Fuel System - Electronic Throttle System Troubleshooting

```
NO:                  25-149A
DATE:                12-06-2005
MODEL/YEAR:          C70 1999-2002
                     S70 1999-2000
                     S60 2001-2002
                     V70 1999-2002
                     V70XC 1999-2001
                     S80 1999-2001
SUBJECT:             Troubleshooting Electronic Throttle System (ETS)
REFERENCE:           VIDA, SMB 25-149 TNN 25-149-B TNN 25-149-C TNN 25-
149-D
                     TNN 25-149-E TNN 37-22 SB 37-0015 TNN 30-04
```

Troubleshooting Electronic Throttle System (ETS),

Supplementary Information

DESCRIPTION:

This TNN contains information and help for troubleshooting the electronic throttle system.

This information is a supplement to the fault tracing in VIDA.

You must follow the fault tracing in this TNN before replacing any components.

General Instructions

1. Perform fault tracing including read out of Diagnostic Trouble Codes (DTC) in accordance with VIDA and the instructions in This TNN.

2. Where VIDA fault tracing indicates cleaning of crankcase breather is necessary, First Measure the crankcase pressure in accordance with TNN 25-149-B "Checking Crankcase Ventilation System".

3. If required based on the diagnosis clean the crank case ventilation (PCV) in accordance with TNN 25-149-C "Cleaning the Crankcase Ventilation".

4. If required based on the diagnosis clean the ETM and the crank case ventilation (PCV) in accordance with TNN 25-149-D "Cleaning the Crankcase Ventilation and Electronic Throttle Module".

5. If required based on the diagnosis replace the ETM in accordance with TNN 25-149-E "Electronic Throttle Module (ETM) Replacement", including downloading of ETM software reload and ECM software upgrade.

6. If required based on the diagnosis download software upgrades for ETM and ECM according to VIDA Software Download Manager.

System Description

The throttle system implemented in the above vehicles comprises an Engine Control Module (ECM), and an independent Electronic Throttle Module (ETM) that communicate with each other over the vehicles Controller Area Network (CAN). It is important to be aware that all throttle system fault codes are stored in the ECM, when either the ECM detects a fault or the ETM requests that a fault be stored. The CAN network is vital to the throttle operation, because the ECM uses the CAN network to make requests to the ETM for throttle positions and the ETM continuously sends updates to the ECM about its current throttle position.

General Fault Tracing Tips

Using Freeze Frames
Electronic Throttle System (ETS) faults can be intermittent in nature and that is important to remember when checking the possible source identified in VIDA. If the fault is not present while the vehicle is in the workshop it may cause us to overlook an identified source as the root cause because the values may be good at time of testing. Therefore a good indication of the "source" condition at the time the fault was set, is the freeze frame data available from VIDA, which has recently been improved to remove incorrect values. The freeze frame data (frozen values) will be stored just after a fault has been detected. Most of the parameters in the freeze frames are the same for all faults and reflect a general condition when a fault was detected, e.g. engine speed, load, coolant temp, vehicle speed and battery voltage. A few of them are chosen to give a better understanding of the specific fault.
DTC ECM 903F (example) - Throttle unit internal fault (signal too low or missing). The first possible source indicated in VIDA is "the power supply to the throttle unit" and goes on to suggest checking the battery and charging system. However the condition of the battery when the car is in the workshop doesn't indicate the voltage when the fault was detected. The best source of information is available in the freeze frames, but it is the voltage seen by the ECM at the time the ETM requested the fault, and it should be kept in mind that this is not an indication of the condition of the supply wiring to the throttle itself, and this should be checked independently. But if the ECM had good voltage, the battery was good.

Fuel system status bank 1	LR: closed loop operating with two sensors
Fuel system status bank 2	LR: closed loop operating with two sensors
Calculated load	4.71 %
Engine Coolant Temperature	87 °C
Short term fuel trim, bank 1	15.63 %
Long term fuel trim, bank 1	-0.78 %
Short term fuel trim, bank 2	23.44 %
Long term fuel trim, bank 2	-0.78 %
Engine speed	760 rpm
Vehicle Speed	0 km/h
Turbo pressure	30 %
Battery voltage	12.50 V
Throttle angle, desired value	14.84 %
Mass air flow	23.8 kg/h
Ambient temperature	33 °C

Freeze Frame for ECM 903F
In this particular case the car had low battery voltage in the workshop, but as you can see from the freeze frames the battery voltage was good at the time of the fault, and not the cause.
This is an example of how the freeze frame data can be used to streamline the fault tracing, and possibly prevent wasting too much time on "Dead end" fault tracing and the possibility of finding and fixing a fault that was not actually the root cause of the problem

we set out to resolve.

There will be a patch for VIDA from which point mileage (Km) will be included in the ECM freeze frame data. This will allow a very quick comparison with the odometer to determine if the fault has occurred as part of your fault tracing and should be ignored. E.g. CAN network related codes can be set because the battery has run down while working on the vehicle, with interior lights and other loads draining the battery.

The freeze frame will give the distance in Km. Multiplying this value by 0.62 you will get the mileage. On a vehicle with a DIM (Driver Information Module) the distance can be read from the DIM in Km for an easier comparison.

There are some things to consider when using freeze frames for fault tracing. The freeze frames that should be used carefully are those captured for CAN network related ETM DTC's. If the ETM detects a loss of communication with the ECM, fault flags will be set in the ETM, however the DTC's in the ECM won't be stored until the communication between ETM and ECM is restored, and that is when the freeze frame data is recorded. So where ETM CAN faults are concerned, the freeze frame data will be from after the fault event.

Using Counters

Another useful tool in VIDA for fault tracing is the Counters. Counters can be used for determining when and how often the fault was detected. We have seen examples where due to low battery voltage during cranking while connected to VIDA, the VCT caused errors on the network and set communication faults in the high speed nodes. This also caused the ETM and ECM to enter a limp home mode. Using the Counters for the fault code, it would be possible to see if the fault was only detected on the current drive cycle or if it had been detected previously. For Example:

- Counter 1   15   Number of fault-free driving cycles since fault was last detected
- Counter 3   69   Total driving cycles since the DTC was set for the first time
- Counter 4   1   Number of driving cycles with fault since the DTC was set for the first time
- Counter 5   91764 Number of seconds of ECU operation since the DTC was set for the first time
- Counter 6   0   Number of seconds with test in ECU running since the DTC was set for the first time
- Counter 7   0   Number of seconds that the ECU detected the fault since the DTC was set for the first time

Example of Counters

In the example above, counter 1 shows the number of driving cycles where the diagnostic ran and no faults were detected, counted since the fault was last detected. Counter 3 is the total number of driving cycles regardless of whether the diagnostic ran or not. Counter 4 shows the number of driving cycles where the diagnostic detected a fault. Counters 3 and 4 starts to count from the first drive cycle after the drive cycle in which the fault was first detected.

In the example counter 4 is 1, which means that the fault was detected 2 times.

We can see that no fault was detected on the current drive cycle, and depending on the number of drive cycles and the customers driving patterns, this may help to rule this DTC out as having any relevance to the customer's current concern. Or if this is the problem we

are

fault tracing, this can help us to understand how intermittent the problem may be. If counters 1, 3 and 4 are 0 this indicates that there are no drive cycles since the fault was detected and the fault was set in the workshop. For a drive cycle to be counted a coolant temperature increase may be needed, but in some cases a key cycle counts as a drive cycle.

Counter 5 can be useful if the fault was detected in this drive cycle, the time can be used to determine when the fault occurred.

Using engine parameters to diagnose airflow problems (ECM-130A)

Leakage Flow over Throttle (long term air trim at Idle)

This parameter is the adaptation for the airflow at idle, the MAF is the Master value and the adaptation value, is what needs to be added to or subtracted from the calculated Airflow. The calculated airflow +/- the adaptation value should equal the MAF value. This is a slow or long term adaptation. This adaptation value is not used as part of a diagnostic function and will not result in a fault code. But we can use it to evaluate the airflow into the intake. The adaptation value is shown in kg/h, and normal values are approximately 5-10 kg/h. There are several sources of air that are fed to the inlet manifold that do not go through the throttle or MAF e.g. air from the brake booster, the evaporative purge system, and the crankcase breather. The sum of these air sources would give us our normal adaptation value of 5-10 kg/h that does

not pass through the throttle and MAF.

If we take away one of these sources or restrict one of them, for example a clogged crankcase breather system, the adaptation value would go down (<5 kg/h). Dirt build up on the throttle bore can have the same effect and it is usually the result of the breather system being restricted. The breather should be checked first.

If we had an air leak into the manifold the value would go up (>10 kg/h).

Air mass Correction value (long term adaptation of the air trim above idle)

This is the part load adaptation for the mass air flow, to allow for small tolerances between engines and for aging of components.

The normal value with no adaptation is 1. A number lower than 1 e.g. 0.95 indicates that more air is passing through the MAF sensor than calculated and an adaptation has been made. E.g. if the crankcase breather system becomes blocked, one indication of this would be a low mass air flow correction value around 0.85 or lower, a value higher than 1 might indicate an air leak into the manifold e.g. a loose or broken vacuum line might give a value of 1.15 or higher.

The Fault Code ECM-130A is set if the value of the long term AIR trim part load (air mass correction value) and the short term air trim become excessive. Unfortunately the short term air trim is not available to be viewed in VIDA, but if we have the fault code then the Short term can be assumed excessive. These adaptations should not be used as a diagnosis on their own but as an indication of what path to take next. First look at the fuel trims (Lambda adaptations), to evaluate the possibility of air leakage, then: if we have less air bypassing the

throttle than normal (< 5kg/h & or <1), we might suspect that the crankcase breather may be blocked and we can use the diagnostic method in TNN 25-149B to check that. If the amount of air bypassing the throttle is higher than normal (>10kg/h & or >1), we could

use the tools to pressurize the intake system and check for leakage. Do not forget to check the purge valve as a leak source, it is easy to overlook as in some cars the outlet from the system is at the back of the car. It is best checked off the vehicle.

Fault tracing CAN Network

As mentioned earlier in this Document the ETM/ECM can not function together without the CAN Network. The two control modules Monitor the CAN Network continuously for problems, and are very sensitive to disturbances on the Network. These Modules will set Fault codes very quickly if they detect problems on the Network, and may go to a Limp Home Mode because of it. If the ECM/ETM detect a fault on the CAN Bus, this is not an indication that they were the cause of the problem, it is more likely they were just the most sensitive to it.

As you can/will see from this document many of the other fault codes can be triggered due to a loss communication on the CAN Network also , again this is a consequence of the fault and not an indication of the root cause.

CAN Network fault codes should be fault traced along with any other CAN Network fault codes from other Modules Using the fault tracing in VIDA and supplemented by the information in TNN 37-22.

CAN faults generated by VIDA/VCT

When the VIDA station is connected to the vehicle and the battery voltage is low this might generate fault codes. The VCT (Volvo Communication Tool) gets its power from the vehicle and both can be disturbed and cause disturbances when it's supply voltage is low (Particularly when the engine is cranked with a weak battery). Fault codes that occur during fault tracing can be identified using freeze frames and counters, to eliminate fault tracing the wrong codes.

This situation can be minimized by using a battery charger to keep the voltage stable when fault tracing for extended periods. Note! Only use the Volvo approved battery chargers (power supply) TNN 30-04, as some booster chargers produce excessive voltage, creating problems and fault codes.

Low battery voltage fault tracing tip (only C70 MY99-02 and S70/V70 MY99-00)

Resistance in the B+ cable to the fuse box can be the root cause for many ECM/ETM fault codes. Fault trace according to Service Bulletin 37-0015 (released December 2001)

Erasing ETM memory

Some fault tracing instructions recommend that the ignition be turned off and on twice, after erasing codes. The reason for this is: the fault codes may have been set at the request of the ETM, but we only erase the ECM, so the ETM needs to power down fully to erase its memory before the car is test driven, otherwise the fault may be set in the ECM again. For the ECM and ETM to power down fully the ignition should be turned off for 5 minutes each time, if the cooling fan is running you will need to wait until 2 minutes after the cooling fan has stopped to ensure the ETM is powered down.

Symptoms

Limp home modes

ETS related faults will result in the system running in a limp home status for the remainder of the drive cycle that the fault occurred in, and any following driving cycles where the fault is still present.

There are different limp home levels depending on the fault detected. The limp home

functions range from things like not allowing cruise control, because of a momentary interruption in communication with the Cruise control switches, to the ETM adopting a fixed throttle angle and the ECM controlling the engine speed using ignition and fuel injection. This particular limp home function can appear as if the engine idle is very erratic, because the ECM turns off fuel to individual cylinders to control the engine speed. We should be careful that we do not confuse these limp home functions for real drivability concerns. For example a short interruption in the Power supply to the throttle, could cause this limp function to be used. We need to be aware that the behavior is because a fault was detected and not that the fault was detected due to this behavior. The limp home functionalities are:

^   Fuel shut-off system which follows accelerator pedal (AP) position. Engine speed (RPM) is controlled by disabling the injectors, engine speed (RPM) is governed by the accelerator pedal (AP) position. Maximum engine speed (RPM) is approximately 5000 rpm

^   Slower throttle opening than requested throttle opening. The throttle opens slower than normal because the system is only regulated by the pulse width modulated signal from the accelerator pedal (AP) position sensor.

^   Throttle closure when braking. The accelerator pedal (AP) position is ignored when the brake pedal is depressed. No response to the Accelerator pedal while the brake pedal is used.

^   Throttle follows accelerator pedal (AP) position. The throttle and accelerator pedal (AP) are used as if they were mechanically connected to each other.

^   Throttle disabled. Throttle is not affected and is in its mechanical stop position.

^   Cruise control switched off.

Uneven and/or rough running without any relevant trouble codes
Clean crankcase ventilation and ETM according to TNN 25-149-D (adaptations are probably on the verge of generating trouble code).
Note! Only applies to turbo engines and natural aspirated 6-cylinder engines.
The idle speed is calibrated to allow for an amount of air coming into the system from the breather, if this air is missing it will be hard for the ECM to maintain a steady idle.
Combined Fault Codes
Faults detected by the ETM system, will normally result in multiple fault codes.
To aid in diagnosing these cases we have provided two charts below that show the fault code combinations, and in the column (Follow fault tracing for) to the right of the combination shows the fault code that should be fault traced to determine the root cause. These fault code combinations can exist with or without other fault codes that are not necessarily throttle related.

With this combination of codes	Follow the fault tracing for:		With this combination of codes	Follow the fault tracing for:
130A, 91CF	130A		9150, 9160, 903F, 904C, 904D, 982A	9150, 9160
130A, 903F, 904D, 91CF	130A		901E, 903F	901E
130A, 904D, 91A7	130A		901E, 903C, 903F	901E
91A7, 904D	91A7		902A, 903F, 904D, 959F	902A
91A7, 903C	91A7		902A, 903F, 904D	902A
91A7, 903F, 904D	91A7		902A, 903F, 959F	902A
91B7, 904D, 91A7	91B7		902A, 928C	902A
9150, 9160 903F, 904C, 904D	9150, 9160		902A, 903C, 959F	902A
9150, 9160 903F, 904C, 904D, 91A7	9150, 9160		903F, 904D	903F
9150, 9160 903C, 903F	9150, 9160		958F, 917F	958F
9150, 9160 903F, 904C	9150, 9160		958F, 959F	958F
9150, 9160, 903F 904C, 904D, 91B7	9150, 9160		981A, 904D	981A
9150, 9160, 903F, 904C, 91A7	9150, 9160		981A, 6805, 904D	981A
9150, 9160, 903F, 904C, 904D, 91A7, 91B7	9150, 9160		982A, 904D	982A
9150, 9160, 903C, 903F, 91A7	9150, 9160		9190, 903F, 904D, 91A7	9190
			9520, 917F, 958F	9520

With this combination of codes	Follow the fault tracing for:	With this combination of codes	Follow the fault tracing for:
E003, 902B	E003	911A, 912A	911A
E003, 902B, 903F	E003	918F, 917F, 951F	918F
91A7, 903F, 980F	91A7	950F, 951F	950F
91A7, 903F	91A7	950F, 903F, 917F, 951F	950F
91A7, 903F, 980F, 9818	91A7	950F, 917F, 951F	950F
91B7, 91A7	91B7	980F, 9818	980F
91B7, 903F, 91A7	91B7	9150, 91B7	9150
91B7, 903F, 980F	91B7	9150, 903F, 91B7, 980F	9150
91F0, 91A7	91F0	9150, 9160, 903F, 91B7	9150, 9160
130A, 903F, 980F	130A	9150, 9160, 903F, 980F	9150, 9160
130A, 903F	130A	9150, 9160, 903F	9150, 9160
130A, 91B7	Fault trace both	9150, 9160, 903F, 91B7, 980F	9150, 9160
150A, 980F, 9818	150A	9150, 9160, 130A, 903F, 980F	9150, 9160
902B, 903F	902B	9160, 91B7	9160
902B, 902A	902B	9160, 903F, 91B7, 980F	9160
902B, 903F, 980F	902B	9200, 922A	9200
902B, 902A, 903F, 951F, 980F	902B	9300, 930A	9300
902B, 902A, 951F	902B	9400, 941F	9400
902B, 902A, 903F	902B	9520, 918F	9520
902B, 902A, 903F, 951F	902B	9520, 918F, 951F	9520
903F, 980F	903F	9530, 950F	9530

FAULT CODES	
ECM-903F	This fault code usually occurs because of another fault, e.g. no or disturbed CAN communication. The code is set because the ECM is trying to check the throttle angle and gets a wrong or no answer from the ETM. The code may also be generated if the vehicle has another trouble code that has forced the ETM in "limp home" mode. After a repair and erasing codes in the ECM, you must also erase the ETM memory (See section "Erasing ETM memory" above), otherwise ECM-903F will be generated again when brake and accelerator pedal are activated at the same time, e.g. during a test-drive.
ECM-91CF	On five-cylinder vehicles with turbocharged engines, ECM-91CF may be generated as a consequence of fault code ECM-130A. The code may also be generated if the vehicle has another trouble code that has forced the ETM into "limp home" mode. After a repair and erasing codes in the ECM, you must also erase the ETM memory (See section "Erasing ETM memory" above), otherwise ECM-91CF will be generated incorrectly when the cruise control is activated, e.g. during a test-drive.
ECM-958F **ECM-950F**	This fault code indicates that the ECM detected a significant difference between the analogue and PWM (Pulse Width Modulated) signals from the APM (Accelerator Pedal Module) as monitored by the ECM. Differences of more than 10% for more than 300 ms, are the threshold for fault detection. This fault is usually detected during cranking, and is most likely the result of a low voltage condition. Check for fault codes directly identifying problems with the individual APM signals.
ECM-959F **ECM-951F**	These faults indicate that there was a significant difference between the analogue signals from the APM (Accelerator Pedal Module) monitored by ECM, and the PWM (Pulse Width Modulated) signal, reported to the ECM by the ETM. This problem is most often due to a loss of communication between ECM and ETM on the CAN bus. Check for and fault trace CAN related faults. Check for fault codes directly identifying problems with the individual APM signals. If 958F is detected with 959F the probable cause is the power supply to the APM.
ECM-901A **ECM-902A** **ECM-902B** **ECM-911A** **ECM-912A** **ECM-E000** **ECM-E003**	These are CAN bus codes and only indicate that the ECM and or ETM were not able to communicate with each other due to a CAN bus fault, use the information in TNN 37-22 CAN bus network Information along with the trouble code's freeze frame, and counters to determine driving conditions when the problem was detected, the current status of the problem and the problem's degree of intermittence, if any. Check with the help of frozen values, that the code has not been caused accidentally during earlier troubleshooting in the car. See the example earlier in this TNN where a weak battery combined with a VCT connected during cranking can set these fault codes in the workshop.

ECM-130A **Note!** Only applies to Turbo & 6cyl Engine Management Systems.	Fault indicates that there is a difference between the intake Airflow measured by the MAF (Mass Air Flow meter) and the calculated Mass air flow (calculated from the engine speed throttle angle and air temperature). The most probable cause for the difference is a restricted or clogged crankcase breather system. Check the breather system by following TNN 25-149-B, then we can read parameters "Mass air flow, correction value" and "Leakage flow over the throttle" to understand the problem. Read the section above describing the functions behind these parameters, and how to interpret the values.
ECM-150A **Note!** Only applies to 5cyl Normally aspirated	Much the same as 130A for turbo engines, except the normally aspirated engine has a another "load" (air mass) sensor, the MAP (Manifold Absolute pressure sensor) so it can check the MAF against the MAP instead of a calculated Airflow. Follow the VIDA fault tracing to test the two sensors.
ECM-904C	This fault code indicates that the ETM requested an immediate Check engine Light on, in support of another fault code. We should fault trace the other fault codes, as this one only tells us that the ETM has detected a problem.
ECM-9520 **ECM-9530** **ECM-9540**	These fault codes are for the APM signals, and all of them are detected by the ECM, they are not ETM codes. Fault trace according to VIDA, check connections, power supply and measure the signals.
ECM-91A7	This fault is detected by the ETM and uses the power consumption of the throttle motor, to determine possible high friction. This fault can be caused by dirt build up in the throttle housing, or by a low battery voltage, use Freeze frames and VIDA fault tracing to analyze and remedy the problem.
ECM-91B7	This fault is detected if the throttle fails to go to the correct position at start up, can be due to dirt build up or foreign object in the throttle, or can be caused by supply voltage to the throttle being too low during start up. Use freeze frames and VIDA Fault tracing to analyze and remedy the fault.
ECM-9150 **ECM-9160**	These faults are detected, if there is a difference between the values for the internal potentiometers, this can be caused externally by a bad power supply / low voltage, or bad cables. Thoroughly check these and use the freeze frames to evaluate power supply at the time of the fault, before following the fault tracing in VIDA.
ECM-981A **ECM-982A**	981A indicate that the result of the engine torque calculation is not valid and 982A that the result of the engine fuel cut off calculation is not valid. Both faults can be the result of an incorrect MAF or boost pressure value, and or a wrong throttle position. Any fault codes related to these sensors should be fault traced first. If no other codes are present, use the freeze frame data for the fault codes 981A and 982A to find the driving condition at the time of the fault. Monitor the values for these sensors by using VIDA while driving, to look for inconsistencies in the values (unrealistic boost pressure etc.). These codes can also be the result of a cold start in extremely cold weather. The coolant temperature at the time of the fault can be seen in the freeze frame. If it is very low the system is not faulty and the ECM should not be replaced.

ECM-91F0	The fault is detected if the voltage applied to the throttle motor does not correspond to the measured current consumed by the motor. This can be caused by low voltage from a weak battery, or a bad battery cable. Corrosion and or loose terminals in the connector to the ETM can also be a possible fault source.
ECM-9180 ECM-918F	Faults for the PWM signal from the APM, which could be shorted to supply/ground, missing or interference on the cable from an outside source. Follow the fault tracing in VIDA.
ECM-9400	Fault indicates either signal too high or low from the brake position sensor located in the brake booster, or that the signal from the position sensor is indicating that the pedal is pressed, but the brake light switch is not yet activated. This will cause the cruise control to be disabled during the whole driving cycle in which the fault was detected. This fault is usually caused by a poorly adjusted brake light switch or a faulty position sensor. **Note!** It is possible to have the fault and no cruise control without setting the fault code.
ECM-9300	Fault indicates a problem with the signal from the clutch pedal position sensor. Signal too high indicates a short to supply (voltage > 4.771V), and signal too low indicates a short to ground (voltage < 1.66V). This will also cause cruise to be disabled during the drive cycle when the fault was detected.
ECM-9200 ECM-928C	Fault indicates that the ECM sees a fault with the signal from the cruise control switches on MY 99-2000. On later model cars the cruise switch information is transmitted to the ECM from the steering wheel module via CAN communication, this fault is an indication that the ECM did not receive the signal, and not a fault in ECM/ETM .This can be due to CAN network problems (fault trace CAN Network DTC's first according to TNN 37-22). This can also be because of low battery voltage during cranking.

DTC specific tips for ETM troubleshooting