COMMISSION IMPLEMENTING DECISION (EU) 2019/314

of 21 February 2019

on the approval of the technology used in SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter for use in conventional combustion engine and certain hybrid powered passenger cars as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council

(Text with EEA relevance)

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EC) No 443/2009 of the European Parliament and of the Council of 23 April 2009 setting emission performance standards for passenger cars as part of the Union's integrated approach to reduce CO_2 emissions from passenger cars ([1]), and in particular Article 12(4) thereof,

Whereas:

(1) On 14 May 2018, the supplier SEG Automotive Germany GmbH submitted an application for the approval of the High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter for M_1 vehicles as an eco-innovation. The application has been assessed in accordance with Article 12 of Regulation (EC) No 443/2009 and Commission Implementing Regulation (EU) No 725/2011 ([2]).

(2) The 48V motor generator is a reversible machine that may operate as either an electric motor converting electrical energy into mechanical energy, or a generator converting mechanical energy into electrical energy as a standard alternator. The application submitted focused on the generation function of the component.

(3) The applicant proposed two different methodologies to determine the total efficiency of the system, combining the efficiency of the 48V motor generator and the efficiency of the 48V/12V DC/DC converter. The first method aims to calculate the efficiency of the 48V motor generator and its 48V/12V DC/DC converter separately, while the second method aims to calculate the efficiency of the 48V motor generator plus its 48V/12V DC/DC converter (combined method). Both testing procedures are in line with the Technical Guidelines for the preparation of applications for the approval of innovative technologies pursuant to Regulation (EC) No 443/2009. As compared to the testing methodology defined in Commission Implementing Decision (EU) 2017/785 ([3]) on the approval of efficient 12V motor-generators, the testing methodologies for 48V motor generators include different voltage and test current to take into account the specificities of the 48V motor generator.

(4) The information provided in the application demonstrates that the conditions and the criteria referred to in Article 12 of Regulation (EC) No 443/2009 and in Articles 2 and 4 of Implementing Regulation (EU) No 725/2011 have been met for the two proposed case studies. As a consequence, the SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter applied to M_1 vehicles should be approved as an eco-innovation.

(5) It is appropriate to approve the testing methodologies for determining the CO_2 savings from the SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter. Only emission savings certified on the basis of one of the two testing methodologies set out in this Decision can be taken into account for determining a manufacturer's specific emission performance pursuant to Regulation (EC) No 443/2009.

([1]) OJ L 140, 5.6.2009, p. 1.

([2]) Commission Implementing Regulation (EU) No 725/2011 of 25 July 2011 establishing a procedure for the approval and certification of innovative technologies for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 194, 26.7.2011, p. 19).

([3]) Commission Implementing Decision (EU) 2017/785 of 5 May 2017 on the approval of efficient 12 V motor-generators for use in conventional combustion engine powered passenger cars as an innovative technology for reducing CO_2 emissions from passenger cars pursuant to Regulation (EC) No 443/2009 of the European Parliament and of the Council (OJ L 118, 6.5.2017, p. 20)

(6) In order to determine the CO_2 savings from the SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter, it is necessary to establish the baseline technology against which the efficiency of the generator function should be assessed. Taking into account expert judgement it is appropriate to consider an alternator with 67 % efficiency as baseline technology to be used for the purpose of determining the CO_2 savings under this Decision..

(7) In the case of hybrid M_1 vehicles, the testing methodologies are based on certain conditions that are only valid for vehicles for which it is allowed to use uncorrected measurements like the fuel consumption or the CO_2 emissions measured during type 1 test as specified in Annex 8 to UNECE Regulation No 101. This is why the scope of this decision applies to any internal combustion engine powered M_1 vehicles, but is limited to certain hybrid M_1 vehicles only.

(8) The savings from the SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter may be partially demonstrated on the test referred to in Annex XII to Commission Regulation (EC) No 692/2008 ([4]). It is therefore necessary to ensure that this partial coverage is taken into account in the testing methodology for CO_2 savings from the motor generator.

(9) If the type approval authority finds that the SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter does not satisfy the conditions for certification, the application for certification of the savings should be rejected.

(10) This Decision should apply until 2020 inclusive in relation to the test procedure referred to in Annex XII to Regulation (EC) No 692/2008. With effect from 1 January 2021, innovative technologies are to be assessed in relation to the test procedure laid down in Commission Regulation (EU) 2017/1151 ([5]).

(11) For the purposes of determining the general eco-innovation code to be used in the relevant type approval documents in accordance with Annexes I, VIII and IX to Directive 2007/46/EC of the European Parliament and of the Council ([6]), the individual code to be used for the innovative technology for the SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter should be specified,

HAS ADOPTED THIS DECISION:

Article 1

Approval

The technology used in the SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter is approved as an innovative technology within the meaning of Article 12 of Regulation (EC) No 443/2009 provided the innovative technology is fitted in internal combustion engine powered M_1 vehicles, or in hybrid M_1 vehicles for which the conditions specified in point 6.3.2(2) or (3) of Annex 8 to UNECE Regulation 101 are fulfilled.

Article 2

Definitions

For the purpose of this Decision, 48V motor generator means a reversible machine that may operate as either an electric motor converting electrical energy into mechanical energy, or a generator converting mechanical energy into electrical energy as a standard alternator. This Decision focus on the generation function of the component.

([4]) Commission Regulation (EC) No 692/2008 of 18 July 2008 implementing and amending Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (EUR 5 and EUR 6) and on access to vehicle repair and maintenance information (OJ L 199, 28.7.2008, p. 1).

([5]) Commission Regulation (EU) 2017/1151 of 1 June 2017 supplementing Regulation (EC) No 715/2007 of the European Parliament and of the Council on type-approval of motor vehicles with respect to emissions from light passenger and commercial vehicles (EUR 5 and EUR 6) and on access to vehicle repair and maintenance information, amending Directive 2007/46/EC of the European Parliament and of the Council, Commission Regulation (EC) No 692/2008 and Commission Regulation (EU) No 1230/2012 and repealing Commission Regulation (EC) No 692/2008 (OJ L 175, 7.7.2017, p. 1).

([6]) Directive 2007/46/EC of the European Parliament and of the Council of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (Framework Directive) (OJ L 263, 9.10.2007, p. 1).

Article 3

Application for certification of CO_2 savings

1. A manufacturer may apply for certification of the CO_2 savings from one or several SEG Automotive Germany GmbH High efficient 48V motor generators (BRM) plus 48V/12V DC/DC converters intended for use in M_1 vehicles that comply with the conditions set out in Article 1.

2. An application for the certification of the savings from one or several SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter shall be accompanied by an independent verification report confirming that the CO_2 savings threshold of 1 g CO_2/km specified in Article 9 of Implementing Regulation (EU) No 725/2011 is met.

3. The type approval authority shall reject the application for certification if it finds that the motor generator plus converter or motor generators plus converters are fitted in vehicles that do not comply with the conditions set out in Article 1, or where the CO_2 emission savings are below the threshold specified in Article 9(1) of Implementing Regulation (EU) No 725/2011.

Article 4

Certification of CO_2 savings

1. The reduction in CO_2 emissions from the use of a SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter shall be determined using one of the two methodologies set out in the Annex.

2. Where a manufacturer applies for the certification of the CO_2 savings from more than one SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus 48V/12V DC/DC converter in relation to one vehicle version, the type approval authority shall determine which of the motor generators plus converters tested delivers the lowest CO_2 savings, and record those savings in the relevant type approval documentation. That value shall also be indicated in the certificate of conformity in accordance with Article 11(2) of Implementing Regulation (EU) No 725/2011.

3. The type approval authority shall record the verification report and the test results on the basis of which the savings were determined and shall make that information available to the Commission on request.

Article 5

Eco-innovation code

The eco-innovation code No 27 shall be entered into the type approval documentation where reference is made to this Decision in accordance with Article 11(1) of Implementing Regulation (EU) No 725/2011.

Article 6

Applicability

This Decision shall apply until 31 December 2020.

Article 7

Entry into force

This Decision shall enter into force on the twentieth day following that of its publication in the *Official Journal of the European Union*.

Done at Brussels, 21 February 2019.

For the Commission
The President
Jean-Claude JUNCKER

ANNEX

Methodology to determine the CO_2 savings of the SEG Automotive Germany GmbH High efficient 48V motor generator (BRM) plus the 48V/12V DC/DC converter fitted in vehicles in compliance with the conditions set out in Article 1

1. INTRODUCTION

In order to determine the CO_2 emission reductions that can be attributed to the use of the generation function of the SEG Automotive Germany GmbH High efficient 48V motor generator (BRM), hereinafter referred to as 48 V motor generator or motor generator, plus the 48V/12V DC/DC converter, for use in vehicles in compliance with the conditions set out in Article 1, it is necessary to specify the following:

(1) The test conditions;

(2) The test equipment;

(3) The procedure to determine the total efficiency;

(4) The procedure to determine the CO_2 savings;

(5) The procedure to determine the uncertainty of the CO_2 savings.

Two alternative methods can be used to determine the CO_2 savings. The methods are described as follows.

2. SYMBOLS, PARAMETERS AND UNITS

Latin symbols

C_{CO_2} — CO_2 savings [g CO_2/km]

CO_2 — Carbon dioxide

CF — Conversion factor (l/100 km) - (g CO_2/km) [gCO_2/l] as defined in Table 3

h — Frequency as defined in Table 1

i — Number of operating points

I — Current intensity at which the measurement shall be carried out [A]

l — Number of measurement of the sample for the 48V/12V DC/DC converter

m — Number of measurement of the sample for the 48V motor generator

M — Torque [Nm]

n — Rotational frequency [min^{-1}] as defined in Table 1

P — Power [W]

$s_{\overline{\eta_{DCDC}}}$ — Standard deviation of the 48V/12V DC/DC converter efficiency mean [%]

$s_{\eta_{MG}}$ — Standard deviation of the 48V motor generator efficiency [%]

$s_{\overline{\eta_{MG}}}$ — Standard deviation of the 48V motor generator efficiency mean [%]

$s_{\eta_{TOT}}$ — Standard deviation of the total efficiency [%]

$s_{C_{CO_2}}$ — Standard deviation of the total CO_2 savings [g CO_2/km]

U — Test voltage at which the measurement shall be carried out [V]

v — Mean driving speed of the New European Driving Cycle (NEDC) [km/h]

V_{Pe} — Consumption of effective power [l/kWh] as defined in Table 2

Greek symbols

Δ — Difference

η_B — Baseline alternator efficiency [%]

η_{DCDC} — 48V/12V DC/DC converter efficiency [%]

$\overline{\eta_{DC/DC}}$ — Mean of the 48V/12V DC/DC converter efficiency [%]

η_{MG} — 48V motor generator efficiency [%]

$\overline{\eta_{MG_i}}$ — Mean of the 48V motor generator efficiency at operating point i [%]

η_{TOT} — Total efficiency [%]

Subscripts

Index (i) refers to operating point

Index (j) refers to measurement of the sample

MG — Motor generator

m — Mechanical

RW — Real-world conditions

TA — Type approval (NEDC) conditions

B — Baseline

3. METHOD 1 ('SEPARATE METHOD')

3.1. **Efficiency of the 48V motor generator**

The efficiency of the 48V motor generator shall be determined in accordance with ISO 8854:2012, with the exception of the elements specified in this section.

Evidence shall be provided to the type approval authority that the rotational frequency ranges of the efficient 48V motor generator are consistent with those set out in Table 1. The measurements shall be conducted at different operating points, as set out in Table 1. The efficient 48V motor generator current intensity shall be defined as half of the rated current for all operating points. For each rotational frequency, the voltage and the output current of the motor generator shall be kept constant, the voltage at 52V.

Table 1

Operating points

Operating point i	Holding time [s]	Rotational frequency n_i [min^{-1}]	Frequency h_i
1	1 200	1 800	0,25
2	1 200	3 000	0,40
3	600	6 000	0,25
4	300	10 000	0,10

The efficiency at each operating point shall be calculated in accordance with Formula 1:

Formula 1

$$\eta_{MG_i} = \frac{60 \cdot U_i \cdot I_i}{2\pi \cdot M_i \cdot n_i} \cdot 100$$

All efficiency measurements are to be performed consecutively at least five (5) times. The average of the measurements at each operating point ($\overline{\eta_{MG_i}}$) shall be calculated.

The efficiency of the generation function (η_{MG}) shall be calculated in accordance with the following Formula 2:

Formula 2

$$\eta_{MG} = \sum_{i=1}^{4} h_i \cdot \overline{\eta_{MG_i}}$$

3.2. **Efficiency of the 48V/12V DC/DC converter**

The efficiency of the 48V/12V DC/DC converter shall be determined under the following conditions:

— Output voltage of 14,3V

— Output current of nominal power of the 48V/12V DC/DC converter divided by 14,3V

The nominal power of the 48V/12V DC/DC converter shall be the continuous output power at the 12V side guaranteed by the manufacturer of the DC/DC converter at the conditions specified in the ISO 8854:2012.

The efficiency of the 48V/12V DC/DC converter shall be measured at least five (5) times consecutively. The average of all the measurements ($\overline{\eta_{DC/DC}}$) shall be calculated and used for the calculations laid down in paragraph 3.3.

3.3. **Total efficiency and saved mechanical power**

The total efficiency of the 48 V motor generator plus the 48V/12V DC/DC converter shall be calculated using Formula 3:

Formula 3

$$\eta_{TOT} = \eta_{MG} \times \overline{\eta_{DC/DC}}$$

The 48 V motor generator plus the 48V/12V DC/DC converter generation function lead to saved mechanical power under real-world conditions (ΔP_{mRW}) and type approval NEDC conditions (ΔP_{mTA}) as set out in Formula 4.

Formula 4

$$\Delta P_m = \Delta P_{mRW} - \Delta P_{mTA}$$

Where the saved mechanical power under real-world conditions (ΔP_{mRW}) shall be calculated in accordance with Formula 5 and the saved mechanical power under type-approval NEDC conditions (ΔP_{mTA}) in accordance with Formula 6:

Formula 5

$$\Delta P_{mRW} = \frac{P_{RW}}{\eta_B} - \frac{P_{RW}}{\eta_{TOT}}$$

Formula 6

$$\Delta P_{mTA} = \frac{P_{TA}}{\eta_B} - \frac{P_{TA}}{\eta_{TOT}}$$

where

P_{RW}: Power requirement under 'real-world' conditions [W], which is estimated at 750W

P_{TA}: Power requirement under NEDC type-approval conditions [W], which is estimated at 350W

η_B: Efficiency of the baseline alternator [%], which is 67 %

3.4. **Calculation of the CO_2 savings**

The CO_2 savings of the 48 V motor generator plus the 48V/12V DC/DC converter shall be calculated in accordance with Formula 7:

Formula 7

$$C_{CO_2} = \Delta P_m \cdot \frac{V_{Pe} \cdot CF}{v}$$

Where:

v: Mean driving speed of the NEDC [km/h], which is 33,58 km/h

V_{Pe}: Consumption of effective power specified in Table 2:

Table 2

Consumption of effective power

Type of engine	Consumption of effective power (V_{Pe}) [l/kWh]
Petrol	0,264
Petrol Turbo	0,280
Diesel	0,220

CF: Conversion factor (l/100 km) - (g CO_2/km) [gCO_2/l] as defined in Table 3

Table 3

Fuel conversion factor

Type of fuel	Conversion factor (l/100 km) - (g CO_2/km) (CF) [gCO_2/l]
Petrol	2 330
Diesel	2 640

3.5. **Calculation of the statistical margin**

The statistical margin of the results of the testing methodology caused by the measurements shall be quantified. For each operating point the standard deviation shall be calculated in accordance with Formula 8:

Formula 8

$$s_{\overline{\eta_{MG_i}}} = \frac{s_{\eta_{MG_i}}}{\sqrt{m}} = \sqrt{\frac{\sum_{j=1}^{m} (\eta_{MG_{ij}} - \overline{\eta_{MG_i}})^2}{m(m-1)}}$$

The standard deviation of the efficiency value of the efficient 48V motor generator ($s_{\eta_{MG}}$) shall be calculated in accordance with Formula 9:

Formula 9

$$s_{\eta_{MG}} = \sqrt{\sum_{i=1}^{4} (h_i \cdot s_{\overline{\eta_{MG_i}}})^2}$$

The standard deviation of the efficiency value of the 48V/12V DC/DC converter ($s_{\overline{\eta_{DC/DC}}}$) shall be calculated in accordance with Formula 10:

Formula 10

$$s_{\overline{\eta_{DC/DC}}} = \sqrt{\frac{\sum_{j=1}^{1}\left(\eta_{DC/DC_{ij}} - \overline{\eta_{DC/DC_i}}\right)^2}{l(l-1)}}$$

The standard deviation of the motor generator efficiency ($s_{\eta_{MG}}$) and of the 48V/12V DC/DC converter ($s_{\overline{\eta_{DC/DC}}}$) lead to an uncertainty in the CO_2 savings ($s_{C_{CO_2}}$). That uncertainty is calculated in accordance with Formula 11:

Formula 11

$$s_{C_{CO_2}} = \frac{(P_{RW} - P_{TA})}{\eta_{TOT}} \cdot \frac{V_{Pe} \cdot CF}{v} \cdot \sqrt{\left(\frac{s_{\eta_{MG}}}{\eta_{MG}}\right)^2 + \left(\frac{s_{\overline{\eta_{DC/DC}}}}{\overline{\eta_{DC/DC}}}\right)^2}$$

4. METHOD 2 ('COMBINED METHOD')

4.1. **Efficiency of the 48V motor generator plus the 48V/12V DC/DC converter**

The efficiency of the 48V motor generator plus the 48V/12V DC/DC converter shall be determined in accordance with ISO 8854:2012, with the exception of the elements specified in this section.

Evidence shall be provided to the type approval authority that the speed ranges of the efficient 48V motor generator are consistent with those set out in Table 1.

The measurements shall be conducted at different operating points, as set out in Table 1. The efficient 48V motor generator plus the 48V/12V DC/DC converter current intensity shall be defined as half of the rated current of the 48V/12V DC/DC converter for all operating points.

The rated current of the 48V/12V DC/DC converter is defined as the output nominal power of the 48V/12V DC/DC converter divided by 14,3V. The nominal power of the 48V/12V DC/DC converter shall be the continuous output power at the 12V side guaranteed by the manufacturer of the DC/DC converter at the conditions specified in the ISO 8854:2012.

For each speed the voltage and the output current of the motor generator shall be kept constant, the voltage at 52 V.

The efficiency at each operating point shall be calculated in accordance with Formula 12:

Formula 12

$$\eta_{TOT_i} = \frac{60 \cdot U_i \cdot I_i}{2\pi \cdot M_i \cdot n_i} \cdot 100$$

All efficiency measurements are to be performed consecutively at least five (5) times. The average of the measurements at each operating point ($\overline{\eta_{TOT_i}}$) shall be calculated.

The efficiency of the generation function (η_{TOT}) shall be calculated in accordance with Formula 13:

Formula 13

$$\eta_{TOT} = \sum_{i=1}^{4} h_i \cdot \overline{\eta_{TOT_i}}$$

The measurement set up has to allow the measurement of the 48V motor generation efficiency alone.

4.2. **Demonstration of conservativeness of the 48V motor generator plus 48V/12V DC/DC converter efficiency determination**

In order to use the procedure specified in 4.1 for the determination of η_{TOT}, it has to be demonstrated that the efficiency of the 48V motor generator alone obtained with the conditions specified in 4.1 is lower than the efficiency obtained with the conditions specified in 3.1.

4.3. **Saved mechanical power**

The 48 V motor generator plus the 48V/12V DC/DC converter generation function lead to saved mechanical power under real-world conditions (ΔP_{mRW}) and type approval conditions (ΔP_{mTA}) as set out in Formula 14.

Formula 14

$$\Delta P_m = \Delta P_{mRW} - \Delta P_{mTA}$$

Where the saved mechanical power under real-world conditions (ΔP_{mRW}) shall be calculated in accordance with Formula 15 and the saved mechanical power under type-approval conditions (ΔP_{mTA}) in accordance with Formula 16:

Formula 15

$$\Delta P_{mRW} = \frac{P_{RW}}{\eta_B} - \frac{P_{RW}}{\eta_{TOT}}$$

Formula 16

$$\Delta P_{mTA} = \frac{P_{TA}}{\eta_B} - \frac{P_{TA}}{\eta_{TOT}}$$

where

P_{RW}: Power requirement under 'real-world' conditions [W], which is estimated at 750W

P_{TA}: Power requirement under type-approval NEDC conditions [W], which is estimated at 350W

η_B: Efficiency of the baseline alternator [%], which is 67 %

4.4. **Calculation of the CO_2 savings**

The CO_2 savings of the 48 V motor generator plus the 48V/12V DC/DC converter shall be calculated in accordance with Formula 17:

Formula 17

$$C_{CO_2} = \Delta P_m \cdot \frac{V_{Pe} \cdot CF}{v}$$

Where:

v: Mean driving speed of the NEDC [km/h], which is 33,58 km/h

V_{Pe}: Consumption of effective power specified in Table 2

CF: Conversion factor (l/100 km) - (g CO_2/km) [gCO_2/l] as defined in Table 3

4.5. **Calculation of the statistical margin**

The statistical margin of the results of the testing methodology caused by the measurements shall be quantified. For each operating point the standard deviation shall be calculated in accordance with Formula 18:

Formula 18

$$s_{\overline{\eta_{TOT_i}}} = \frac{s_{\eta_{TOT_i}}}{\sqrt{m}} = \sqrt{\frac{\sum_{j=1}^{m} \left(\eta_{TOT_{ij}} - \overline{\eta_{TOT_i}}\right)^2}{m(m-1)}}$$

The standard deviation of the efficiency value of the efficient 48V motor generator plus the 48V/12V DC/DC converter ($s_{\eta_{TOT}}$) shall be calculated in accordance with Formula 19:

Formula 19

$$s_{\eta_{TOT}} = \sqrt{\sum_{i=1}^{4}(h_i \cdot s_{\overline{\eta_{TOT_i}}})^2}$$

The standard deviation of the motor generator and of the 48V/12V DC/DC converter efficiency leads to an uncertainty in the CO_2 savings ($s_{C_{CO_2}}$). That uncertainty is calculated in accordance with Formula 20:

Formula 20

$$s_{C_{CO_2}} = \frac{(P_{RW} - P_{TA})}{{\eta_{TOT}}^2} \cdot \frac{V_{Pe} \cdot CF}{v} \cdot s_{\eta_{TOT}}$$

5. ROUNDING

The calculated CO_2 savings value (C_{CO_2}) and the statistical margin of the CO_2 saving ($s_{C_{CO_2}}$) must be rounded to a maximum of two decimal places.

Each value used in the calculation of the CO_2 savings can be applied unrounded or must be rounded to the minimum number of decimal places which allows the maximum total impact (i.e. combined impact of all rounded values) on the savings to be lower than 0,25 gCO_2/km.

6. STATISTICAL SIGNIFICANCE (for both methods)

It shall be demonstrated for each type, variant and version of a vehicle fitted with the efficient 48V motor generator that the uncertainty of the CO_2 savings calculated in accordance with Formula 7 or Formula 17 is not greater than the difference between the total CO_2 savings and the minimum savings threshold specified in Article 9(1) of Implementing Regulation (EU) No 725/2011 and Commission Implementing Regulation (EU) No 427/2014 [1] (see Formula 21).

Formula 21

$$MT < C_{CO_2} - s_{C_{CO_2}} - \Delta CO_{2_m}$$

Where:

MT: minimum threshold [g CO_2/km]

C_{CO_2}: total CO_2 saving [g CO_2/km]

$s_{C_{CO_2}}$: standard deviation of the total CO_2 saving [gCO_2/km]

ΔCO_{2_m}: CO_2 correction coefficient due to the positive mass difference between the efficient 48V motor generator plus 48V/12V DC-DC converter and the baseline alternator. For ΔCO_{2_m} the data in Table 4 is to be used.

Table 4

CO_2 correction coefficient due to the extra mass

Type of fuel	CO_2 correction coefficient due to the positive mass difference (ΔCO_{2_m}) [g CO_2/km]
Petrol	0,0277 · Δm
Diesel	0,0383 · Δm

[1] Commission Implementing Regulation (EU) No 427/2014 of 25 April 2014 establishing a procedure for the approval and certification of innovative technologies for reducing CO_2 emissions from light commercial vehicles pursuant to Regulation (EU) No 510/2011 of the European Parliament and of the Council (OJ L 125, 26.4.2014, p. 57).

Δm (in Table 4) is the extra mass due to the installation of the 48V motor generator and the 48V/12V DC-DC converter. It is the positive difference between the mass of the 48V motor generator plus the 48V/12V DC-DC converter and the mass of baseline alternator. The mass of the baseline alternator is 7 kg. The extra mass is to be verified and confirmed in the verification report to be submitted to the type approval authority together with the application for certifications.