



NANO/COM

DESIGNERS AND MANUFACTURERS OF CUTTING EDGE AUTOMOTIVE DIAGNOSTIC EQUIPMENT.

FUNCTIONS DESCRIPTION MANUAL

Coverage	Nanocom EVOLUTION
ECU	GEMS Engine P38
List of Functions	<ul style="list-style-type: none">○ Faults○ Settings○ Inputs○ Outputs○ Utility<ul style="list-style-type: none">Security Learn modeReset Adaptive Values

DIAGNOSTIC FUNCTIONS OF THE GEMS ENGINE

The GEMS is a very sophisticated system using feedback from many sensors to self compensate for wear, tolerance, climate, etc., thus helping it maintain the same running standards to which it was designed. The system also has an equally sophisticated self-diagnostic system and can self detect up to approximately 1000 different faults, ranging from very bad ones causing the engine to not start, through to logging slightly abnormal events in the normal course of vehicle usage which don't even create a warning. Sometimes multiple faults may be logged which may have been caused by the same faulty component but in this event they will all share a common thread which can help to locate the faulty part. Under certain fault conditions, the ECU stores freeze frame data. The ECU will store only one freeze frame data at the time. If another malfunction that has freeze frame data occurs, any freeze frame data stored previously will be replaced by the new conditions.

FAULTS FUNCTIONS

The GEMS ECU has the READ FAULTS and CLEAR FAULTS to read and clear the fault codes. We do not give any faults explanation or suggestions, in order to avoid giving wrong information to the user, because we think that the faults codes must be collocated in the context of the car which they come from.

Clear Faults

This function completely erases and clears the fault code memory. Having deleted the faults, it then rechecks the fault memory, to check that it is clear, reporting success, if it is. Failure to clear the fault memory successfully is usually due to the system re-logging the fault the moment the fault memory is clear. This indicates that the fault has not been rectified properly and as far as the system is concerned, still exists. The recheck for successful clearing of the fault code memory may be successfully executed but then the system may re-log the fault shortly after.

SETTINGS FUNCTIONS

Security - This is part of the contents of a specially allocated part of memory used to store security information within the GEMS ECU, which may be used in certain markets for storing unique information. It is supplied to enable total transference of identity from one ECU to its replacement.

Dealer ID - This is part of the contents of a specially allocated part of memory used to store Dealer information within the GEMS ECU, which may be used in certain markets for storing unique information. It is supplied to enable total transference of identity from one ECU to its replacement.

Last 6 of VIN - The last six digits of the Vehicle Identification Number (VIN), which are unique to each vehicle. The designation for the remainder of the VIN is detailed in the relevant manual.

Build Code - This value is a code which determines the build week and year.

Transmission - Used to select between usage of the GEMS ECU with either an Automatic or a Manual gearbox.

Engine - Used to select between usage of the GEMS ECU with either a 4.0 or 4.6 litre engine.

Market - This is the market which this GEMS ECU is intended to be used in, denoting tunes and oxygen sensor configuration. It is factory set and not changeable.

GEMS - The internal revision information displayed exactly as it is stored in the ECU.

Patented Number - As printed on the lid of the ECU.

Intel Number - Revision number of the INTEL processor used in the GEMS.

TMS Number - Revision number of the Texas Instruments processor used in the GEMS.

Part Number - OEM part number as stored in the GEMS.

ECU Tune ID - An OEM reference number used to denote the specific market tune for this ECU.

Fuel Flow Rate - The Adaptive Fuel Mass Flow Rate (FMFR) is learnt by the system over a period of time and is added to the normal fuel rate to compensate for manufacturing tolerances between fuelling components. The extremes of tolerance that GEMS allows for is +0.625 to -0.625 after which it will log a fault in its fault code memory. The value can be adjusted here but may be reset by engines using closed loop correction.

Air Flow Rate - The Adaptive Air Mass Flow Rate (AMFR) is learnt by the system over a period of time and is added to the normal air rate to compensate for manufacturing tolerances between airflow components. The extremes of tolerance that GEMS allows for is +5.5 KG/HR to -5.5 KG/HR after which it will log a fault in its fault code memory. The value can be adjusted here but may be reset by engines using closed loop correction.

Short Term Idle (Steps) - This is the value that the GEMS uses to regulate the current idle speed to take into account current engine load, temperature etc. It can be manually altered here but may later be changed by GEMS. The value is in steps and it can be a number between 0 and 255.

Long Term Idle - This is the value that the GEMS learns over a period of time to take into account manufacturer's tolerances on components which affect overall idle speed. This value cannot be modified, but it can be reset, forcing the GEMS to re-learn this value.

Closed Throttle - This adaptive value is stored by the GEMS so it knows when the vehicle is at idle. It is a voltage value and is compared against the voltage that the GEMS ECU reads from the potentiometer mounted on the plenum throttle spindle. The value should be around 0.6 volts. If any adjustments are made which result in the stored value being lower than the current throttle position with the throttle properly closed and the vehicle at idle, it is possible to have the GEMS relearn its new value by resetting all ECU adaptations or the value can be manually edited here.

Write Settings

INPUTS FUNCTIONS

FUELLING

Bank 1

Loop status - This confirms the current status of the GEMS loop tuning system and tells if it is currently active and working correctly. Options are:

- **OPEN NOT YET SATISFIED CONDITIONS:** The engine is not running or is still too cold to use the feedback from the sensors so when there is nothing wrong, the system is open loop.
- **CLOSED USING O2 SENSORS NORMALLY:** Proper operation with no faults.
- **OPEN DUE TO DRIVING CONDITIONS:** The system has been using the sensors and there are no problems, but it has decided not to use them at the moment as the feedback is not required for correction.
- **OPEN DUE TO A DETECTED FAULT:** There is a fault with the sensor and the system has reverted to using the pure map without the aid of closed loop correction.
- **CLOSED BUT AN O2 SENSOR IS FAULTY:** This can only happen in vehicles fitted with 2 sensors per bank (NAS). Although the system knows one of the sensors is faulty it can switch to using the other one to give closed loop fuel correction.

Pre cat O2 Sensor - This is the returning voltage value from the odd/even banks front (pre-catalyst) Oxygen sensor, which under normal operation (closed loop) should switch between very low values (near zero volts) when the mixture is too rich and very high values (near 5.0 volts) when the mixture is too weak. This switching may pause for brief periods, which is normal. Some markets (mainly Australia) had no sensors fitted and work entirely open loop.

Post cat O2 Sensor - This is the returning voltage value from the even banks rear (post-catalyst) Oxygen sensor, which under normal operation (closed loop) should switch between very low values (near zero volts) when the mixture is too rich and very high values (near 5.0 volts) when the mixture is too weak. This switching may pause for brief periods, which is normal. Sensors are only fitted after the catalyst in some countries like North America (NAS) and are used mainly for confirming the correct operation of the catalytic converter although this sensor can be used in the event of failure of the main pre-catalyst sensor.

Fuel trim long term - The percentage of alteration from the map value that the system is applying, to compensate for engine temperature, air temperature, fuel temperature, current engine load and other related conditions.

Fuel trim short term - The percentage of alteration from the map value that the system is applying, to momentarily compensate for feedback information, acceleration and other load conditions.

Bank 2

Loop status – ALL AS ABOVE

Pre cat O2 Sensor

Post cat O2 Sensor

Fuel trim long term

Fuel trim short term

Adaptive FMFR - The Adaptive Fuel Mass Flow Rate (FMFR) is learnt by the system over a period of time and is added to the normal fuel rate to compensate for manufacturing tolerances between fuelling components. The extremes of tolerance that GEMS allows for is + 0.625 to -0.625. After which it will log a fault in its fault code memory.

Fuel temp - This is the value obtained from the fuel temperature sensor, which is located on the metal fuel rail in-between, the cylinder heads. When the engine has been running and is then stood for a short time, heat escaping from the engine can super heat the fuel trapped in the fuel rail, meaning that when restarting an already hot engine, problems can arise (hot starting problems). Having the fuel temperature information means that the GEMS can compensate for this by increasing the injector opening (pulse) period when the fuel temperature is high. This sensor is treated as fail-safe by GEMS with the system substituting a value of 40 degrees centigrade upon detection of its failure.

Fuel level - This is the measured voltage indicating current fuel tank level, which is used by GEMS for internal evaporative emission tests. The value is inverted, meaning the closer to the maximum of 5 volts it becomes, the emptier the fuel tank is and the closer to the minimum of zero the value becomes, the fuller the fuel tank.

O2 configuration- This is the numerical value obtained from GEMS, which denotes it's expected oxygen sensor layout. Options are:

- **00:** No oxygen sensors are fitted and GEMS runs completely open loop.
- **11:** The most common arrangement with 1 sensor in each cylinder bank mounted upstream of the catalytic converters (where fitted).
- **33:** This configuration is usually used in countries that have stricter emission control regulations (e.g. North America). Besides having the two normal sensors as per 11, it also has two more sensors each being mounted downstream of the catalytic converters in each cylinder bank. This not only gives GEMS the ability to monitor the efficiency of the catalytic converters but also provides a fail-safe in the event of one of the sensors going faulty.

Pre CAT O2 Sensor Heater - This value shows the returning voltage from the front pair of (pre-catalyst) oxygen sensor heaters, which corresponds to their current heat output. The value should fluctuate as the GEMS switches or pulses the Heaters power on and off to regulate the temperature. If the value remains fixed in normal operating conditions one of the heaters may be faulty.

Post Cat O2 Sensor Heater - This value shows the returning voltage from the rear pair of (post-catalyst) oxygen sensor heaters (when fitted), which corresponds to their current heat output. The value should fluctuate as the GEMS switches or pulses the Heaters power on and off to regulate the temperature. If the value remains fixed in normal operating conditions one of the heaters may be faulty.

AIR – IDLE

Current thrott. pos(V) - The value returned from the Throttle position potentiometer, which is located on the side of the Throttle body. During normal idling this should be around 0.5 to 0.65 volts, increasing towards 5.0 volts as the throttle pedal is pressed and the engine approaches 5500 RPM. This input signal is fail-safe, as failure in the closed position results in the GEMS limiting the engine RPM to 1740, above which is restricted by the over run fuel cut-off being applied.

Stored thrott. pos (V) - This Adaptive value is stored by the GEMS so it knows when the vehicle is at idle. If any adjustments are made which result in the stored value being lower than the current throttle position with the throttle properly closed and the vehicle at idle, it is possible to have the Gems either re-learn its new value by re-setting all ECU Adaptations or the value can be manually edited in the Settings section.

Adaptive air flow(kg/hr) - The Adaptive Air Mass Flow Rate (AMFR) is learnt by the system over a period of time and is added to the normal air rate to compensate for manufacturing tolerances between airflow components. The extremes of tolerance that GEMS allows for is + 5.5 KG/HR to -5.5 KG/HR. after which it will log a fault in its fault code memory.

Current air flow - This is the current reading taken from the Air Flow Meter. It should be around middle 20's at idle rising steadily with engine RPM until around 200 KG/HR at 5500 RPM.

Intake air temp. - The current value read from the Temperature sensor, which is mounted in the side of the air filter box. Used by GEMS to compensate for climatic variances. The sensor is fail-safe with GEMS substituting a value of 50 degrees centigrade in the event of sensor failure.

Air flow sensor(V) - This value is the pure voltage reading taken from the Air Flow Meter that GEMS uses to work out the flow rate in Kg/Hr. At idle, the value should be around 20 - 25Kg/Hr.

Secondary air status - Commanded Secondary air Status. Options are:

- **1:** Upstream of first catalytic converter.
- **2:** Downstream of first catalytic converter inlet.
- **4:** Atmosphere / off.

Any other value is invalid.

Curr. run line position - This value is the number of steps for the current run line position.

Long term adapt. Idle - This is the value that the GEMS learns over a period of time to take into account manufacturers' tolerances on components which affect overall idle speed. It can be reset, forcing the GEMS to re-learn this value or it can be manually altered in the settings section.

Short term adapt.idle - This is the value that the GEMS uses to regulate the current idle speed to take into account current engine load, temperature, etc. It can be manually altered in the settings section.

Idle speed reference - This is the target idle speed in RPM that the GEMS uses as a reference when self adjusting the idle speed. This is not settable and is pre-set into the ECU.

Idle air control valve - The Idle Air Control Valve (IACV) has a stepper motor mounted on it, which controls its position in steps thereby regulating the air flow at idle and thus the idle speed. The position of this stepper motor is adjustable and should be such that a warm engine at normal idle should cause the stepper motor to be at between 15 and 30 steps. The value can be between zero (closed) and 200 (open).

Engine speed - The current Engine RPM.

Gear box retard - This is derived from a signal sent by the Automatic Gearbox (where fitted) and is used to inform the GEMS of gear changes, torque and load so that GEMS may retard the ignition accordingly, producing smoother gear changes. At idle this should be 17% increasing towards 100% as and when ignition retarding is required.

Calc. load value(%) - This is an internal value where the GEMS keeps a track on the load that the engine is under it is used in internal fuelling calculations.

Gear box status(D/P) - This status is used by the GEMS so that idle may be better maintained as the Automatic Gearbox load is applied to the engine.

ENGINE – OTHER

Coolant temp - The value obtained from the engines coolant temperature sensor.

Battery(V) - The current state of the battery at the GEMS ECU. Some GEMS ECUS built around 1996 were faulty and did not correctly report the voltage, instead supplying a fixed signal which incorrectly indicates 16 volts.

Road speed(mph) - The road speed as supplied to the GEMS ECU from the ABS ECU in Mph

Road speed(km/h) - The road speed as supplied to the GEMS ECU from the ABS ECU in Kph

Air cond request - When the A/C button is pressed an active low signal is output to the GEMS ECU (The Request). This then looks at factors like engine temperature, load, current acceleration etc., and when these conditions allow, grant Air conditioning. This involves it engaging the clutch to drive the Air Conditioning pump, altering its internal fuelling to compensate for the load imposed by the pump,

managing along with the Hevac the Condenser fans, and also telling the Hevac that Air Conditioning has been Granted. This shows the current status of the request line from the Hevac ECU.

Front screen load - This is an input which tells the GEMS ECU that the heated front windscreen is being switched on so that it can compensate for the heavier electrical load on the alternator.

Ignition switch - The current ignition switch state as determined by GEMS.

abs volts - The ABS has the ability to inform the GEMS ECU that the vehicle is encountering unusually rugged terrain. Thus, should the GEMS think that it has had a engine misfire during such driving it can be persuaded not to falsely log a misfire fault in its fault code memory.

Security learn - When the ignition is turned on, the BECM providing it is in receipt of a valid mobilisation code and is therefore not in an alarmed or immobilised state, sends a coded signal to the GEMS which the GEMS then compares against a mobilisation code it has stored in it. If the two codes compare OK the GEMS allows the engine to start. This forms the basis of the immobiliser. If the GEMS ECU, the BECM, or the lockset & key fob is replaced, or other data in the BECM is changed, it may be required for the GEMS to re-learn a new mobilisation code. This is done by putting the GEMS into Security learn mode whereby the next coded signal it receives is not compared, but is instead stored as the master copy. When security learn mode has been entered, the ignition has to be turned off and turned back on to trigger the BECM into sending the code. The GEMS will check the incoming code and should accept it; however, if there is an error, however slight in the codes makeup, the GEMS can reject it; in such a case there will be no valid code stored. This status indicates whether the system has a valid code stored or not and is only valid in the ignition cycle in which is learned.

Security mobilized - This shows the status of the engine immobiliser built in to the GEMS.

Transfer box(V) - This signal is only valid for the North American specification (NAS) vehicles. It allows the Transfer box to signal to the GEMS situations which affect emissions.

Inj timing advance(deg) - An internal record of calculated timing advance applied by the GEMS.

OUTPUTS TESTS

MIL Lamp - This output flashes the MIL lamp or Check Engine light on the instrument cluster to check correct operation and confirm full control of the lamp by GEMS ECU. The lamp is permanently ON when ignition on, and OFF with the engine running.

O2 sensor heater - Turns On and Off the power to the heaters, which are built into the oxygen sensors to check correct operation and confirm full control of the heaters by the GEMS ECU. (voltage measurement)

Fuel pump - Turns On and Off the power to the fuel pump relay to check correct operation and confirm full control of the fuel pump by the GEMS ECU.

Air Cond. Grant - Turns On and Off the grant line to the AC to check correct operation. A fluctuation of a voltmeter needle between 0V and 5V can be seen when connected on PIN 1 of the big black connector of the GEMS ECU.

Condensor fan- Turns On and Off the power to the Air conditioning's condenser fans control relay to check correct operation and confirm control of the fans by the GEMS ECU.

UTILITY FUNCTIONS

SECURITY CODE LEARN

If the engine will not start because the GEMS or BECM code has changed you need to use this function to set the new code. In the BECM enter any code between 0 and 65535. Then in the GEMS ECU SELECT Security Code Learn and this forces the 2 ECUs to learn the new code.

Reset Adaptive Values

As the GEMS runs, it keeps a long-term tally of the constant adjustments it is making to keep values on target. After a while it realises that it is always adding or subtracting more or less the same amounts and so stores these adjustments as long term adaptive values (those it always uses). These adjustments are really designed to compensate for tolerance in components, natural leakage through gaskets, or air spillage etc.

If, however, major rebuilds are undertaken or major components replaced, these values could suddenly become very wrong. This function deletes the current adaptive values (except short term idle) for the stored closed throttle position, which controls the idle speed, and for adaptive AMFR, which controls the fuel mixture, and makes the system re-learn them. Unfortunately a zero value can be as wrong as the previous value, so having performed the reset it is possible that the engine may not run as smoothly as before; however it will correct itself as the system re-learns the new values after several driving cycles. On vehicles with no oxygen sensors the Adaptive Air Mass Flow Rate (AMFR) will have to be manually set as the system has no feedback to learn this value. This can be done in the Settings section and requires an external CO meter.