



Koenigsegg
Press information
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The Gemera's Tiny Friendly Giant engine

The Koenigsegg Gemera's engine is small. At the same time, it is big when it comes to – power, torque and sound. Still, it is small when it comes to emissions and consumption. In short – it is a contradiction of an engine, developed and created by Koenigsegg and its sister company, Freevalve. Therefore, it has been named the “Tiny Friendly Giant” – or TFG for short. Being a two-liter three-cylinder engine, the TFG is future-proofed given its extreme performance, reduced fuel consumption and lowered emissions – not to forget its ability to run on second-generation CO2 neutral renewable fuels.

CEO and founder, Christian von Koenigsegg comments on the Gemera's engine: “The Koenigsegg TFG motor is designed to be super-efficient, CO2-neutral, give exceptionally low emissions and be able to be packaged in super small spaces. Any upcoming and foreseeable emission regulations are going to be an easy match for the TFG.”

The future of performance and efficiency

The Gemera complements the TFG with three electric motors and the patented single-gear Koenigsegg Direct Drive (KDD) transmission. The total output is a combined 1700 bhp or 1.27 MW of power and 3500 Nm of torque.

The immense torque combined with the relatively low curb weight of 1850 kg means that the Gemera can go from 0 to 100 km/h in only 1.9 seconds and from 0 to 400 km/h in record matching pace. To top things off, it also comes fitted with a lightweight 800V battery which enables the Gemera to go full electric for up to 50 km.

How it works

The Freevalve system in the TFG offers the unique ability to have independent control of the intake and exhaust valves. For any engine load criteria, the timing of intake and exhaust can be independently adjusted. The system can then “decide” how to operate the valves depending on driving conditions – which combination to use in order to maximize performance, minimize fuel consumption or regulate emissions. Freevalves allows for a greater degree of control over the engine, which in turn provides significant performance and environmental benefits.

Fuel consumption reduction

The TFG has an estimated fuel consumption of 15 – 20% less than a typical modern four-cylinder two-liter engine with direct injection and variable camshaft.

The Freevalves improve engine efficiency at part load by eliminating throttle losses since there is no throttle.



Furthermore, Freevalves deactivates cylinders with Frequency Modulated Torque to further reduce fuel consumption.

Freevalves are also capable of running the so-called Miller cycle, which is why the TFG can have a static compression of 9.5:1, which is high for a high boost turbo engine. Using the Freevalve system to run for example the Miller cycle, gives the TFG high efficiency and high power at the same time. All factors considered, the TFG is one of the most frugal and most powerful production engines in the world for its size.

Cleaner exhausts

Traditional combustion engines with camshafts give out most of their pollution during their first 20 or so seconds of cold start, due to cold cylinders, cold catalytic converters and poor fuel mixing at idle.

As traditional engines heat up, the cylinders and catalytic converters become warm and far less polluting, although there is still poor fuel mixing at idle. Given how good modern catalytic converters have become, these engines are virtually clean when warm and during normal driving.

The TFG overcomes two of the three issues directly at start up, by heating up and provoking turbulence of the fuel mixture back and forth through the intake and exhaust valves. This much-improved cold combustion also leads to much faster catalytic converter heat up, thereby reducing cold-start emission by around 60% compared to an equal-sized traditional engine with camshafts.

The Freevalve system basically eliminates the last emission drawback of the modern combustion engine – the cold start related emissions.

When running the TFG on renewable alcohol fuels – there are virtually no particulates produced and in many “normal” environments the TFG consumes and burns more particles from the surrounding air than it produces, thereby actually cleaning the air.

Using the best alternatives of alcohols there is even the chance for net-zero or CO₂ negative emissions.

Improved starting ability with different fuel types

Alcohol fuels maximizes performance, as they give more internal cooling effects and have higher octane compared to petrol. However, they are more difficult to vaporize than petrol when cold. Therefore, petrol is added to the alcohol during severe cold starts to solve the problem.

The Freevalve system overcomes this cold start issue by utilizing a pre-start heating mode for the initial cranking and first combustion. One intake valve is used and opened late with low lift for maximum turbulence and vaporization. Cylinder deactivation is applied to increase the amount of air and fuel in each combustion during starting and warm-up. Internal exhaust gas recirculation (EGR) is activated in the



following combustion cycles, using hot residuals from the previous combustion to vaporize the fuel. Lastly, the engine's variable compression ratio is adjusted by the Miller cycle.

Furthermore, the TFG can be turned multiple times before turning on the ignition, using the piston to pump the air back and forth to the inlet in a "Heating Mode" cycle. The result – the inlet air temperature is increased by 30° C in 10 cycles (taking about 2 seconds) and without need to add petrol to the fuel or starting cycle anymore, making the TFG fossil fuel independent in any climate.

Compactness

The TFG is extremely compact compared to its power and torque capabilities. One would typically associate a 600 bhp power output and 600 Nm of torque with a twin turbo V8 engine. The dry-sump system helps to shrink the engine further while allowing for perfect oil control during extreme driving. The complete long block does not weigh more than 70 kg and fits in a typical carry-on luggage case.

Improved performance

The TFG's Freevalve system allows full control of the combustion cycle. No other variable valve actuation system offers this level of control and reliability.

Both the intake and exhaust valves can be opened and closed at any desired crankshaft angle and to any desired lift height. This flexibility enables the TFG to deliver low fuel consumption and emission numbers, while still delivering massive torque and power.

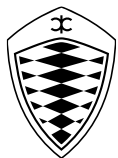
Patent-pending two stage turbo system

The Freevalve system made it possible to create a patent-pending, simplified two-stage turbo system. Quite simply, one turbo is connected to three exhaust valves – one from each cylinder. The second turbo is connected to the other three exhaust valves. During low rpm and part to high load, all exhaust gasses are pushed to only one turbo, by only opening one exhaust valve per cylinder – thereby doubling the exhaust gases to that turbine. When adequate boost is reached, the second exhaust valve is opened to start the second turbo.

The result is a three-cylinder two-liter engine that gives 400 Nm of torque from 1700 rpm and max torque of 600 Nm. These never-before-achieved numbers in an engine of this size make the TFG the most powerful engine per cylinder and volume to date, putting it light years ahead of any other production three-cylinder engine today.

Precision performance with Artificial Intelligence (AI)

There are many variables at play in the workings of an internal combustion engine (ICE). These include the complexity of achieving maximum performance, efficiency, reliability and safety with minimum fuel consumption, emission, size and cost.



Adding the Freevalve system to the mix makes it possible for the ICE to reach new heights. The Freevalve system creates many more variables to consider and tune. These can include NOx, CO2 emissions, fuel consumption, HC/NMOG, power and torque, all competing for priority in a cycle.

Then there's fuel types, lubricants, temperatures, component wear and tear, alongside the Freevalve liberation.

Clearly it becomes virtually impossible for humans to tune each parameter for optimum results. Given this, Koenigsegg has decided to use AI in order to optimize the TFG for different conditions and situations.

That is why Koenigsegg has chosen to partner with SparkCognition, the world's leading AI company, in order to leverage the development of the Freevalve equipped TFG.

An alluring engine sound

Fitted with a custom titanium Akrapovič exhaust, the TFG's 2-liter three-cylinder engine gives lag-free response and comes with an evocative and deep-throated growl. The TFG may be a small engine but it has a big and "thumpy" sound thanks to its large bore and stroke, combined with the "open" sound of Freevalves. The result is a deep, throaty, responsive and alluring sounding engine. The sound can also be smooth as the exhaust notes can be tuned and balanced by the Freevalve system.

Technical specification

See press information called "Technical specification".

All data is provisional

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