right, worn out, timing way off, etc.) Or, you have good spark and something else is wrong – fuel problem, compression, timing belt slipped, etc.
- If there is no trigger signal to the coil, go on to step 2

2 – Check that the ECM is getting a signal from the CPS.
The Hall Senders are also a known weak point on these vans, although they are more reliable than the coils.
The signal comes from the CPS (Hall Sender) in the distributor. Pull the shield off the distributor by lifting straight up to get access to the connector. .

- Disconnect the three-wire connector
- Check for battery voltage between the side terminal towards the front (red/black wire) and ground (Brown/white wire) with the ignition on. If no voltage, check for voltage to the negative battery terminal or known good ground.
- Check for good ground on the Brown/white wire.
- Pull back the rubber covering on the three-pin connector, and insert probes (I used chunks of wire from household wiring – the solid copper wire makes a good probe) into the back of the centre signal (green/white) wire and the ground (brown/white) wire.
- Re -connect the three pin connector
- Hook up the LED tester to these two probes
- Crank the motor, and look for flashes. The flashes are the signals to the ECM.
- If no flashes, make sure the probes are connecting inside the plug, and not to each other: if you still get no flashes this points to the CPS as the problem.

If you get flashes from the CPS but not at the coil, then the problem is likely in the ECM or the ECM wiring. There is nothing else that would prevent the signal getting to the coil – all the other sensors only modify the spark timing; none of them eliminate it.

Check the ECM wiring before ordering a replacement!
Checking the ECM wiring:
- turn the ignition OFF before removing the ECM Plug.
- to remove the ECM plug, squeeze on the clip at the back of the plug, and lift the back of the plug up. When it comes free at the back, swing it up until you can unhook the front of the plug from the ECM.
- remove the small slotted screw from the front of the ECM plug and separate the cover from the plug base.
- First thing to do is check the grounds, and check for good circuits to the coil and CPS. (See below or a Bentley manual to know which wires).

- To do the full series of tests, you will need a Bentley Manual, a multimeter, and a selection of probes. Check that you are working with the right test procedure for your van. There are differences depending on the month it was built, automatic or manual, California or 49 state/Canada. The wire numbers in the Bentley diagram match the wire numbers on the plug as well as the socket numbers on the VAG tool described in the manual. You can cross-reference by checking the colors against the number. The number scheme in the wiring diagram is Txx/yy where xx is the number of pins in the connector (38 for an AAF engine, more for the later ACU motor) and yy is the wire number. I have laid out the wiring scheme for my 5 speed, 49-state, Pre-1993 Eurovan at the end of this document.

If the ECM wiring passes the tests, you are getting a trigger signal from the CPS, but no trigger signal at the coil, consider replacing the CPS before dropping big dollars on a new/used/rebuilt ECM. In my case, I had an intermittently failing CPS which always passed the test. I installed two “known good” ECMs, yet the problems did not finally go away until I replaced the CPS. Coincidence? Maybe… or maybe I should have replaced the CPS much earlier. Bottom line is, the CPS is a “known failure” item (i.e. you might need to replace it one day anyway), and it is easier to get and much less expensive than an ECM.

Other Digifant System info

This only matters once your van starts and runs (or at least idles, see #2 below for Jan 1993 and later)

There are 10 sensor/senders on the Digifant system. None are needed for ignition to work (the engine will run / idle, and waste a lot of fuel, without any sensors attached; the resulting "default mode" is rich to make sure the motor starts and doesn't run too lean/hot.)

1 -Oxygen sensor
2 - throttle position sensor (TPS)
3 - coolant temperature sensor (blue, two wire)
4 - CO potentiometer (before January 1993) or Closed Throttle Switch (Jan 1993 and after)
5 - Air intake temperature sensor (the IAT unit)
6 - idle control valve
7 - cold start valve
8 - evaporative emissions frequency valve (valve allows air to flow though from Charcoal Canister)
9 - power steering pressure sender (sends data to ECM so ECM will raise idle when P/S fluid is cold and thick)
10 - Manifold Absolute Pressure Sensor (MAPS), inside the ECM, connected by vacuum line to the intake manifold

The 5 key inputs are the TPS, the IAT (2 inputs), the MAPS and the coolant temperature sender. You could disconnect all the rest and the motor would basically run the same. It would be harder to start when cold, might stall when turning the steering, would idle too high and would release more emissions, but once warmed up it would run the same with the following 5 as it would otherwise run with all 10.

1) TPS: the ECM uses info from the TPS for...
idle air control
deceleration fuel shut-off
wide-open throttle enrichment
Mine reads 2.7kilo-ohm at closed throttle, drops quickly to 2kilo-ohm in the first part of of opening the throttle, goes to 1.14kilo-ohm at wide-open throttle. Makes sense that the potentiometer would be more sensitive when close to closed for better driveability. I took the readings at the TPS between the red-blue and the blue-black wires.

2) IAT (Intake Air Temperature) unit
- Pre- January 1993 this is comprised of a thermistor that loses resistance as it heats up and a CO potentiometer...
- January 1993 and after this is comprised of a-thermistor that loses resistance as it heats up and a Closed Throttle Position Switch
- ECM's are ***not interchangeable*** between before and after January, 1993. With a newer ECM in an older van, the motor will start and idle, but not rev.

The signal from the thermistor is used by the ECM to modify fuel injection duration for richer mixtures when cold and leaner mixtures when hot. Early Eurovans tended to go into "rich mode" too often, which caused problems with passing emissions tests. The Aircare emissions program in Vancouver, Canada identified this problem and worked out a solution. This is posted in the files – look for "ev_smog".
The signal from the CO potentiometer does the same thing (change injection duration) but does so as a result of throttle position (its maximum affect is at idle and it's also affective at partial load).
The Closed Throttle Position Switch is important to the ECM. Without the signal, the engine will not rev beyond idle.

3) MAPS
The vacuum line to the ECM is connected to the MAPS (Manifold Absolute Pressure Sensor), which is built into the ECM. The ECM uses info from the MAPS to determine engine load and, along with the engine speed signal, helps determine ignition timing and injector duration.

4) Coolant temperature sensor:

There are several coolant sensors on these vans; this one has a the Blue Connector, a 2-wire connector, and is located at the motor end of the top radiator hose. It does not control the radiator fans, the temperature gauge on the dash, air conditioning cut-out or after-run pump. The ECM uses info from this Coolant Temperature Sensor for...

- cold-start enrichment
- acceleration enrichment
- after-start enrichment
- deceleration fuel shut-off
- idle air control during cold start

The coolant temperature sensor is particularly important. If it is not working or disconnected, the engine runs in default rich mode. You will get very poor mileage, a noticeable smell of unburned gas, and very high HC emissions. The engine will start and run, however.

Thanks to Mike McCarthy, Gomi and many others in the EV_Update group.

1993 Eurovan ECM Wiring Harness

5cyl, 2.5L AAF Engine, from August 1992 to December 1992 - after January 1993 Closed Throttle Sensor replaced CO Fuel Trim (#35)

Wire #	Wire Colors			Wire #	Wire Colors		
(Bentley)	Main	Stripe	Description	(Bentley)	Main	Stripe	Description
1	Blue	Black	from Throttle Position Sensor	20	Brown		Ground (near battery)
2	Brown	Yellow	from Fuel Injectors	21			
3	Black	Red	Cold Start Injector	22			
4	Green	Yellow	Evaporation Canister Valve	23			
5	Black	Yellow	Power Steering Pressure Switch	24			
6				25	White		Idle Air Control Valve
7	Yellow	Blue	Fuel Pump Relay (activated by ECM)	26	Red	Green	Battery Voltage when cranking starter
8	Violet		Oxygen Sensor	27	Green	Black	trigger signal to coil
9				28			
10	Green	Red	Signal to Tachometer	29	Brown	Black	Ground (Engine, and Fuel Inj. Wiring harness)
11	Green	White	Signal from Hall Sender	30	Red	Black	12v to Hall sender
12	Red	Blue	to Throttle Position Sensor	31	Violet	Black	to Automatic Transmission Controller
13	Brown	White	Ground (in harness)	32	Green	White	to OBD connector
14	Brown	Green	Engine Coolant Temp Sensor	33	Black		Ground (Engine)
15	Blue	Yellow	Intake Air Temp Sensor	34			
16				35	Blue	White	CO Fuel Trim Potentiometer
17				36	Black	White	Battery Voltage ign on (through key switch)
18				37	Green		to A/C Connector
19				38	Black	Yellow	Battery Voltage from ECM Relay