

PRODUCT NOTE

EU MEPS

Efficiency requirements for low voltage motors New Commission Regulation (EU) 2019/1781



Commission Regulation (EU) 2019/1781 and the amending Regulation (EU) 2021/341 extend the scope of energy efficient motors covering the output power range from 0.12 kW up to 1000 kW and setting for the first time energy efficiency requirements for the variable speed drives (VSD).

New regulation for electric motors

Step 1: Starting 01.07.2021

Induction electric motors without brushes, commutators, slip rings or electrical connection to the rotor, rated for operation on a 50 Hz, 60 Hz or 50/60 Hz sinusoidal voltage, that:

- have 2, 4, 6 or 8 poles;
- have a rated voltage U_N above 50 V and up to and including 1000 V;
- have a rated power output P_N from 0.12 up to and including 1000 kW
- are rated on the basis of continuous duty operation (means capable of continuous operation at rated power with a temperature rise within the specified insulation temperature class, specified as specific duty types of S1, S3 \geq 80% or S6 \geq 80% as defined in the standards) and
- are rated for direct-on-line operation.

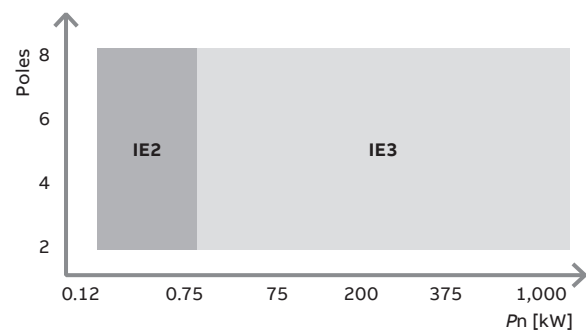
It is important to note that the option of IE2 and VSD ceases.

Step 2: Starting 01.07.2023 (additions to Step 1)

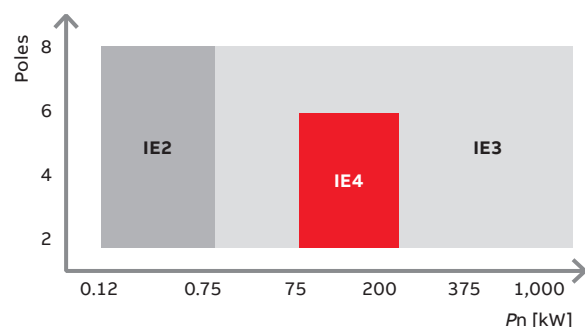
2, 4 and 6 pole single speed motors from 75 kW up to 200 kW shall be of IE4.

Ex motors with the protection type Ex eb and 1-phase motors shall be of IE2.

[Please visit our website for Ecodesign.](#)



Picture 1: Step 1 starting from 01.07.2021



Picture 2: Step 2 introduction of IE4

EU Ecodesign Regulation 2019/1781

Motors scope

Regulation (EU) 2019/1781 scope

Included in the scope starting July 1, 2021

- 3-phase single-speed motors rated for direct on-line (DOL) operation
- Rated output power from 0.12 to 1000 kW
- Rated voltage up to 1000 V and 50 Hz, 60 Hz or 50/60 Hz
- 2, 4, 6 or 8-pole
- Continuous duty (S1, S3 ≥ 80% or S6 ≥ 80%)
- Motors with protection types Ex ec, Ex d, Ex de or Ex t
- Motors with cooling method IC418 (TEAO)
- Brake motors with external brake

Included in the scope starting July 1, 2023 - additions from July 1, 2021

- 3-phase 2, 4 and 6 pole single-speed motors from 75 kW up to 200 kW (not for Ex motors) must be IE4
- 3-phase 2,4, 6 and 8 pole single-speed motors with protection type Ex eb must be IE2
- 1-phase single speed motors must be IE2

Excluded from the scope:

- Motors with cooling method IC410 (TENV)
- Motors completely integrated into a product (for example into a gear, pump, fan or compressor) and whose energy performance cannot be tested independently from the product, even with the provision of a temporary endshield and drive-end bearing
- Motors with an integrated variable speed drive whose energy performance cannot be tested independently from the variable speed drive
- Motors specifically designed and specified to operate exclusively
 - at altitudes exceeding 4000 m above sea level
 - where the ambient temperature exceeds +60°C
 - maximum operating temperature above +400 C
 - where the ambient temperature is below -30°C
 - water coolant below 0 °C or above 32°C
- Motors specifically designed and specified to operate wholly immersed in liquid
- Motors designed specifically for the traction of electric vehicles
- Motors placed on the market before July 1, 2029 as substitutes for identical motors integrated in products placed on the market before July 1, 2022, and specifically marketed as such

CE mark

The CE mark can only be fixed on motors and products when it fulfills the requirement of all relevant European directives and regulations to the product. The assessment for a product shall be done by the manufacturer and is generally done by applying harmonized EN standards. After compiling a technical documentation including tests, calculations, risk assessment etc. the CE mark shall be affixed on products.

There are four relevant EU Directives, each of them separately requiring the CE mark:

- For 'standard' electric motors three of them apply: Directive 2014/35/EU (LVD), Directive 2009/125/EC (Ecodesign) with the motor specific Regulation 2019/1781 and the amending Regulation (EU) 2021/341 and the Directive 2011/65/EU with the amending annexes.
- For motors intended for the potentially explosive atmospheres the Directive 2014/34/EU (ATEX) replaces the Directive 2014/35/EU (LVD) whereas some parts of the Machinery Directive 2006/42/EC also apply.

| | | | | | | | |
|---|----|--|-------|------------------|-------|--------|--|
| ABB | | ABB Oy, Motors and Generators Strömbergin puistotie 5 A 65320 Vaasa, Finland | | | | | |
| CE | | IE3 | | IEC60034-1 | | | |
| 3- Motor | | M3BP 280SMC 2 IMB3/IM1001 | | | | 2019 | |
| 1763532-10 | | | | | | | |
| No. 3G1F1951641613 | | | | Ins. cl. F IP 55 | | | |
| V | Hz | kW | r/min | A | cos φ | Duty | |
| 690 Y | 50 | 90 | 2981 | 88.7 | 0.88 | S1 | |
| 400 D | 50 | 90 | 2981 | 153 | 0.88 | S1 | |
| 660 Y | 50 | 90 | 2978 | 91.8 | 0.89 | S1 | |
| 380 D | 50 | 90 | 2978 | 159 | 0.89 | S1 | |
| 415 D | 50 | 90 | 2982 | 149 | 0.87 | S1 | |
| 460 D | 60 | 90 | 3582 | 133 | 0.88 | S1 | |
| IE3-50Hz-95.7%(100%)-95.6%(75%)-94.8%(50%) / IE3-60Hz-95.3%(100%) | | | | | | | |
| Product code 3GBP281230-ADK | | | | | | | |
| | | | | Nmax 3600 r/min | | | |
| 6316/C3 | | | | 6316/C3 | | 680 kg | |

EU Ecodesign Regulation for motors in variable speed operation

What do these definitions mean?

EU Ecodesign Regulation covers induction motors rated for 50 Hz, 60 Hz or 50/60 Hz sinusoidal voltage. It is also mentioned that 'Operation with an inverter does not exclude the motor from the scope of the Regulation' and 'Motors specified to operate exclusively with a variable speed drive are excluded from the Regulation'.

Standard induction motors for direct-on-line (DOL) operation

When motors rated for sinusoidal supply (DOL) are used with a DOL supply, they must meet the minimum efficiency level requirements specified in the regulation.

Standard induction motors can additionally have a rating plate showing their performance characteristics in variable speed drive (VSD) controlled applications. This additional information on VSD duty has no relation to the energy efficiency requirements or IE classification. This is because the regulation applies only to motors rated for DOL use.

Note that IE2 DOL rated motors can no longer be sold with the CE mark, even if they are used with a VSD.

Motors specified for operation exclusively with a variable speed drive

Motors specified for operation exclusively with a variable speed drive are outside the scope of the regulation. Hence the regulation does not cover motors such as synchronous reluctance, permanent magnet and DC motors.

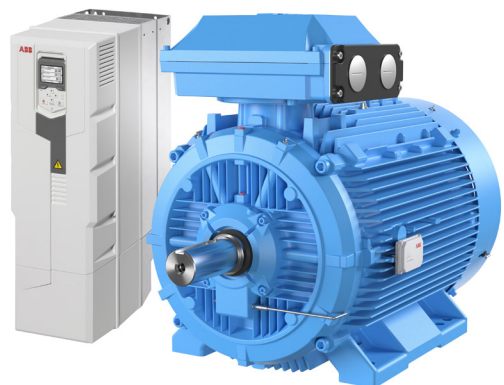
Application and industry specific induction motors for VSD duty, that cannot be DOL connected, such as roller table, high-speed and servo motors, belong to this category. These types of motor can also be labelled 'VSD only' or 'Inverter duty' motors. These motors may also have an IE class according to EN IEC TS 60034-30-2.

Direct-on-line duties and VSD duty

The scope of the regulation covers induction motors rated for continuous duty, i.e. duty class S1, S3 \geq 80% and S6 \geq 80% as defined in the regulation.

Restamping a standard induction motor for S9 duty does not put it outside the scope of the regulation. If a motor is rated for DOL operation then it is covered by the regulation.

However, induction motors that are not rated for 50 Hz or 60 Hz, but are rated for duty cycle S9, e.g. 'VSD duty only', may have some non-standard and specific features meeting the conditions to be specifically designed for VSD duty.



Efficiency classes and values

International standards

EU Ecodesign Regulation 2019/1781 is technically based on two IEC standards, IEC 60034-2-1:2014 and IEC 60034-30-1, that are adopted to identical EN standards and efficiency tables from the EN/IEC 60034-30-1 for IE2 and higher as such are listed in the Regulation:

- [IEC/EN 60034-2-1 specifying methods for determining losses efficiency for electric motors](#)
- [IEC/EN 60034-30-1 providing efficiency classes for line operated AC motors \(IE code\)](#)

Minimum 50 Hz efficiency levels for IE2 up to IE4 classes:

| Output kW | IE2 | | | | IE3 | | | | IE4 | | | |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 2 pole | 4 pole | 6 pole | 8 pole | 2 pole | 4 pole | 6 pole | 8 pole | 2 pole | 4 pole | 6 pole | 8 pole |
| 0.12 | 53.6 | 59.1 | 50.6 | 39.8 | 60.8 | 64.8 | 57.7 | 50.7 | 66.5 | 69.8 | 64.9 | 62.3 |
| 0.18 | 60.4 | 64.7 | 56.6 | 45.9 | 65.9 | 69.9 | 63.9 | 58.7 | 70.8 | 74.7 | 70.1 | 67.2 |
| 0.20 | 61.9 | 65.9 | 58.2 | 47.4 | 67.2 | 71.1 | 65.4 | 60.6 | 71.9 | 75.8 | 71.4 | 68.4 |
| 0.25 | 64.8 | 68.5 | 61.6 | 50.6 | 69.7 | 73.5 | 68.6 | 64.1 | 74.3 | 77.9 | 74.1 | 70.8 |
| 0.37 | 69.5 | 72.7 | 67.6 | 56.1 | 73.8 | 77.3 | 73.5 | 69.3 | 78.1 | 81.1 | 78.0 | 74.3 |
| 0.40 | 70.4 | 73.5 | 68.8 | 57.2 | 74.6 | 78.0 | 74.4 | 70.1 | 78.9 | 81.7 | 78.7 | 74.9 |
| 0.55 | 74.1 | 77.1 | 73.1 | 61.7 | 77.8 | 80.8 | 77.2 | 73.0 | 81.5 | 83.9 | 80.9 | 77.0 |
| 0.75 | 77.4 | 79.6 | 75.9 | 66.2 | 80.7 | 82.5 | 78.9 | 75.0 | 83.5 | 85.7 | 82.7 | 78.4 |
| 1.1 | 79.6 | 81.4 | 78.1 | 70.8 | 82.7 | 84.1 | 81.0 | 77.7 | 85.2 | 87.2 | 84.5 | 80.8 |
| 1.5 | 81.3 | 82.8 | 79.8 | 74.1 | 84.2 | 85.3 | 82.5 | 79.7 | 86.5 | 88.2 | 85.9 | 82.6 |
| 2.2 | 83.2 | 84.3 | 81.8 | 77.6 | 85.9 | 86.7 | 84.3 | 81.9 | 88.0 | 89.5 | 87.4 | 84.5 |
| 3 | 84.6 | 85.5 | 83.3 | 80.0 | 87.1 | 87.7 | 85.6 | 83.5 | 89.1 | 90.4 | 88.6 | 85.9 |
| 4 | 85.8 | 86.6 | 84.6 | 81.9 | 88.1 | 88.6 | 86.8 | 84.8 | 90.0 | 91.1 | 89.5 | 87.1 |
| 5.5 | 87.0 | 87.7 | 86.0 | 83.8 | 89.2 | 89.6 | 88.0 | 86.2 | 90.9 | 91.9 | 90.5 | 88.3 |
| 7.5 | 88.1 | 88.7 | 87.2 | 85.3 | 90.1 | 90.4 | 89.1 | 87.3 | 91.7 | 92.6 | 91.3 | 89.3 |
| 11 | 89.4 | 89.8 | 88.7 | 86.9 | 91.2 | 91.4 | 90.3 | 88.6 | 92.6 | 93.3 | 92.3 | 90.4 |
| 15 | 90.3 | 90.6 | 89.7 | 88.0 | 91.9 | 92.1 | 91.2 | 89.6 | 93.3 | 93.9 | 92.9 | 91.2 |
| 18.5 | 90.9 | 91.2 | 90.4 | 88.6 | 92.4 | 92.6 | 91.7 | 90.1 | 93.7 | 94.2 | 93.4 | 91.7 |
| 22 | 91.3 | 91.6 | 90.9 | 89.1 | 92.7 | 93.0 | 92.2 | 90.6 | 94.0 | 94.5 | 93.7 | 92.1 |
| 30 | 92.0 | 92.3 | 91.7 | 89.8 | 93.3 | 93.6 | 92.9 | 91.3 | 94.5 | 94.9 | 94.2 | 92.7 |
| 37 | 92.5 | 92.7 | 92.2 | 90.3 | 93.7 | 93.9 | 93.3 | 91.8 | 94.8 | 95.2 | 94.5 | 93.1 |
| 45 | 92.9 | 93.1 | 92.7 | 90.7 | 94.0 | 94.2 | 93.7 | 92.2 | 95.0 | 95.4 | 94.8 | 93.4 |
| 55 | 93.2 | 93.5 | 93.1 | 91.0 | 94.3 | 94.6 | 94.1 | 92.5 | 95.3 | 95.7 | 95.1 | 93.7 |
| 75 | 93.8 | 94.0 | 93.7 | 91.6 | 94.7 | 95.0 | 94.6 | 93.1 | 95.6 | 96.0 | 95.4 | 94.2 |
| 90 | 94.1 | 94.2 | 94.0 | 91.9 | 95.0 | 95.2 | 94.9 | 93.4 | 95.8 | 96.1 | 95.6 | 94.4 |
| 110 | 94.3 | 94.5 | 94.3 | 92.3 | 95.2 | 95.4 | 95.1 | 93.7 | 96.0 | 96.3 | 95.8 | 94.7 |
| 132 | 94.6 | 94.7 | 94.6 | 92.6 | 95.4 | 95.6 | 95.4 | 94.0 | 96.2 | 96.4 | 96.0 | 94.9 |
| 160 | 94.8 | 94.9 | 94.8 | 93.0 | 95.6 | 95.8 | 95.6 | 94.3 | 96.3 | 96.6 | 96.2 | 95.1 |
| 200 | 95.0 | 95.1 | 95.0 | 93.5 | 95.8 | 96.0 | 95.8 | 94.6 | 96.5 | 96.7 | 96.3 | 95.4 |
| 250 | 95.0 | 95.1 | 95.0 | 93.5 | 95.8 | 96.0 | 95.8 | 94.6 | 96.5 | 96.7 | 96.5 | 95.4 |
| 315 | 95.0 | 95.1 | 95.0 | 93.5 | 95.8 | 96.0 | 95.8 | 94.6 | 96.5 | 96.7 | 96.6 | 95.4 |
| 355 | 95.0 | 95.1 | 95.0 | 93.5 | 95.8 | 96.0 | 95.8 | 94.6 | 96.5 | 96.7 | 96.6 | 95.4 |
| 400 | 95.0 | 95.1 | 95.0 | 93.5 | 95.8 | 96.0 | 95.8 | 94.6 | 96.5 | 96.7 | 96.6 | 95.4 |
| 450 | 95.0 | 95.1 | 95.0 | 93.5 | 95.8 | 96.0 | 95.8 | 94.6 | 96.5 | 96.7 | 96.6 | 95.4 |
| 500-1000 | 95.0 | 95.1 | 95.0 | 93.5 | 95.8 | 96.0 | 95.8 | 94.6 | 96.5 | 96.7 | 96.6 | 95.4 |

Minimum 60 Hz efficiency levels for IE2 up to IE4 classes:

| Output kW | IE2 | | | | IE3 | | | | IE4 | | | |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 2 pole | 4 pole | 6 pole | 8 pole | 2 pole | 4 pole | 6 pole | 8 pole | 2 pole | 4 pole | 6 pole | 8 pole |
| 0.12 | 59.5 | 64.0 | 50.5 | 40.0 | 62.0 | 66.0 | 64.0 | 59.5 | 66.0 | 70.0 | 68.0 | 61.0 |
| 0.18 | 64.0 | 68.0 | 55.0 | 40.0 | 65.6 | 69.5 | 67.5 | 64.0 | 70.0 | 74.0 | 72.0 | 68.0 |
| 0.25 | 68.0 | 70.0 | 59.5 | 52.0 | 69.5 | 73.4 | 71.4 | 68.0 | 74.0 | 77.0 | 75.5 | 72.0 |
| 0.37 | 72.0 | 72.0 | 64.0 | 58.0 | 73.4 | 78.2 | 75.3 | 72.0 | 77.0 | 81.5 | 78.5 | 75.5 |
| 0.55 | 74.0 | 75.5 | 68.0 | 62.0 | 76.8 | 81.1 | 81.7 | 74.0 | 80.0 | 84.0 | 82.5 | 77.0 |
| 0.75 | 75.5 | 78.0 | 73.0 | 66.0 | 77.0 | 83.5 | 82.5 | 75.5 | 82.5 | 85.5 | 84.0 | 78.5 |
| 1.1 | 82.5 | 84.0 | 85.5 | 75.5 | 84.0 | 86.5 | 87.5 | 78.5 | 85.5 | 87.5 | 88.5 | 81.5 |
| 1.5 | 84.0 | 84.0 | 86.5 | 82.5 | 85.5 | 86.5 | 88.5 | 84.0 | 86.5 | 88.5 | 89.5 | 85.5 |
| 2.2 | 85.5 | 87.5 | 87.5 | 84.0 | 86.5 | 89.5 | 89.5 | 85.5 | 88.5 | 91.0 | 90.2 | 87.5 |
| 3.7 | 87.5 | 87.5 | 87.5 | 85.5 | 88.5 | 89.5 | 89.5 | 86.5 | 89.5 | 91.0 | 90.2 | 88.5 |
| 5.5 | 88.5 | 89.5 | 89.5 | 85.5 | 89.5 | 91.7 | 91.0 | 86.5 | 90.2 | 92.4 | 91.7 | 88.5 |
| 7.5 | 89.5 | 89.5 | 89.5 | 88.5 | 90.2 | 91.7 | 91.0 | 89.5 | 91.7 | 92.4 | 92.4 | 91.0 |
| 11 | 90.2 | 91.0 | 90.2 | 88.5 | 91.0 | 92.4 | 91.7 | 89.5 | 92.4 | 93.6 | 93.0 | 91.0 |
| 15 | 90.2 | 91.0 | 90.2 | 89.5 | 91.0 | 93.0 | 91.7 | 90.2 | 92.4 | 94.1 | 93.0 | 91.7 |
| 18.5 | 91.0 | 92.4 | 91.7 | 89.5 | 91.7 | 93.6 | 93.0 | 90.2 | 93.0 | 94.5 | 94.1 | 91.7 |
| 22 | 91.0 | 92.4 | 91.7 | 91.0 | 91.7 | 93.6 | 93.0 | 91.7 | 93.0 | 94.5 | 94.1 | 93.0 |
| 30 | 91.7 | 93.0 | 93.0 | 91.0 | 92.4 | 94.1 | 94.1 | 91.7 | 93.6 | 95.0 | 95.0 | 93.0 |
| 37 | 92.4 | 93.0 | 93.0 | 91.7 | 93.0 | 94.5 | 94.1 | 92.4 | 94.1 | 95.4 | 95.0 | 93.6 |
| 45 | 93.0 | 93.6 | 93.6 | 91.7 | 93.6 | 95.0 | 94.5 | 92.4 | 94.5 | 95.4 | 95.4 | 93.6 |
| 55 | 93.0 | 94.4 | 93.6 | 93.0 | 93.6 | 95.4 | 94.5 | 92.4 | 94.5 | 95.8 | 95.4 | 94.5 |
| 75 | 93.6 | 94.5 | 94.1 | 93.0 | 94.1 | 95.4 | 95.0 | 93.6 | 95.0 | 96.2 | 95.8 | 94.5 |
| 90 | 94.5 | 94.5 | 94.1 | 93.6 | 95.0 | 95.4 | 95.0 | 93.6 | 95.4 | 96.2 | 95.8 | 95.0 |
| 110 | 94.5 | 95.0 | 95.0 | 93.6 | 95.0 | 95.8 | 95.8 | 94.1 | 95.4 | 96.2 | 96.2 | 95.0 |
| 150 | 95.0 | 95.0 | 95.0 | 93.6 | 95.4 | 96.2 | 95.8 | 94.5 | 95.8 | 96.5 | 96.2 | 95.4 |
| 185 | 95.4 | 95.0 | 95.0 | 93.6 | 95.8 | 96.2 | 95.8 | 95.0 | 96.2 | 96.5 | 96.2 | 95.4 |
| 220 | 95.4 | 95.4 | 95.0 | 93.6 | 95.8 | 96.2 | 95.8 | 95.0 | 96.2 | 96.8 | 96.5 | 95.4 |
| 375- 1000 | 95.4 | 95.8 | 95.0 | 94.1 | 95.8 | 96.2 | 95.8 | 95.0 | 96.2 | 96.8 | 96.5 | 95.8 |

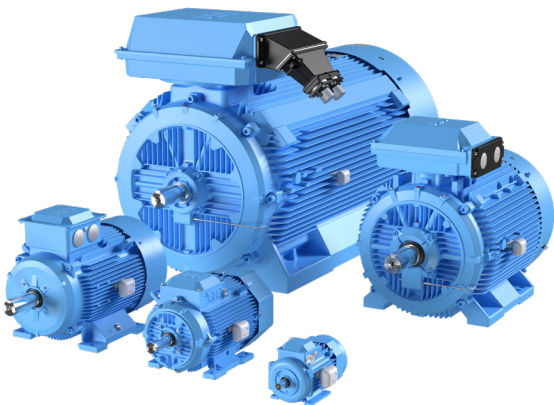
EU Ecodesign Regulation 2019/1781

Power loss points for motors

The EU Ecodesign Regulation 2019/1781 defines that the motor power losses, 'loss points', expressed as a percentage (%) of the rated output power at the following seven operating points for speed vs. torque: (25;25) (25;100) (50;25) (50;50) (50;100) (90;50) (90;100) shall be determined by either a direct input-output measurement or by a calculation based on an ambient reference temperature of 25 °C and rounded to one decimal place.

This power loss information shall be visibly displayed on the technical data sheet or user manual supplied with the motor unless an internet link or QR code to that information is supplied with the product.

The same information shall also be available on free access websites of the manufacturer of the motor, and on the technical data sheet supplied with products in which the motor is incorporated.



Regulation motor scope and loss points requirements

The scope of EU Regulation 2019/1781 applies only for induction motors rated for direct-on-line operation and for 50Hz, 60Hz or 50/60Hz sinusoidal voltage. Step 2, valid from 1.7.2022, requires that power losses in seven different operating or load points shall be defined for such motors.

ABB implementation

The defined seven loss points will be available for customers in the datasheet from the motor selection tools like the Optimizer, MotSize and EcoDesign tool.

In future, a QR code will lead customers to ABB websites and to the same information as provided by other previously mentioned means that can be found there.

In addition, for market surveillance purposes, the same loss point information is one part of the technical documentation, and the document for the product information for motors as required in the Regulation shall be available.

Even though the Regulation does not clearly state whether the loss points should be determined on the VSD supply or not, ABB has determined loss points in the VSD supply by calculation at a reference ambient temperature of 25 °C, and the calculations have been verified by measurements.

In addition to the requirement by the Regulation, ABB will also publish the same loss point information for converter duty motors like SynRM.

abb.com/motors&generators

[Ecodesign for motors and drives](#)

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