Heat Management

The engine control unit of the N54 engine controls the coolant pump according to requirements:

- Low output in connection with low cooling requirements and low outside temperatures
- High output in connection with high cooling requirements and high outside temperatures

The coolant pump may also be completely switched off under certain circumstances, e.g. to allow the coolant to heat up rapidly during the warm-up phase. However, this only occurs when no heating is required and the outside temperature is within the permitted range.

The coolant pump also operates differently than conventional pumps when controlling the engine temperature. To date, only the currently applied temperature could be controlled by the thermostat.

The software in the engine control unit now features a calculation model that can take into account the development of the cylinder head temperature based on load.
In addition to the characteristic map control of the thermostat, the heat management system makes it possible to use various maps for the purpose of controlling the coolant pump. For instance, the engine control unit can adapt the engine temperature to match the current operating situation.

This means that four different temperature ranges can be implemented:

- 108°C ECO mode
- 104°C Normal mode
- 95°C High mode
- 90°C High + map-thermostat mode

The control system aims to set a higher cylinder-head temperature (108°C) if the engine control unit determines ECO (economy) mode based on the engine performance.
The engine is operated with relatively low fuel consumption in this temperature range as the internal friction is reduced.

An increase in temperature therefore favors slower fuel consumption in the low load range. In HIGH and map-thermostat mode, the driver wishes to utilize the optimum power development of the engine. The cylinder-head temperature is reduced to 90°C for this purpose. This results in improved volumetric efficiency, thus increasing the engine torque. The engine control unit can now set a certain temperature mode adapted to the respective operating situation. Consequently, it is possible to influence fuel consumption and power output by means of the cooling system.

The temperatures specified only ever represent a target value, the attainment of which is dependent on many factors. These temperatures are first and foremost not attained precisely.

The consumption-reducing and power increasing effects arise in each case in a temperature spectrum. The function of the cooling system is to provide the optimal cooling output according to the boundary conditions under which the engine is being operated.

Intelligent Heat Management Options

The previous section dealt with the various temperature ranges in which heat management is effected. However, an electrically driven coolant pump makes available even further options. For instance, it is now possible to warm up the engine without recirculating the coolant or to allow the pump to continue to operate after turning off the engine to facilitate heat dissipation. The advantages offered by this type of pump are listed in the following table:

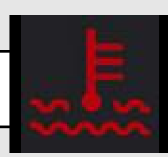
Consumption	• Faster warm-up as coolant is not recirculated until needed • Increased compression ratio due to greater cooling output all full load as compared to similar engines without this option
Emissions	• Faster engine warm-up by drastically reduced pump speed and the lower volumetric flow of coolant • Reduced friction • Reduced fuel consumption • Reduced exhaust emissions
Power Output	• Component cooling independent of engine speed • Requirement controlled coolant pump output • Avoidance of power loss
Comfort	• Optimum volumetric flow - Heating capacity reduced as required - Residual heat with engine stationary
Component Protection	• After-running of electric coolant pump = improved heat dissipation from engine switch off point. Allows protection of turbochargers by reduced oil “coking” during heat soak.

System Protection

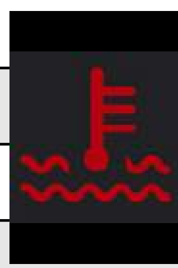
In the event of the coolant or engine oil being subject to excessive temperatures while the engine is running, certain functions in the vehicle are influenced so that more energy is made available to the engine-cooling system, i.e. temperature-increasing loads are avoided.

These measures are divided into two operating modes:

- Component protection
- Emergency

Engine oil temp (T-oil C)	Operating mode	Display in Cluster	Power output reduction, Air conditioning	Power output reduction, Engine	Torque converter clutch lockup
148			Start 0 %	Start 0 %	
149			–		
150	Component Protection		–		
151	Component Protection		–	From here = clear reduction	
152	Component Protection		End - 100 %		
153	Component Protection				
154	Component Protection				
155	Component Protection				
156	Component Protection				
157	Component Protection			End @ 90 %	
158	Emergency				Active
159	Emergency				Active
160	Emergency				Active
161	Emergency				Active
162	Emergency				Active
163	Emergency				Active

Measures and Displays for Coolant Temperature

Coolant (T-Coolant)	Operating mode	Display in Cluster	Power output reduction, Air conditioning	Power output reduction, Engine	Torque converter clutch lockup
115					
116					
117	Component Protection		Start 0 %	Start 0 %	
118	Component Protection		–	From here = clear reduction	
119	Component Protection		–	–	
120	Component Protection		End - 100 %	–	
121	Component Protection			–	
122	Component Protection			–	Active
123	Component Protection			–	Active
124	Component Protection			End @ 90 %	Active
125	Emergency				Active
126	Emergency				Active
127	Emergency				Active
128	Emergency				Active
129	Emergency				Active