PRODUCT ENVIRONMENTAL PROFILE
Environmental Product Declaration

AF09/12/16(Z)(B) Contactors &
NF(Z)22E,31E,40E Contactor relays

Production site: Xinhui, China
April 2024

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INTERNAL ☐ EXTERNAL ☒	
THE PCR REVIEW WAS CONDUCTED BY A PANEL OF EXPERTS CHAIRED BY JULIE ORGELET (DDEMAIN)	
PEP ARE COMPLIANT WITH XP C08-100-1 :2016 OR EN 50693:2019 THE COMPONENTS OF THE PRESENT PEP MAYNOT BE COMPARED WITH COMPONENTS FROM ANY OTHER PROGRAM.	
DOCUMENT IN COMPLIANCE WITH ISO 14025: 2006 « ENVIRONMENTAL LABELS AND DECLARATIONS. TYPE III ENVIRONMENTAL DECLARATIONS »	

EPD Owner	ABB Xinhui Low Voltage Switchgear Co., Ltd. www.abb.com
Manufacturer name and address	ABB Xinhui Low Voltage Switchgear Co., Ltd. Xinhui district, Jiangmen city, Guangdong Province, 529100, P.R. China.
Company contacts	EPD_ELSP@in.abb.com
Reference product	AF09-30-10-13 Contactor
Description of the product	The AF09-30-10-13 is a 3-pole - 690 V IEC or 600 UL contactor with 1 built-in auxiliary contact and screw terminals, controlling motors up to 4 kW / 400 V AC (AC-3) or 5 hp / 480 V UL and switching power circuits up to 25 A (AC-1) or 25 A UL general use. Thanks to the AF technology, the contactor has a wide control voltage range (100-250 V 50/60 Hz and DC), managing large control voltage variations, reducing panel energy consumptions, and ensuring distinct operations in unstable networks. Furthermore, surge protection is built-in, offering a compact solution.
Functional unit	The functional unit to establish and cut off the supply of a downstream installation from an electrical control characterised by the type of contacts X, a rated voltage of Ue, a rated current Ie, a control circuit voltage Uc, with Nmp & Nap poles in Industrial application areas, according to the appropriate use scenario, and during the reference service life of the product of 20 years. X= Composition of contact type: 3NO + 1NO Ue = Rated Operating voltage (V): 690 Ie = Rated Operating current (A): 9 Nmp = No. of main poles: 3 Nap= No. of auxiliary pole: 1 Uc = Control circuit voltage (V): 24-500 Category of use: AC3
Other products covered	The PEP covers offerings for: *3-pole variants of AF09, AF12, AF16 contactors:* AF09/12/16(Z)(B)-30-01(RT); AF09/12/16(Z)(B)-30-10(RT) *4-pole variants of AF09, AF16 contactors:* AF09/16(Z)(B)-40-00(RT); AF09/16(Z)(B)-22-00(RT) *4-pole variants of contactor relays:* NF(Z)22E,31E,40E
Reference lifetime	20 years
Product category	Electrical, Electronic and HVAC-R Products (Contactors)
Use Scenario	The use phase has been modeled based on the sales mix data (2022), and the corresponding low voltage electricity countries mix
Geographical representativeness	Raw materials & Manufacturing: [China / Global] Assembly: [China] Distribution / Use: [Global] specific sales mix EoL: [Global]
Technological representativeness	Materials and processes data are specific for the production of AF09-30-10-13 Contactors
LCA Study	This study is based on the LCA study described in the LCA report 2TFP200032A1001
EPD type	Products family declaration
EPD scope	“Cradle to grave”
Year of reported primary data	2022
LCA software	SimaPro 9.5.0.1 (2023)
LCI database	Ecoinvent v3.9.1 (2023)
LCIA methodology	EN 50693:2019

Contents

ABB Purpose & Embedding Sustainability

ABB is a leading global technology company that energizes the transformation of society and industry to achieve a more productive, sustainable future. By connecting software to its electrification, robotics, automation and motion portfolio, ABB pushes the boundaries of technology to drive performance to new levels. With a history of excellence stretching back more than 130 years, ABB's success is driven by about 110 thousand talented employees in over 100 countries.

ABB's Electrification business offers a wide-ranging portfolio of products, digital solutions and services, from substation to socket, enabling safe, smart and sustainable electrification. Offerings encompass digital and connected innovations for low voltage and medium voltage, including EV infrastructure, solar inverters, modular substations, distribution automation, power protection, wiring accessories, switchgear, enclosures, cabling, sensing and control.

ABB is committed to continually promoting and embedding sustainability across its operations and value chain, aspiring to become a role model for others to follow. With its ABB Purpose, ABB is focusing on reducing harmful emissions, preserving natural resources and championing ethical and human behaviour.

General Information

ABB Xinhui Low Voltage Switchgear Co., Ltd, located in Xinhui District, Jiangmen City, Guangdong Province, the hometown of overseas Chinese. It is a joint venture company of ABB specializing in the production of low-voltage electrical appliances in China. The company mainly produces low voltage molded case circuit breakers (Tmax XT, Tmax and Formula) for power distribution protection and control. Besides the main product MCCBs, the company also extends its product range into dual power transfer (DPT), Compact/Modular series Pilot Devices; OT Switches; OS Switches Fuse; PSR/PSTX series Soft Starter; Electronic Overload Relay (EOL); Thermal Overload Relay (TOL); A/AS/AF/AX series Contactor; Manual Motor Starter (MMS); etc. In addition to the domestic market, products export to European and Asian markets.

AF Contactor Product cluster

Product cluster declared in this LCA includes the following products: AF09/12/16(Z)(B) Contactors & NF(Z)22E,31E,40E Contactor relays.

Product Range	Product	Composition of poles or contact Type	No. of Main poles	No. of Auxiliary poles	Rated operating voltage	Rated Operating current	Control Circuit Voltage [AC]
		X	Nmp	Nap	[Ue]	[Ie]	[Uc]
					V	A	V
AF09/12/16(Z)(B), NF(Z)22E,31E,40E	AF09/12/16-30-10	3NO+1NO	3	1	690	9-18	24…500
	AF09/12/16-30-01	3NO+1NC	3	1	690	9-18	24…500
	AF09/12/16Z-30-10	3NO+1NO	3	1	690	9-18	24…250
	AF09/12/16Z-30-01	3NO+1NC	3	1	690	9-18	24…250
	AF09/12/16ZB-30-10	3NO+1NO	3	1	690	9-18	24…250
	AF09/12/16ZB-30-01	3NO+1NC	3	1	690	9-18	24…250
	AF09/12/16ZB-30-10RT	3NO+1NO	3	1	690	9-18	24…250
	AF09/12/16ZB-30-01RT	3NO+1NC	3	1	690	9-18	24…250
	AF09/16-40-00	4NO	4	0	690	9-18	24…500
	AF09/16-22-00	2NO+2NC	4	0	690	9-18	24…250
	AF09/16Z-40-00	4NO	4	0	690	9-18	24…250
	AF09/16Z-22-00	2NO+2NC	4	0	690	9-18	24…250
	AF09/16ZB-40-00	4NO	4	0	690	9-18	24…250
	AF09/16ZB-22-00	2NO+2NC	4	0	690	9-18	24…250
	AF09/16ZB-40-00RT	4NO	4	0	690	9-18	24…250
	AF09/16ZB-22-00RT	2NO+2NC	4	0	690	9-18	24…250
	NF22E,31E,40E	2NO+2NC, 3NO+1NC, 4NO	0	4	690	6	24…500
	NFZ22E,31E,40E	2NO+2NC, 3NO+1NC, 4NO	0	4	690	6	24…250

Table 1: Technical characteristics of Contactors (Refer catalog for detail)

Reference Product:
The reference product for the LCA of the complete range of AF09/12/16(Z)(B) contactors & NF(Z)22E,31E,40E contactor relays is an AF09-30-10-13 contactor (3-pole).

Constituent Materials

AF09-30-10-13 weights about 0.308 kg including its installed accessories, packaging and paper documentation.

Materials	Name	IEC 62474 MC	[g]	Weight %
Metals	Steel	M-119	113.6	36.9%
	Cu and Cu Alloys	M-121	56.9	18.5%
	Stainless Steel	M-100	2.5	0.8%
	Precious Metals	M-159	0.5	0.2%
Plastics	Polyamide	M-258	103.9	33.7%
	Elastomer	M-320	0.1	<0.1%
Others	Paper/Cardboard	M-341	22.5	7.3%
	PCBA	N/A	8.0	2.6%
Total			308.0	**100.0%**

Table 2: Weight of materials AF09-30-10-13

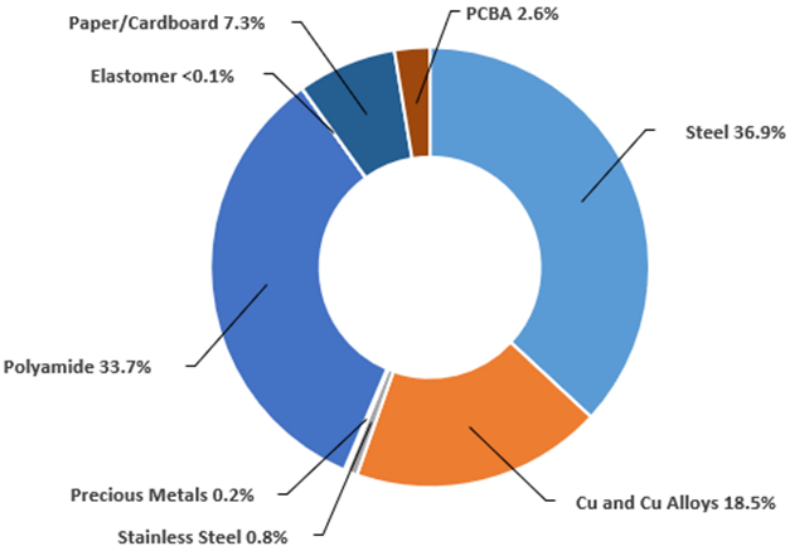

Figure 1: Composition of AF09-30-10-13

Packaging weight for AF09-30-10-13 and its composition is tabulated below.

Materials	Name	IEC 62474 MC	[g]	Weight %
Others	Paper/Cardboard	M-341	22.4	7.3%

Table 3: Weight of materials AF09-30-10-13 Packaging

Official declarations 2CMT2021-006277 [8] and 2CMT2021-006202 [9] states compliance of ABB AF Contactors respectively to RoHS and REACH regulations; 2CMT2021-006277 [8] provides exemptions considered for RoHS while 2CMT2021-006202 [9] lists REACH substances present in a concentration above 0.1% adding reference to products where involved parts are mounted.

LCA background information

Functional unit and Reference Flow

The functional unit to establish and cut off the supply of a downstream installation from an electrical control characterised by the type of contacts X, a rated voltage of Ue, a rated current Ie, a control circuit voltage Uc, with Nmp & Nap poles in Industrial application areas, according to the appropriate use scenario, and during the reference service life of the product of 20 years (Table 1).

The Reference Flow of the study is a single Contactor (including its packaging and accessories) with mass described in table 2.

System boundaries and life cycle stages

The life cycle of the Contactor, an EEPS (Electronic and Electrical Products and Systems), is a “from cradle to grave” analysis and covers the following main life cycle stages: manufacturing, including the relevant acquisition of raw material, preparation of semi-finished goods, etc. and processing steps; distribution; installation, including the relevant steps for the preparation of the product for use; use including the required maintenance steps within the RSL (reference service life of the product) associated to the reference product; end-of-life stage, including the necessary steps until final disposal or recovery of the product system.

The following table shows the stages of the product life cycle and the information stages according to EN 50693:2019 [3] for the evaluation of electronic and electrical products and systems.

Manufacturing	Distribution	Installation	Use	End-of-Life (EoL)
Acquisition of raw materials Transport to manufacturing site Components/parts manufacturing Assembly Packaging EoL treatment of generated waste	Transport to distributor/ logistic center Transport to place of use	Installation EoL treatment of generated waste (packaging)	Usage Maintenance	Deinstallation Collection and transport EoL treatment

Table 4: Phases for the evaluation of construction products according to EN50693:2019 [3].

Temporal and geographical boundaries

The ABB component suppliers are sourced all over the world. All primary data collected are from 2022, which is a representative production year. Secondary data are also representative for this year, as provided by ecoinvent [4].

The selected ecoinvent [4] processes in the LCA model have a global representativeness, due to the unclear origin of each component. In this way, a conservative approach has been adopted.

Boundaries in the life cycle

As indicated in the PCR capital goods such as buildings, machinery, tools and infrastructure, the packaging for internal transport which cannot be allocated directly to the production of the reference product, may be excluded from the system boundary.

Infrastructures, when present, such as processes deriving from the ecoinvent [4] database have not been excluded.

Data quality

In this LCA, both primary and secondary data are used. Site specific foreground data have been provided by ABB. Main data sources are the bill of materials & drawings which are available on the ERP (SAP) & Windchill. For all processes for which primary are not available, generic data originating from the ecoinvent database [4], allocation cut-off by classification, are used. The ecoinvent database available in the SimaPro software [5] is used for the calculations.

The data quality characterized by quantitative and qualitative aspects, is presented in Appendix 1. Each data quality parameter has been rated according to DQR tables from Chapter 7.19.2.2 of the Product Environmental Footprint Guide v.6.3 to give an indication of geography, technology and temporal representativeness.

Environmental impact indicators

The information obtained from the inventory analysis is aggregated according to the effects related to the various environmental issues. According to “PCR-ed4-EN-2021 09 06” and EN 50693:2019 [3] the environmental impact indicators must be determined using the characterization factors and impact assessment methods specified in EN 15804:2012+A2:2019 [6].

PCR-ed4-EN-2021 09 06 and the EN 50693:2019 [3] standard establish four indicators for climate change: Climate change (total) which includes all greenhouse gases; Climate change (fossil fuels); Climate change (biogenic) which includes the emissions and absorption of biogenic carbon dioxide and biogenic carbon stored in the product; Climate change (land use) - land use and land use transformation. Other indicators as per the PCR [1].

Allocation rules

Allocation coefficients are based on labour hours required to produce one unit of AF09 contactor. Total electrical energy consumption for the year 2022 is divided by the total labour hours in the year 2022 to calculate average per hour energy consumption of the total factory. The allocation of the total amount of waste generated by the production line and water consumption has been based on this criterion.

Limitations and simplifications

Raw materials life cycle stage includes the extraction of raw materials as well as the transport distances to the manufacturing suppliers. These distances are assumed to be 1000 km as per PCR. This distance has been added to the one already included in the market processes used for the model, as a result of a conservative choice made by the LCA operators. Surface treatments like galvanizing and tin plating as well as their related transport processes (back and forth from the finishing suppliers) have been considered in the LCA model. Scraps for metal working and plastic processes are included when already defined in ecoinvent [4].

Energy Models

LCA Stage	EN 15804:2012 +A2:2019 module	Energy model	Notes
Raw material extraction and processing	A1-A2	Electricity, {GLO}| market group for | Cut-off	Based on materials and supplier's locations
		Electricity, {RoW}| market group for | Cut-off	
Manufacturing	A3	ABB Green Mix Low Voltage	Specific Energy model for ABB Xinhui, manufacturing plant, 100% renewable
Installation (Packaging EoL)	A5	Electricity, {GLO}| market group for | Cut-off	-
Use Stage	B1	Electricity, [country]x | market for | Cut-off, S	Low voltage, based on 2022 country sales mix
EoL	C1-C4	Electricity, {GLO}| market group for | Cut-off	-

Table 5: Energy models used in each LCA stage

Inventory analysis

In this LCA, both primary and secondary data are used. Site specific foreground data have been provided by ABB. For data collection, Bills of Material (BOM) extracted from ABB's internal SAP and Windchill ERP were used. They are a list of all the components and assemblies that constitute the finished product, organized by hierarchy level. Each item is matched with its code, quantity, weight and supplier. The BOMs were then processed, adding material, surface area, volume and weight data, taken from technical drawings/datasheets. Finally, the manufacturing process and surface treatment were assigned, according to information provided by R&D personnel. Road distances between the suppliers and ABB were calculated using Google Maps.

All primary data collected from ABB are from 2022, which was a representative production year. The ecoinvent cut-off by classification system processes [4] are used to represent the LCA model.

Due to the large amounts of components in the Contactors, raw material inputs have been modelled with data from ecoinvent [4] representing Global [GLO] or Rest of World [RoW] market coverage based on the supplier's location including the corresponding electricity consumption sub-datasets. These datasets are assumed to be representative.

Manufacturing stage

The Contactors are composed of a multitude of components, all of which are made from of numerous materials. Most of the inputs to the products' manufacturing stage are already produced component parts.

The single use packaging as well as paper documentation are also included in the analysis in the manufacturing stage. ABB receives packaging components from outside suppliers and packages the contactor before shipping them.

The entire supplier's network has been modelled with the calculation of each transportation stage, from the first manufacturing supplier to the next. All the specific distances from the last subassembly suppliers' factories up to the ABB manufacturing facility have been calculated.

The electric energy mix used for the production phase is representative for ABB Xinhui production site (year 2022) and includes renewable energy only.

The complete energy mix has been modeled considering the energy certificate.

Distribution

The transport distances from ABB manufacturing plant to the distribution centers (regional distribution centers / local sales organizations) have been calculated considering the specific 2022 sales mix data.

Since no specific data is available for the transport distances from the Distribution Centre to place of actual use (Customer site), distances of 1000 km are assumed (local/domestic transport by lorry, according to PCR [1]).

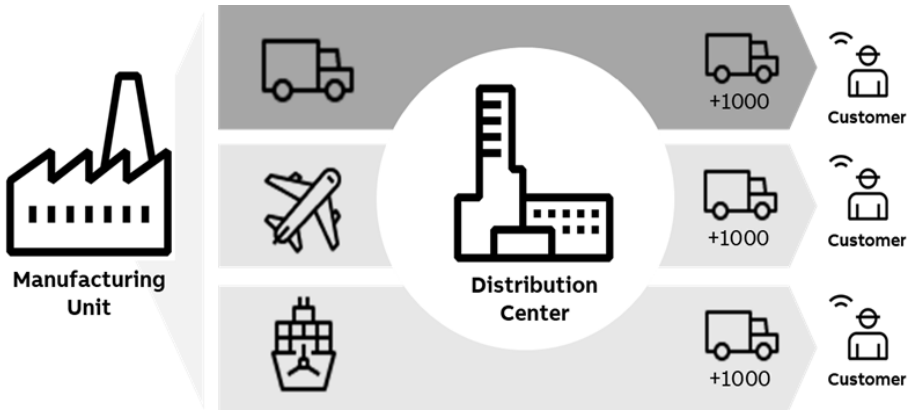

Figure 2: Distribution methodology

Installation

The installation phase only implies manual activities, and no energy is consumed. This phase also includes the disposal of the packaging of the Contactors.

For the disposal of the packaging after installation of the contactor at the end of its life, a transport distance of 1000 km (according to PCR [1]) was assumed. The chosen transportation datasets from Ecoinvent [4].

The actual disposal site is unknown and is managed by the customer.

Use

During the use phase, contactor dissipate some electricity due to power losses. The respective energy for each specific configuration of the entire product family has been calculated according to the data provided in the catalogue of the contactor and following the PCR [1] & PSR [2] rules:

Parameters		
Ie	[A]	9/12/18
Iu	[%]	50
h/year	[h]	8760
RSL	[years]	20
Time operating coefficient	[%]	50

Table 6: Use phase parameters

The formula for the calculation of the electricity consumed is shown below and it is described as follows, where P_{use} is the power consumed by the Contactor at a given value of current:

$$E_{use}\,[kWh] = \frac{P_{use} * 8760 * RSL * \alpha}{1000}$$

The above calculations have been performed according to the number of poles on which relevant current flows during use phase.

The Energy model used for this phase has been modeled based on the 2022 actual sales mix data (SAP ERP sales data as a source). From the Ecoinvent [4] database, the low voltage electricity country mix for each country(x) has been selected with its respective percentage on the total sales mix (Electricity, low voltage [country]x | market for | Cut-off, S).

Since no maintenance happens during the use phase, the environmental impacts linked to this procedure have been considered as null in the analysis.

End of life

The end-of-life stage is modelled according to PCR [1] and IEC/TR 62635 [7]. The percentages for end-of-life treatments of materials are taken from IEC/TR 62635 [7].

Since no specific data is available, the transport distances from the place of use to the place of disposal are assumed to be 1000 km (local/domestic transport by lorry, according to PCR [1]).

Environmental impacts

The following table show the environmental impact indicators of the life cycle of a single Contactor as indicated by PCR [1] and EN 50693:2019 [3]. The indicators are divided into the contribution of the processes to the different stages (manufacturing, distribution, installation, use and end-of-life).

AF09-30-10-13

Impact category	Unit	Total	Manufacturing	Distribution	Installation	Use	End of Life
GWP-total	kg CO2 eq	1.68E+02	3.23E+00	3.91E-01	4.73E-02	1.64E+02	8.76E-02
GWP-fossil	kg CO2 eq	1.67E+02	3.22E+00	3.91E-01	6.19E-03	1.63E+02	8.66E-02
GWP-biogenic	kg CO2 eq	9.99E-01	1.08E-02	9.68E-05	4.11E-02	9.46E-01	9.73E-04
GWP-luluc	kg CO2 eq	6.01E-02	4.45E-03	5.78E-05	2.16E-06	5.55E-02	6.96E-05
ODP	kg CFC11-eq	9.16E-07	5.45E-08	6.06E-09	8.49E-11	8.55E-07	7.00E-10
AP	mol H+ eq	8.32E-01	4.73E-02	1.67E-03	2.24E-05	7.82E-01	4.10E-04
EP-freshwater	kg P eq	4.37E-02	4.00E-03	9.72E-06	4.29E-07	3.97E-02	1.82E-05
EP-marine	kg N eq	1.67E-01	5.39E-03	6.68E-04	9.23E-06	1.61E-01	1.06E-04
EP-terrestrial	mol N eq	1.76E+00	5.56E-02	7.15E-03	9.15E-05	1.70E+00	9.89E-04
POCP	kg NMVOC eq	5.01E-01	1.79E-02	2.30E-03	3.05E-05	4.80E-01	3.26E-04
ADP-m&m	kg Sb eq	1.62E-03	8.93E-04	2.40E-07	1.18E-08	7.26E-04	9.49E-08
ADP-fossil	MJ	1.72E+03	4.15E+01	5.18E+00	6.21E-02	1.67E+03	8.96E-01
WDP	m3 of equiv. depriv.	1.78E+01	1.63E+00	1.19E-02	6.54E-04	1.62E+01	7.22E-03
PENRE	MJ	1.72E+03	3.89E+01	5.18E+00	6.21E-02	1.67E+03	8.96E-01
PENRM	MJ	2.54E+00	2.54E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	1.72E+03	4.15E+01	5.18E+00	6.21E-02	1.67E+03	8.96E-01
PERE	MJ	1.72E+02	4.59E+00	2.57E-02	8.84E-04	1.67E+02	6.70E-02
PERM	MJ	3.85E-01	3.85E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERT	MJ	1.72E+02	4.97E+00	2.57E-02	8.84E-04	1.67E+02	6.70E-02
SM	kg	9.06E-02	9.06E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PET	MJ	1.89E+03	4.64E+01	5.20E+00	6.30E-02	1.84E+03	9.63E-01
FW	m3	4.67E-01	4.50E-02	4.05E-04	2.30E-05	4.21E-01	2.73E-04
HWD	kg	2.87E-03	2.43E-04	3.46E-05	3.87E-07	2.59E-03	3.44E-06
N-HWD	kg	1.26E+01	5.08E-01	8.53E-02	6.02E-03	1.20E+01	5.42E-02
RWD	kg	1.43E-03	6.09E-05	4.99E-07	1.46E-08	1.37E-03	9.41E-07
CfR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MfR	kg	3.24E-01	4.35E-02	0.00E+00	1.62E-02	0.00E+00	2.64E-01
MfER	kg	2.55E-02	0.00E+00	0.00E+00	2.10E-02	0.00E+00	4.50E-03
EN	MJ by energy vector	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Efp	disease inc.	1.01E-05	2.29E-07	9.64E-09	4.52E-10	9.81E-06	7.13E-09
IrHH	kBq U-235 eq	5.93E+00	2.42E-01	2.20E-03	6.09E-05	5.68E+00	3.83E-03
ETX FW	CTUe	3.92E+02	7.63E+01	2.72E+00	5.71E-02	3.13E+02	3.80E-01
HTX CE	CTUh	4.76E-08	7.52E-09	6.17E-11	3.23E-12	3.99E-08	9.14E-11
HTX N-CE	CTUh	2.48E-06	4.68E-07	4.87E-09	1.23E-10	2.00E-06	5.59E-09
IrLS	Pt	3.45E+02	2.30E+01	1.22E+00	6.02E-02	3.20E+02	6.37E-01

Table 7: Impact indicators for AF09-30-10-13

Impact category	Unit	Total
Biogenic Carbon content of the product	kg	5.45E-05
Biogenic Carbon content of the associated packaging	kg	7.33E-03

Table 8: Inventory flow indicators of AF09-30-10-13

Environmental impact indicators

GWP-total	Global Warming Potential total (Climate change)
GWP-fossil	Global Warming Potential fossil
GWP-biogenic	Global Warming Potential biogenic
GWP-luluc	Global Warming Potential land use and land use change
ODP	Depletion potential of the stratospheric ozone layer
AP	Acidification potential
EP-freshwater	Eutrophication potential - freshwater compartment
EP-marine	Eutrophication potential - fraction of nutrients reaching marine end compartment
EP-terrestrial	Eutrophication potential -Accumulated Exceedance
POCP	Formation potential of tropospheric ozone
ADP-m&m	Abiotic Depletion for non-fossil resources potential
ADP-fossil	Abiotic Depletion for fossil resources potential
WDP	Water deprivation potential

Resource use indicators

PERE	Use of renewable primary energy excluding renewable primary energy resources used as raw material
PERM	Use of renewable primary energy resources used as raw material
PERT	Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)
PENRE	Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material
PNERM	Use of non-renewable primary energy resources used as raw material
PENRT	Total use of non-renewable primary energy resources (primary energy and primary energy resources used as raw materials)
PET	Total use of primary energy in the lifecycle

Secondary materials, water and energy resources

SM	Use of secondary materials
RSF	Use of renewable secondary fuels
NRSF	Use of non-renewable secondary fuels
FW	FW: Net use of fresh water

Waste category indicators

HWD	Hazardous waste disposed
N-HWD	Non-hazardous waste disposed
RWD	Radioactive waste disposed

Output flow indicators

CfR	Components for reuse
MfR	Materials for recycling
MfER	Materials for energy recovery
EN	Exported energy

Other indicators

Efp	Emissions of Fine particles
IrHH	Ionizing radiation, human health
ETX FW	Ecotoxicity, freshwater
HTX CE	Human toxicity, carcinogenic effects
HTX N-CE	Human toxicity, non-carcinogenic effects
IrLS	Impact related to Land use / soil quality

Extrapolation for Homogeneous environmental family

This LCA covers different build configurations than the representative product. All the analyzed configurations have the same main functionality, product standards and manufacturing technology. The LCA SimaPro model has been fully parametrized to fulfill each different configuration.

As a result, the impacts of the different life cycle stages can be extrapolated to other products of the same homogeneous environmental family by applying a rule of proportionality to the parameters in the following tables, divided by different life cycle stages.

AF09/12/16(Z)(B), NF(Z)22E,31E,40E Extrapolation:

Category 1	Category 2
AF09/12/16-30-01 AF09/12/16-30-10 AF09/16-22-00 AF09/16-40-00 NF22E/31E/40E	AF09Z(B)/12Z(B)/16Z(B)-30-01(RT) AF09Z(B)/12Z(B)/16Z(B)-30-10(RT) AF09Z(B)/16Z(B)-22-00(RT) AF09Z(B)/16Z(B)-40-00(RT) NFZ22E/31E/40E

Contactor	GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater	EP-marine	EP-terrestrial	POCP	ADP-m&m	ADP-fossil	WDP
Category 1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Category 2	1.04	1.04	1.01	1.10	1.06	1.30	1.29	1.11	1.17	1.14	1.22	1.03	1.07

Table 9a: Manufacturing phase Extrapolation factors for AF09/12/16(Z)(B) contactors & NF(Z)22E,31E,40E contactor relays
Reference product: AF09 30-10-13

Contactor	LCA Phase	Factor
Category 1	Distribution	1.00
Category 2		1.10

Table 9b: Distribution phase Extrapolation factors for AF09/12/16(Z)(B) contactors & NF(Z)22E,31E,40E contactor relays
Reference product: AF09 30-10-13

Product	LCA Phase	Factor
AF09-30-01 AF09-30-10	Use	1.00
AF09Z-30-01 AF09Z-30-10 AF09ZB-30-01 AF09ZB-30-10 AF09ZB-30-01RT AF09ZB-30-10RT		0.76
AF12-30-01 AF12-30-10		1.04
AF12Z-30-01 AF12Z-30-10 AF12ZB-30-01 AF12ZB-30-10 AF12ZB-30-01RT AF12ZB-30-10RT		0.80
AF16-30-01 AF16-30-10		1.09
AF16Z-30-01 AF16Z-30-10 AF16ZB-30-01 AF16ZB-30-10 AF16ZB-30-01RT AF16ZB-30-10RT		0.85
AF09-22-00 AF09-40-00		1.00
AF09Z-22-00 AF09Z-40-00 AF09ZB-22-00 AF09ZB-40-00 AF09ZB-22-00RT AF09ZB-40-00RT		0.76
AF16-22-00 AF16-40-00		1.12
AF16Z-22-00 AF16Z-40-00 AF16ZB-22-00 AF16ZB-40-00 AF16ZB-22-00RT AF16ZB-40-00RT		0.88
NF22E/31E/40E		1.00
NFZ22E/31E/40E		0.76

Table 9c: Use phase Extrapolation factors for AF09/12/16(Z)(B) contactors & NF(Z)22E,31E,40E contactor relays
Reference product: AF09-30-10-13

Contactor	GWP-total	GWP-fossil	GWP-biogenic	GWP-luluc	ODP	AP	EP-freshwater	EP-marine	EP-terrestrial	POCP	ADP-m&m	ADP-fossil	WDP
Category 1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Category 2	1.29	1.28	2.51	1.41	1.20	1.37	1.45	1.24	1.27	1.26	1.15	1.30	1.35

Table 9d: End of Life phase Extrapolation factors for AF09/12/16(Z)(B) contactors & NF(Z)22E,31E,40E contactor relays
Reference product: AF09-30-10-13

Additional environmental information

According to the waste treatment scenario calculation in Simapro [5], based on the recycling rate in the technical report IEC/TR 62635 Edition 1.0 [7] Table D.6, the following recyclability potentials were calculated. The recyclability potential is calculated based on the product weight (excluding packaging).

	AF09-30-10-13
Recyclability potential	92.4%

Table 10: Recyclability potential

References

[1] PCR “PEP-PCR-ed4-EN-2021_09_06” - Product Category Rules for Electrical, Electronic and HVAC-R Products (published: 6th September 2021)

[2] PSR “PSR-0005-ed3-EN-2023 06 06” - Specific rules for Electrical switchgear and control gear Solutions (Contactors)

[3] EN 50693:2019 - Product category rules for life cycle assessments of electronic and electrical products and systems

[4] ecoinvent v3.9.1 (2023). ecoinvent database version 3.9 - (https://ecoinvent.org/)

[5] SimaPro Software version 9.5.0.1 - PRé Sustainability

[6] UNI EN 15804:2012+A2:2019: Sustainability of constructions - Environmental product declarations (September 2019).

[7] IEC/TR 62635 - Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment - Edition 1.0 2012-10

[8] 2CMT2021-006277- RoHS

[9] 2CMT2021-006202- REACH

[10] ISO 14040:2006 - Environmental management -Life cycle assessment - Principles and framework

[11] ISO 14044:2006 - Environmental management - Life cycle assessment - Requirements and guidelines