ENVIRONMENTAL PRODUCT DECLARATION

SINAMICS G120 - PM240-2

Power Modules FSD & FSE

Type II according to ISO 14021 including life cycle impact assessment (LCIA)

SIEMENS

General information

This environmental product declaration (EPD) is based on the international standard ISO 14021 (“Environmental labels and declarations – Self declared environmental claims – Type II environmental labelling”). The data in this EPD has been evaluated on a full-scale life cycle assessment (LCA) study according to ISO 14040/44, taking into account the product category rules (PCR) for electronic and electrotechnical products and systems defined in EN 50693.
The applied use phase scenario including load profile is based on EN 50598-3:2015 Table 5.

Siemens is dedicated to an environmentally conscious design of its products in line with IEC 62430 and has implemented an integrated management system according to ISO 9001, ISO 14001 and ISO 45001.

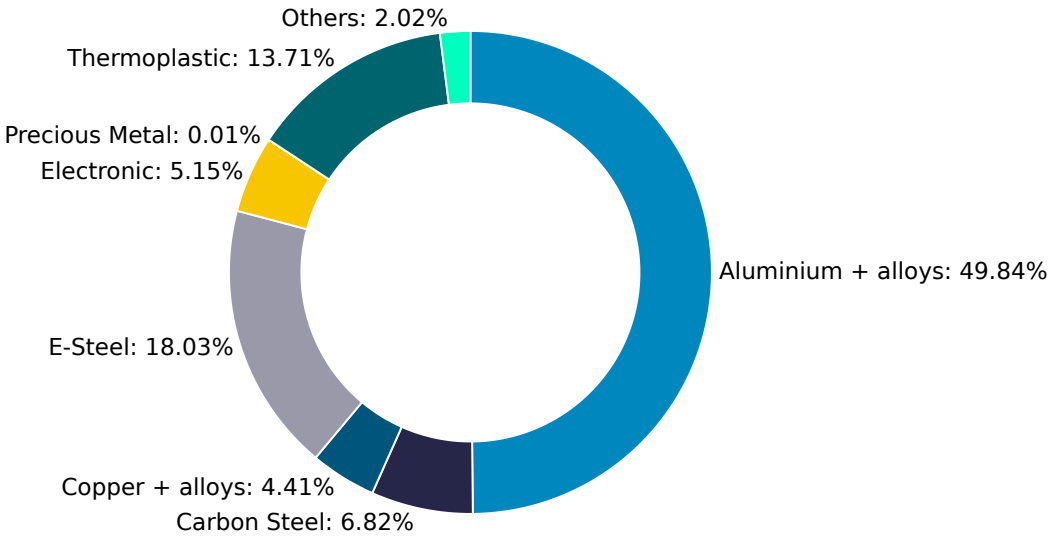
Products	**SINAMICS G120 Power Modules PM240-2 in frame sizes FSD & FSE, voltage classs 200...240 V (11 kW - 30 kW), 380...480 V, 500...690 V (11 kW - 55 kW) in IP20 degree of protection**
Represented by the reference product	6SL3210-1PC25-4UL0, 15 kW, 200...240 V, Unfiltered IP20
Product Description	SINAMICS G120 Power Modules PM240-2, IP 20, air cooled.
Functional Unit	Power Modules together with the dedicated Control Units allow the speed and torque control of asynchronous induction motors Calculation of the environmental impacts is based on 15 years of product service lifetime.[1]

[1] The lifetime value used for calculation is a reference value and does not equate with the minimum, average or real life time.

Material composition

The following chart outlines the overall material composition of the calculated reference product without packaging. Product weight of 17.0 kg adds up with packaging weight of 2.58 kg to a total weight of 19.58 kg. Packaging consists of: PE film, Expanded Polystyrene (EPS) Foam (30 kg/m3), Corrugated box, average composition, Graphic Paper.

Product Weight 17.0 kg



Substance assessment

At Siemens, we are committed to the development and production of environmentally sound and sustainably produced equipment. This includes avoiding hazardous substances in our products without compromising their benefits for our customers. Please visit the following website to learn more about how we comply with product-related environmental regulations like RoHS, REACH, WEEE and others: Product Related Environmental Protection

Life cycle stages and reference scenarios

Manufacturing

This stage covers the extraction of natural resources, production of raw materials, manufacturing, packaging, and transportation.

Distribution and Operation

This stage covers the product's distribution, installation, use, and maintenance. Different operating conditions can lead to deviations from the reference scenario.

End-of-Life

This stage covers the disassembly or shredding and material recycling of all recyclable materials, as well as energy recovery, thermal treatment and the disposal of all other materials.

Scenarios

Energy model used:
China (standard mix),
Europe (standard mix)

Transportation model:
Container Ship, Large Ship 200000 DWT 23000 TEU 19000 km,
Truck 7.5t-12t gross weight 1000 km

Energy model used:
Europe (standard mix)

Distribution scenario:
Container Ship, Large Ship 200000 DWT 23000 TEU 19000 km,
Truck 7.5t-12t gross weight 1000 km

Use Scenario:
Operation profile is defined by 3 operational points (OP):
OP1 : 20% of time at 100% speed and 100% torque
OP2: 70% of time at 50% speed and 25% torque
OP3: 10% of time at 0% speed and 25% torque
Lifetime 15 years and annual operation 5000h/year

Energy model used:
Europe (standard mix)

End-of-life methodology:
Avoid Burden (plastic waste incineration with energy recovery)

Key environmental performance indicators

The following impact categories characterize the product's environmental footprint. They have been calculated with LCIA methodology EF3.1; LCA tool: Green Digital Twin (GDT), Database: One Siemens LCA Database (based on MLC CUP 2023.2, formerly GaBi).

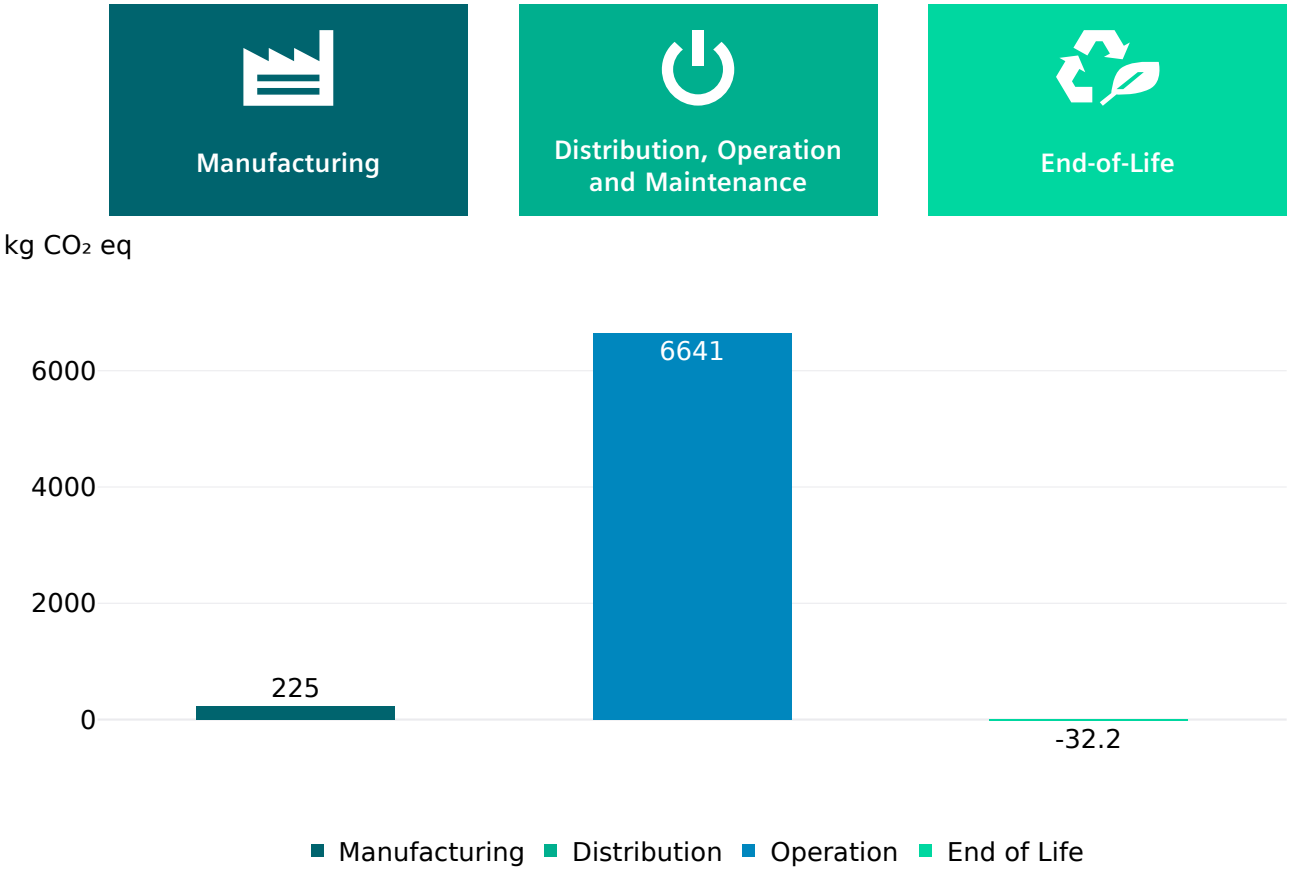
To ensure the high quality and completeness of the LCA results, Primary Data have been used whenever possible. Datasets for resources, such as electrical energy or natural gas, are chosen from the region where the device is produced and assembled. If primary data are not available, datasets reflecting state-of-the-art manufacturing technology are considered.

For products belonging to the same homogeneous product family range the following extrapolation criteria (Appendix) can be used to derive their climate change impact in kg CO2 eq. The rest of the listed impacts will be determined in the following version of the EPD.

Impact Category	Unit	Total	Manufacturing	Distribution	Operation	End-of-life
Acidification	Mole of H+ eq	1.96E+1	5.80E+0	7.47E-2	1.40E+1	-2.59E-1
Climate change – total	kg CO_2 eq	6.84E+3	2.25E+2	6.41E+0	6.64E+3	-3.22E+1
Climate change – fossil	kg CO_2 eq	6.78E+3	2.23E+2	6.36E+0	6.58E+3	-3.22E+1
Climate change – biogenic	kg CO_2 eq	5.97E+1	1.39E+0	1.34E-2	5.83E+1	-6.18E-3
Climate Change, land use and land use change	kg CO_2 eq	8.71E-1	1.69E-1	4.07E-2	7.18E-1	-1.60E-2
Ecotoxicity, freshwater – total	CTUe	3.98E+4	1.39E+3	6.00E+1	3.84E+4	-1.15E+2
Eutrophication, freshwater	kg P eq	2.58E-2	1.15E-3	1.65E-5	2.47E-2	-1.32E-5
Eutrophication, marine	kg N eq	4.02E+0	6.68E-1	1.90E-2	3.36E+0	-2.98E-2
Eutrophication, terrestrial	Mole of N eq	4.23E+1	7.28E+0	2.10E-1	3.51E+1	-3.19E-1
Human toxicity, cancer – total	CTUh	2.14E-6	1.11E-7	1.18E-9	2.03E-6	-7.63E-9
Human toxicity, non-cancer – total	CTUh	3.51E-5	2.93E-6	4.87E-8	3.24E-5	-3.06E-7
Ionising radiation, human health	kBq U235 eq	3.66E+3	1.43E+1	2.09E-2	3.65E+3	-3.85E+0
Land Use	dimensionless (pt)	5.56E+4	1.16E+3	2.51E+1	5.45E+4	-4.37E+1
Ozone depletion	kg CFC-11 eq	1.78E-7	5.63E-8	7.09E-13	1.22E-7	-2.19E-10
Particulate matter	Disease incidences	1.64E-4	4.77E-5	1.28E-6	1.18E-4	-3.09E-6
Photochemical ozone formation, human health	kg NMVOC eq	1.10E+1	2.05E+0	5.30E-2	8.96E+0	-9.49E-2
Resource use, fossils	MJ	1.41E+5	3.05E+3	8.41E+1	1.38E+5	-4.37E+2
Resource use, mineral and metals	kg Sb eq	1.67E-1	1.69E-1	3.09E-7	1.02E-3	-2.90E-3
Water use	m^3 water eq deprived water	1.48E+3	4.18E+1	5.64E-2	1.45E+3	-6.17E+0

Climate change

This chart shows the overall impact of the product on climate change – total. The operations phase is the lifecycle phase with the biggest overall impact. Different operating conditions can lead to deviations from the reference scenario.



End-of-life results

The end-of-life stage was modelled by shredding of the device, followed by sorting and material separation process.

It leads to:

- **an overall** product recyclability of up to 75% mainly due to metal content
- **an** energy recoverability of up to 14% from plastic materials
- **a** minimum disposal rate of 11%

The exact final values depend on the used recycling process and add up to 100%.

Note: The device should not be disposed of as unsorted municipal waste. Special treatment for specific components may be mandated by law or recommended for environmental reasons. Observe all local and applicable laws.

Appendix

For other MLFBs covered by this EPD under SINAMICS G120 PM240-2 homogenous product family, the climate change impact (CC) in kg CO2 eq. can be calculated for the manufacturing and end of life phases using linear regression equations according to the weight in kg (x) of the assessed product.

The following equations based on linear regression is defined as:

$$y = m \times x + b$$

where,

y.... climate change in kgCO2eq.

m.... scaling factor in kgCO2eq./kg of product

x .... mass of the product in kg without packaging

b .... intercept (offset) in kgCO2eq.

Thus, the factors for the **manufacturing phase** are:

m = 9.8183 kgCO2eq./kg of inverter, b = 78.607 kgCO2eq.

For **END of Life**:

m = -3.4826 kgCO2eq./kg of inverter, b = 13.133 kgCO2eq.

For the **operation phase**, the climate change in kgCO2eq was derived for 200 V, 400 V and 690 V and rated power PR (LO) in kW for European standard energy mix, lifetime of 15 years, annual operation 5000h/year and three operation points. The climate change values for operation phase are described in Tab. 1-3

Definition of the operational points are:

OP1: 20% of time at 100% speed and 100% torque.
OP2: 70% of time at 50% speed and 25% torque.
OP3: 10% of time at 0% speed and 25% torque.

Tab.1 Climate change results for the operation phase (200 V)

Voltage	V	**200**	**200**	**200**	**200**	**200**
PR (LO) – unfiltered	kW	11	15	18.5	22	30
Climate change	kg CO2eq	5175	6641	8509	10013	13354

Tab.2 Climate change results for the operation phase (400 V)

Voltage	V	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**
PR (LO) – filtered	kW	11	15	18.5	22	30	37	45	55
Climate change	kg CO2eq	3913	4618	6674	7816	9296	11757	13991	17857
Voltage	V	**400**	**400**	**400**	**400**	**400**	**400**	**400**	**400**
PR (LO) – unfiltered	kW	11	15	18.5	22	30	37	45	55
Climate change	kg CO2eq	3880	4571	6660	7802	9268	11710	13944	17810

Tab.3 Climate change results for the operation phase (690 V)

Voltage	V	**690**	**690**	**690**	**690**	**690**	**690**	**690**	**690**
P_R (LO) – filtered	kW	11	15	18.5	22	30	37	45	55
Climate change	kg CO2eq	5552	6566	7432	8282	10116	11823	13167	15427
Voltage	V	690	690	690	690	690	690	690	690
PR (LO) – unfiltered	kW	11	15	18.5	22	30	37	45	55
Climate change	kg CO2eq	5547	6561	7423	8268	10092	11781	13120	15380

Legal Disclaimer

This Environmental Product Declaration (EPD) is for information purposes only. It is based upon the standards mentioned above. This EPD does not warrant or guarantee the composition of a product or that the product will retain a particular composition for a particular period. Therefore, all warranties, representations, conditions, and all other terms of any kind whatsoever implied by statute or common law are – to the fullest extent permitted by applicable law – excluded.

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Please be aware that the data of this EPD cannot be compared with data calculated based upon product category rules (PCRs) other than the standards mentioned above. The values given are only valid within the context specified and cannot be used directly to draw up the environmental assessment of an installation.

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