

EPD



Environmental Product Declaration

REF/REJ/REM601 2.5 from Relion 605 Series

Production site: Vadodara, India



DOCUMENT KIND Environmental Product Declaration	IN COMPLIANCE WITH ISO 14025 and EN 50693			
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EPD Owner	ABB Switzerland Ltd, Group Technology Management		
Organization No.	CHE-101.538.426		
Manufacturer name and address	ABB India Limited, Digital Substation Products, Electrification, Distribution Solution Maneja Works, Maneja, Vadodara, Gujarat, India 390 013		
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Program operator	The Norwegian EPD Foundation Post Box 5250 Majorstuen, 0303 Oslo, Norway phone: +47 23 08 80 00, email: post@epd-norge.no		
Declared product	REF/REJ/REM601 2.5 from Relion 605 series		
Product description	The REF/REJ/REM601 from Relion 605 series of relays are used in utility, industrial, and transport and infrastructure applications for protection, control, measurement, and supervision of power distribution systems. Specific applications include feeder, transformer, and motor protection and control. The relays are available in ready-made standard configurations but can also be tailored to meet customer-specific requirements		
Functional unit	The functional unit of this study is to protect a power system against faults such as short circuit and overload, using an auxiliary voltage of 110 V DC, during a service life of 10 years and with a use rate of 100 % in Europe.		
Reference flow	A single REF/REJ/REM601 from Relion 605 series protection and control relay, including related connectors, accessories, and packaging.		
Independent verification	Independent verification of the declaration and data, according to ISO 14025:2010 <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL Independent verifier approved by EPD-Norge: Elisabet Amat Signature: 		
Approved by	Håkon Hauan, CEO EPD-Norge Signature: 		
Reference PCR	EN 50693:2019 – Product Category Rules for Life Cycle Assessments of Electronic and Electrical Products and Systems. EPDItaly007 – Electronic and Electrical Products and Systems, Rev. 3.0, 2023/01/13.		
Program instructions	The Norwegian EPD Foundation/EPD-Norge, General Programme Instructions 2019, Version 3.0, 2019/04/24.		
LCA study	This EPD is based on the LCA study described in the LCA report 2RCA059621.		
EPD type	Specific product EPD with extrapolation rules		
EPD scope	Cradle-to-grave		
Product RSL	10 years		
Geographical representativeness	Manufacturing (suppliers): Global	Manufacturing (ABB): India	Downstream: Europe
Reference year	2023		
LCA software	SimaPro 9.5 (2023)		
LCI database	Ecoinvent v3.9.1 (2022)		
Comparability	EPDs published within the same product category, though originating from different programs, may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible.		
Liability	The owner of the declaration shall be liable for the underlying information and evidence. EPD-Norge shall not be liable with respect to manufacturer, life cycle assessment data, and evidence.		

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	2/20

Contents

Sustainability at ABB 4

General Information 5

Constituent Materials7

LCA Background Information 9

Inventory Analysis11

Environmental Indicators.....13

Extrapolation rules15

Sensitivity analysis 18

Additional Environmental Information.....19

References..... 20

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	3/20



Sustainability at ABB

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.

At ABB, we actively contribute to a more sustainable world, leading by example in our own operations and partnering with customers and suppliers to enable a low-carbon society, preserve resources, and promote social progress.

Learn more on our website global.abb/group/en/sustainability or scan the QR code.



STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	4/20



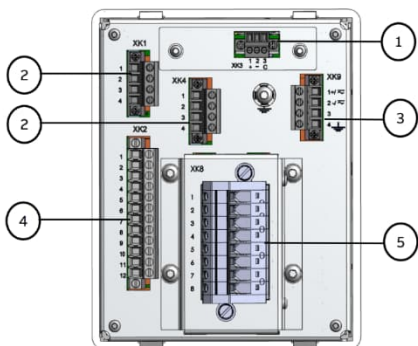
General Information

Abbreviations

Term	Description
CT	Current Transformer
SN	Sensor
COM	Communication module
BOM	Bill of Materials

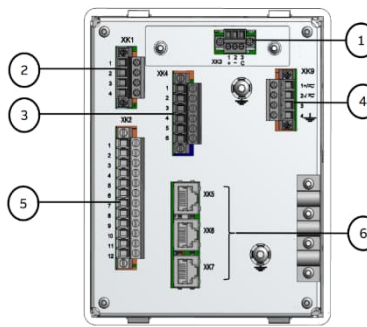
This Environmental Product Declaration is a “specific product EPD” with extrapolation rules. A representative product configuration is declared as reference product, and the results can be extrapolated for other configurations according to the provided extrapolation rules. The EPD covers the following devices of the REF/REJ/REM601 from Relion 605 series, including related accessories and packaging:

- REF601 – Feeder protection and control
- REJ601 – Feeder protection
- REM601 – Motor protection and control



- ① **XX3** Communication module (optional)
- ② **XX1,XX4** Binary input
- ③ **XX9** Power supply
- ④ **XX2** Binary output
- ⑤ **XX8** Analog CT input

Rear View of CT Variant



- ① **XX3** Communication module (optional)
- ② **XX1** Binary input
- ③ **XX4** Binary input, Earth input
- ④ **XX9** Power supply
- ⑤ **XX2** Binary output
- ⑥ **XX5,6,7** Analog Sensor input

Rear View of SN Variant

General technical information of the reference product configuration are presented below.

	Description	Module	CT with COM (Reference)
Config.	XK3	Communication	COM
	XK1,XK4	Binary Input	BI
	XK9	Power Supply	PSM
	XK2	Binary Output	BO
	XK8	Analog CT input	AIM_CT
	XK5,6,7	Analog Sensor Input	-
	CPU		CPU
	Display		DIS
	Height		Frame: 160 mm Case: 151.5 mm
	Depth		151.5 mm
	Weight		1.53
Ratings	Nominal auxiliary voltage U_n		24...240 V AC, 50 and 60 Hz 24-240 V DC
	Burden of auxiliary voltage supply under quiescent (P_q)/operating condition		< 5.0 VA

The REF/REJ/REM601 from Relion 605 series protection and control relay manufactured by ABB India manufacturing site located in Vadodara and sold globally. The manufacturing site is certified according to the following standards:

- ISO 9001:2015 – Quality Management Systems
- ISO 14001:2015 – Environmental Management Systems
- ISO 45001:2018 – Occupational Health and Safety Management Systems

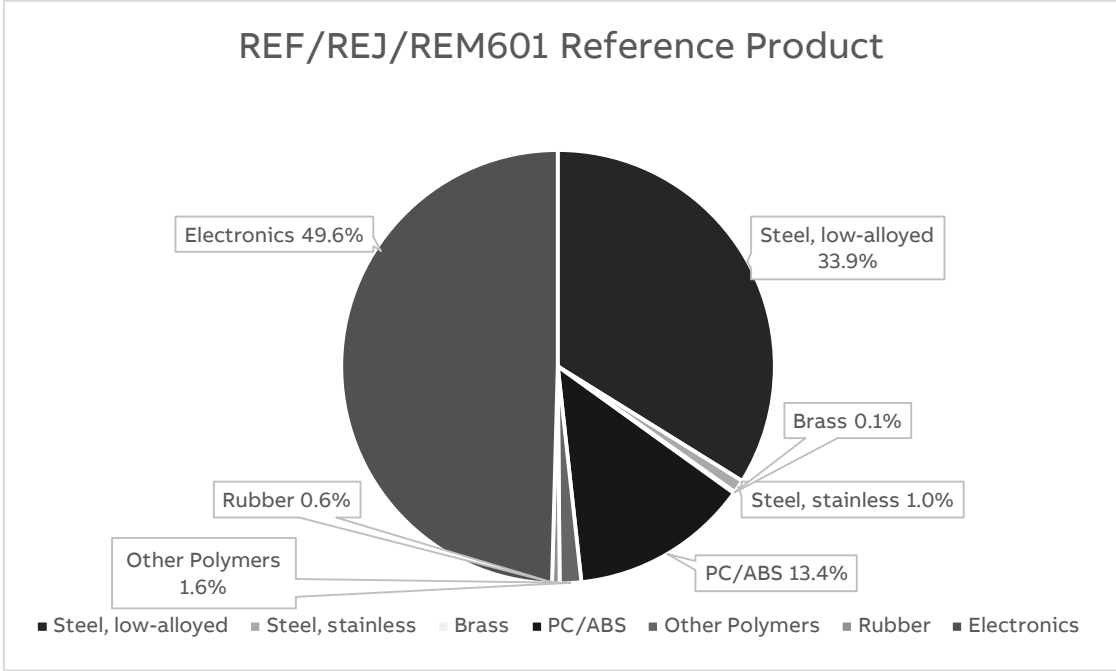
STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	6/20



Constituent Materials

The constituent materials of REF/REJ/REM601 reference product are presented below.

Type	Material	Weight [kg]	Weight %
Metals	Steel, low-alloyed	0.52	33.9
	Steel, stainless	0.01	1.0
	Brass	0.00	0.1
Plastics	PC/ABS	0.20	13.4
	Other Polymers	0.02	1.6
Others	Rubber	0.01	0.6
	Electronics	0.76	49.6
Total		1.53	100



The constituent materials of the packaging and accessories are presented below. Both primary packaging (unit) and secondary packaging (bulk) are considered, and 50 pcs are assumed per pallet.

	Description	Material	Weight [kg]	Weight [%]
Relay	Packaging box	Cardboard	0.18	0.7
	Box interior	Cardboard	0.21	0.9
	Subtotal		0.38	1.6
Bulk (1/50)	Packaging box Bulk	Cardboard	8.0	33.2
	Plastic straps	PET	0.05	0.2
	Wooden Palette	Wood	15.65	65.0
	Subtotal		23.7	98.4
Total			24.08	100 %

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	8/20



LCA Background Information

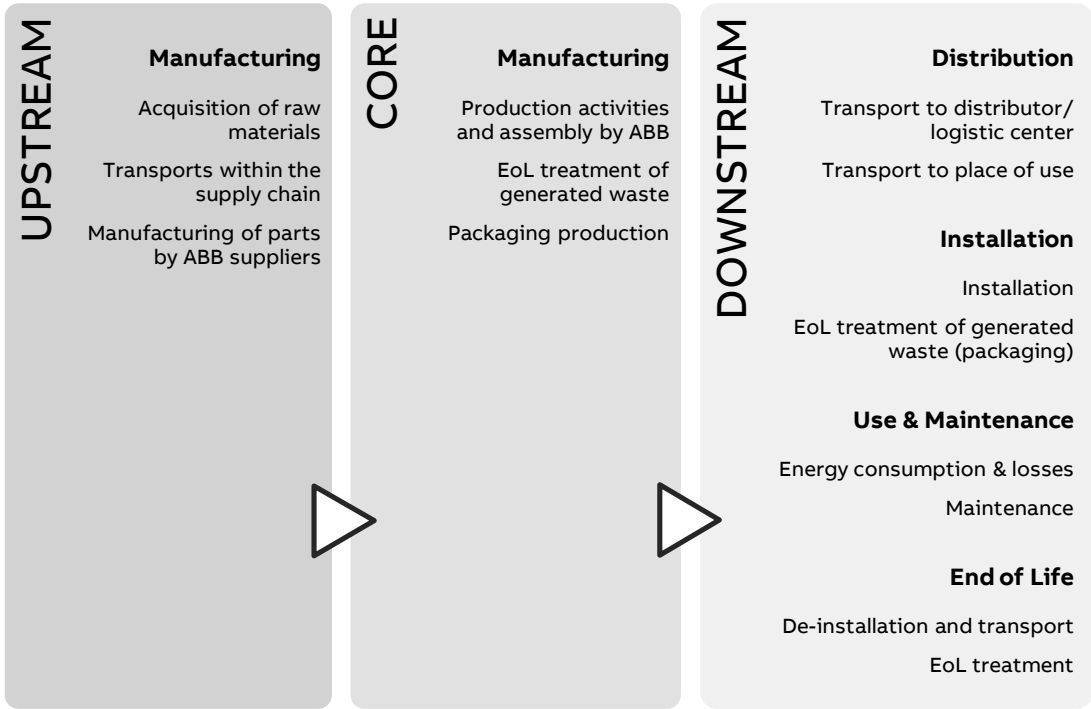
Functional Unit

The functional unit of this study is to protect a power system against faults such as short circuit and overload using an auxiliary voltage of 110 V DC and use rate of 100 %, during a service life of 10 years in Europe. The reference flow is a single REF/REJ/REM601 protection and control relay, including related connector, accessories and packaging.

Note, the reference service life (RSL) of 10 years is a theoretical period selected for calculation purposes only – this is not representative for the minimum, average, nor actual service life of the product.

System Boundaries

The life cycle assessment is a “cradle-to-grave” analysis, and the system boundaries are defined according to EN 50693, as required by the PCR. For transparency reasons, the manufacturing stage is further divided into an upstream and core stage.



Data quality

Both primary and secondary data are used. The main sources for primary data are the bill of materials (BOM), CAD-files, technical drawings, and site-specific foreground data provided by ABB.

For all processes for which primary data are not available, generic background data originating from the ecoinvent v3.9.1 database, with system model “allocation, cut-off by classification”, are used. The LCA software used for the calculations is SimaPro 9.5.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	9/20

Allocation rules

The utility consumption and waste generation by ABB, in the core manufacturing stage, is allocated to the production of one reference product according to applicable rules. For the end-of-life allocation, the “Polluter Pays” principle is adopted according to what is defined in the CEN/TR 16970 standard. However, the potential benefits and avoided loads from recovery and recycling processes are not considered because it is not required by the PCR.

Cut-off criteria

According to EN 50693, the cut-off criteria can be set to a maximum of 5 % of the overall environmental impacts. In this LCA, labels as well as the tape and staples used in the packaging have been excluded as their weights are negligible.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	10/20



Inventory Analysis

Manufacturing Stage (upstream)

The life cycle inventory in the upstream manufacturing stage is based on the primary data available from ABB. Datasets are applied accordingly, to the best of our knowledge, to represent each material, manufacturing process, and surface treatment. Modelling decisions and assumptions that are highly relevant to the results are as following:

- Printed wiring boards are modelled on a component level, i.e., each component is considered and mapped with the most representative dataset available.
- The amount of gold used in each connector is considered, due to its high impact.

Additionally, supply chain transports are added as far as data is available between ABB, the suppliers, and sub-suppliers. Only primary suppliers are considered. The rest of the transports are assumed to already be included in ecoinvent's "market for"-processes.

Manufacturing Stage (core)

In the core manufacturing stage, utility consumption and waste generation at the ABB manufacturing site are accounted for. The packaging materials and accessories associated with the product are also considered. Modelling decisions and assumptions that are highly relevant to the results are as following:

- 100% renewable electricity and district heating is considered, which is procured by the ABB manufacturing site through Guarantees of Origins (GO's). However, due to the lack of datasets based on residual mix data, other electricity mixes are calculated without residual mix.

Distribution

The transport distance from ABB's plant to the site of installation is assumed to be 19000 km international transport by Sea and 1000km by lorry, as suggested in EN 50693. The selected ecoinvent process are Transport, freight, sea, container ship {GLO} and transport, freight, lorry 16-32 metric ton, EURO4 {RER}, and the scenario is representative for selling to Europe and globally.

	Dataset	Amount	Unit	Represent.
Transport	<i>Transport, freight, lorry 16-32 metric ton, EURO4 {RER} market for transport, freight, lorry 16-32 metric ton, EURO4 Cut-off, S</i>	1000	km	EN50693
	<i>Transport, freight, sea, container ship {GLO} market for transport, freight, sea, container ship Cut-off, S</i>	19000	km	

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	11/20

Installation

The installation phase only implies manual activities, and no energy is consumed. Therefore, this phase only considers the end-of-life of the packaging materials used.

	Scenario	Transport	Representation
Packaging End-of-Life	<i>Packaging waste by waste management operations (Eurostat, 2021)*</i>	100 km by lorry (assumption)	Europe

Use

The use stage considers the reference power consumption over the reference service life as defined in the functional unit. This is calculated using the following formula.

$$E_{use} [kWh] = \frac{P_{use} * 8760 * RSL * \alpha}{1000} = \frac{1.52 \text{ W} * 8760 \text{ hours} * 10 \text{ years} * 100 \%}{1000} = 132.98 \text{ kWh}$$

Where:

- E_{use} = Total energy use over the reference service life
- P_{use} = Reference power consumption in watts
- RSL = Reference Service Life in years
- α = Use time rate
- 8760 is the number of hours in a year
- 1000 is the conversion factor from W to kW

Because the product is sold globally and is not limited to any specific country, the latest energy mix of the European Union is adopted as suggested by the standard EN 50693

	Dataset	Amount	Unit	Represent.
Energy	<i>Electricity, medium voltage {RER}/ market group for Cut-off, S</i>	0.36	kg CO ₂ -eq./kWh	Europe

Maintenance is not considered because the REF/REJ/REM601 from Relion 605 series relays do not have any required maintenance within its service life. There is no planned or preventive maintenance for this product. The only maintenance that is performed is corrective maintenance if, for example, something breaks or stops working. However, corrective maintenance is unusual, and thus considered negligible.

End of life

Decommissioning of the product only implies manual activities, and no energy is consumed. Therefore, this phase only considers the end-of-life of the product.

	Scenario	Transport	Representation
Product End-of-Life	IEC/TR 62635 (Annex D.3)*	100 km by lorry (assumption)	Europe

* A conservative approach is adopted by considering all parts as either: requiring selective treatment, difficult to process, or going through a separation process; no individual part is considered as a single recyclable material. Also, due to the transformer containing parts difficult to process through separation, these are all modelled as 100 % waste to landfill to represent the typical waste streams within Europe.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	12/20



Environmental Indicators

In accordance with the PCR EPDItaly007, the environmental impact indicators are determined by using the characterization factors and impact assessment methods specified in EN 15804:2012+A2:2019.

REF/REJ/REM601 Reference Product

Impact category	Unit	Total	Cradle-to-gate							
			Cradle-to-grave				Distribution	Installation	Use and maintenance	End-of-life
			UPSTREAM	CORE	DOWNSTREAM					
Manufacturing										
GWP – total	kg CO ₂ eq.	8.51E+01	3.47E+01	3.32E-01	7.18E-01	1.61E-02	4.81E+01	1.19E+00		
GWP – fossil	kg CO ₂ eq.	8.38E+01	3.45E+01	1.09E+00	7.17E-01	1.61E-02	4.63E+01	1.17E+00		
GWP – biogenic	kg CO ₂ eq.	1.15E+00	1.88E-01	-7.68E-01	2.46E-04	1.47E-05	1.71E+00	1.68E-02		
GWP – luluc	kg CO ₂ eq.	1.84E-01	6.09E-02	6.90E-03	4.53E-04	7.87E-06	1.16E-01	1.92E-04		
ODP	kg CFC-11 eq.	2.26E-06	1.36E-06	5.62E-08	1.32E-08	3.53E-10	8.32E-07	2.10E-09		
AP	mol H+ eq.	6.13E-01	3.60E-01	6.49E-03	1.23E-02	6.67E-05	2.33E-01	9.63E-04		
EP – freshwater	kg P eq.	8.42E-02	4.10E-02	8.23E-04	3.70E-05	1.13E-06	4.23E-02	5.23E-05		
EP – marine	kg N eq.	1.03E-01	5.43E-02	3.30E-03	3.27E-03	2.54E-05	4.13E-02	8.29E-04		
EP – terrestrial	mol N eq.	1.11E+00	6.87E-01	1.87E-02	3.59E-02	2.72E-04	3.65E-01	3.28E-03		
POCP	kg NMVOC eq.	3.12E-01	1.77E-01	5.97E-03	1.02E-02	9.76E-05	1.18E-01	9.02E-04		
ADP – minerals and metals	kg Sb eq.	1.15E-02	1.14E-02	8.47E-06	1.49E-06	5.21E-08	9.22E-05	1.13E-06		
ADP – fossil	MJ, net calorific value	1.54E+03	4.52E+02	1.38E+01	9.49E+00	2.30E-01	1.07E+03	1.85E+00		
WDP	m ³ eq.	1.68E+01	9.20E+00	-3.33E+00	3.05E-02	9.33E-04	1.09E+01	3.90E-02		

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-marine compartment; EP-terrestrial: Eutrophication potential-accumulated exceedance; POCP: Formation potential of tropospheric ozone; ADP-minerals & metals: Abiotic Depletion for non-fossil resources potential; ADP-fossil: Abiotic Depletion for fossil resources potential; WDP: Water deprivation potential.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	13/20

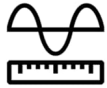
Resource use parameters	Unit	Total	Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
PENRE	MJ, low cal. value	1.53E+03	4.35E+02	1.38E+01	9.49E+00	2.30E-01	1.07E+03	1.85E+00
PERE	MJ, low cal. value	2.80E+02	4.94E+01	2.56E+01	1.10E-01	3.57E-03	2.05E+02	1.76E-01
PENRM	MJ, low cal. value	1.72E+01	1.71E+01	2.35E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ, low cal. value	1.12E+01	0.00E+00	1.12E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ, low cal. value	1.54E+03	4.52E+02	1.38E+01	9.49E+00	2.30E-01	1.07E+03	1.85E+00
PERT	MJ, low cal. value	2.91E+02	4.94E+01	3.68E+01	1.10E-01	3.57E-03	2.05E+02	1.76E-01
FW	m ³	1.05E+00	3.20E-01	-1.08E-01	1.08E-03	3.28E-05	8.34E-01	1.36E-03
MS	kg	6.46E-01	1.83E-01	4.63E-01	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	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

PENRE: Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material; PERE: Use of renewable primary energy excluding renewable primary energy resources used as raw material; PENRM: Use of non-renewable primary energy resources used as raw material; PERM: Use of 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); PERT: Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials); FW: Net use of fresh water; MS: Use of secondary materials; RFS: Use of renewable secondary fuels; NRSF: Use of non-renewable secondary fuels.

System output indicators	Unit	Total	Cradle-to-gate		Cradle-to-grave			
			UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
HWD	kg	6.03E-03	4.55E-03	6.14E-05	5.42E-05	1.46E-06	1.35E-03	7.92E-06
NHWD	kg	8.75E+00	4.55E+00	3.82E-01	2.57E-01	1.12E-02	2.92E+00	6.29E-01
RWD	kg	8.66E-03	8.78E-04	1.83E-05	2.12E-06	7.47E-08	7.76E-03	3.10E-06
MER	kg	3.37E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.37E-01
MFR	kg	2.06E+00	1.27E-01	4.42E-01	0.00E+00	8.60E-01	0.00E+00	6.31E-01
CRU	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ETE	MJ	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+00
EEE	MJ	5.57E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.57E-01

HWD: hazardous waste disposed; NHWD: non-hazardous waste disposed; RWD: radioactive waste disposed; MER: materials for energy recovery; MFR: material for recycling; CRU: components for reuse; ETE: exported thermal energy; EEE: exported electricity energy.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	14/20



Extrapolation rules

Due to the large variations in environmental impacts present within the series, extrapolation rules are established according to EN 50693. Changes in percentages per kilogram and watt are presented below in relation to the reference product. This allows for estimating more precise impacts of other relay configurations. Specifically, the changes in percentages are based on linear regression from the LCIA results of product variant 1, 2, 3, and 4. As a result, the following rules are established:

- The manufacturing stage, distribution stage, and end-of-life stage can be extrapolated based on the weight:
 - Formula: $Value_{refproduct} * (1 - change\% * (1.53 - Weight))$
- The use stage can be extrapolated based on the actual, measured power consumption:
 - Formula: $Value_{refproduct} * (1 - change\% * (1.52 - Power))$

	Weight [kg]	Power [W] @ 110 V DC
REF/REJ/REM601 CT+COM (Reference)	1.53	1.52
REF/REJ/REM601 CT	1.51	1.49
REF/REJ/REM601 SN+COM	1.26	1.58
REF/REJ/REM601 SN	1.25	1.55

Example: A REF601 CT variant with weight of 1.51 kg and power consumption of 1.49 W.

- “GWP-total” in upstream = $34.8 \text{ kg CO}_2\text{-eq} * (1 - 17.2\% * (1.53 - 1.51)) = 34.7 \text{ kg CO}_2\text{-eq}$
- “GWP-total” in use stage = $48.1 \text{ kg CO}_2\text{-eq} * (1 - 65.9\% * (1.52 - 1.49)) = 47.1 \text{ kg CO}_2\text{-eq}$
- “ADP-fossil” in distribution = $9.5 \text{ MJ} * (1 - 55.7\% * (1.53 - 1.51)) = 9.39 \text{ MJ}$
- “ADP-fossil” in use stage = $1066.25 \text{ MJ} * (1 - 65.9\% * (1.52 - 1.49)) = 1044.6 \text{ MJ}$

An Excel tool for the extrapolation rules of the REF/REJ/REM601 from Relion 605 series is available at:

<https://search.abb.com/library/Download.aspx?DocumentID=2RCA059623&LanguageCode=en&DocumentPartId=&Action=Launch>

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	15/20

ENVIRONMENTAL PRODUCT DECLARATION

Impact category	Change per kg						Change per watt
	Upstream	Core	Distribution	Installation	Use and maintenance	End-of-life	Use and maintenance
GWP – total	17.2 %	-	55.7 %	-	-	96.4 %	65.9 %
GWP – fossil	17.4 %	-	55.7 %	-	-	97.3 %	65.9 %
GWP – biogenic	-11.5 %	-	55.7 %	-	-	33.5 %	65.9 %
GWP – luluc	7.2 %	-	55.7 %	-	-	64.4 %	65.9 %
ODP	8.1 %	-	55.7 %	-	-	71.5 %	65.9 %
AP	21.7 %	-	55.7 %	-	-	74.9 %	65.9 %
EP – freshwater	22.6 %	-	55.7 %	-	-	68.8 %	65.9 %
EP – marine	17.8 %	-	55.7 %	-	-	38.3 %	65.9 %
EP – terrestrial	-18.3 %	-	55.7 %	-	-	81.2 %	65.9 %
POCP	20.7 %	-	55.7 %	-	-	77.1 %	65.9 %
ADP – minerals and metals	13.3 %	-	55.7 %	-	-	63.1 %	65.9 %
ADP – fossil	17.2 %	-	55.7 %	-	-	65.9 %	65.9 %
WDP	45.2 %	-	55.7 %	-	-	76.9 %	65.9 %

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-marine compartment; EP-terrestrial: Eutrophication potential-accumulated exceedance; POCP: Formation potential of tropospheric ozone; ADP-minerals & metals: Abiotic Depletion for non-fossil resources potential; ADP-fossil: Abiotic Depletion for fossil resources potential; WDP: Water deprivation potential.

Resource use parameters	Change per kg						Change per watt
	Upstream	Core	Distribution	Installation	Use and maintenance	End-of-life	Use and maintenance
PENRE	14.8 %	-	55.7 %	-	-	65.9 %	65.9 %
PERE	18.4 %	-	55.7 %	-	-	67.2 %	65.9 %
PENRM	78.8 %	-	-	-	-	-	65.9 %
PERM	-	-	-	-	-	-	65.9 %
PENRT	17.2 %	-	55.7 %	-	-	65.9 %	65.9 %
PERT	18.4 %	-	55.7 %	-	-	67.2 %	65.9 %
FW	30.7 %	-	55.7 %	-	-	76.6 %	65.9 %
MS	33.4 %	-	-	-	-	-	65.9 %
RSF	-	-	-	-	-	-	65.9 %
NRSF	-	-	-	-	-	-	65.9 %

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	16/20

ENVIRONMENTAL PRODUCT DECLARATION

PENRE: Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw material; PERE: Use of renewable primary energy excluding renewable primary energy resources used as raw material; PENRM: Use of non-renewable primary energy resources used as raw material; PERM: Use of 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); PERT: Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials); FW: Net use of fresh water; MS: Use of secondary materials; RFS: Use of renewable secondary fuels; NRSF: Use of non-renewable secondary fuels.

Waste production indicators	Change per kg						Change per watt
	Upstream	Core	Distribution	Installation	Use and maintenance	End-of-life	Use and maintenance
HWD	33.5 %	-	55.7 %	-	-	70.9 %	65.9 %
NHWD	46.4 %	-	55.7 %	-	-	62.9 %	65.9 %
RWD	4.3 %	-	55.7 %	-	-	62.1 %	65.9 %
MER	-	-	-	-	-	102.9 %	65.9 %
MFR	33.1 %	-	-	-	-	49.4 %	65.9 %
CRU	-	-	-	-	-	-	65.9 %
ETE	-	-	-	-	-	96.0 %	65.9 %
EEE	-	-	-	-	-	96.0 %	65.9 %

HWD: hazardous waste disposed; NHWD: non-hazardous waste disposed; RWD: radioactive waste disposed; MER: materials for energy recovery; MFR: material for recycling; CRU: components for reuse; ETE: exported thermal energy; EEE: exported electricity energy.

The accuracy of the extrapolation rules has been tested by comparing the extrapolated values from the reference product against the actual values of the other relay configurations. The variations of the results for all impact indicators were within $\pm 10\%$, which is the acceptable range of variation according to the General Programme Instructions for The Norwegian EPD Foundation.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	17/20



Sensitivity analysis

A sensitivity analysis is also conducted to understand how the impact category “GWP – total” varies for REF/REJ/REM601 from 605 series relays that are used in different geographical locations.

Scenario	Total	UPSTREAM	CORE	DOWNSTREAM			
		Manufacturing	Distribution	Installation	Use and maintenance	End-of-life	
Declared scenario (Europe) Manufacturing site: India Distribution: 1000 km by lorry and 19000 km by ship Use stage: Europe	8.51E+01	3.47E+01	3.32E-01	7.18E-01	1.61E-02	4.81E+01	1.19E+00
India Manufacturing site: India Distribution: 300 km by lorry Use stage: India	2.14E+02	3.47E+01	3.32E-01	1.06E-01	1.61E-02	1.77E+02	1.19E+00
China Manufacturing site: India Distribution: 300 km by lorry Use stage: China	1.63E+02	3.47E+01	3.32E-01	1.06E-01	1.61E-02	1.26E+02	1.19E+00

#	Electricity mix	Data source	Amount	Unit
1	European energy mix; <i>Electricity, medium voltage {RER} market group for Cut-off, S</i>	Ecoinvent v3.9.1	0.36	kg CO ₂ -eq/kWh
2	India national energy mix; <i>Electricity, medium voltage {IN} market group for electricity, medium voltage Cut-off, S</i>	Ecoinvent v3.9.1	1.33	kg CO ₂ -eq/kWh
3	China national energy mix; <i>Electricity, medium voltage {CN} market group for Cut-off, S</i>	Ecoinvent v3.9.1	0.95	kg CO ₂ -eq/kWh

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	18/20



Additional Environmental Information

Circularity Values

The recyclability potential of the product (excluding packaging) is calculated by dividing “MFR: material for recycling” in the end-of-life stage by the total weight of the product. As a result, the recyclability potential of the product are presented below. The results are representative for Europe according to IEC/TR 62635.

	Recyclability potential
REF/REJ/REM601 CT+COM (Reference product)	41 %
REF/REJ/REM601 CT	42 %
REF/REJ/REM601 SN+COM	43 %
REF/REJ/REM 601 SN	44 %

Greenhouse gas emissions from the use of electricity in the manufacturing phase

Production mix from import, medium voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing process.

Energy mix	Source	Amount	Unit
ABB IN energy mix 2023	Ecoinvent v3.9.1	0.03	kg CO ₂ -eq/kWh

Dangerous substances

The product complies with REACH and RoHS directive requirements and does not contain any of the listed materials in excess of the authorized proportions. For further information about REACH and RoHS, please visit the ABB webpage:

<https://new.abb.com/contact/form>

Indoor environment

The product meets the requirements for low emissions.

Carbon footprint

Carbon footprint has not been worked out for the product.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	19/20



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STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2RCA059622	A	EN	20/20