

EPD

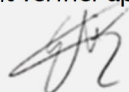

Environmental Product Declaration

REF/REJ/REM601 2.2 from Relion 605 series

Production site: Vadodara, India



DOCUMENT KIND Environmental Product Declaration	IN COMPLIANCE WITH ISO 14025 and EN 50693			
PROGRAM OPERATOR The Norwegian EPD Foundation	PUBLISHER The Norwegian EPD Foundation			
REGISTRATION NUMBER OF THE PROGRAM OPERATOR NEPD-4514-3758-EN	ISSUE DATE 2023-05-29			
VALID TO 2028-05-29	STATUS Approved	SECURITY LEVEL Public		
OWNING ORGANIZATION ABB Switzerland Ltd, Group Technology Management	ABB DOCUMENT ID 2REA069475	REV. B	LANG. EN	PAGE 1/20

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		
Company contact	Seila Rodriguez-Vilches – seila.rodriguez-vilches@ch.abb.com Sustainability Product Manager		
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 2.2 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	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.		
CPC code	4621 - Electricity distribution or control apparatus.		
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 and PSR	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 2REA069473.		
EPD type	Specific product		
EPD scope	Cradle-to-grave		
Product RSL	10 years		
Geographical representativeness	Manufacturing (suppliers): Global	Manufacturing (ABB): India	Downstream: Europe
Reference year	2022		
LCA software	SimaPro 9.4.0.2 (2023)		
LCI database	Ecoinvent v3.8 (2021)		
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 evidences.		

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	EN	2/20

Contents

Sustainability at ABB 4

General Information 5

Constituent Materials7

LCA Background Information 9

Inventory Analysis11

Environmental Indicators.....13

Extrapolation rules15

Additional Environmental Information..... 18

Additional Norwegian Requirements..... 18

References..... 20

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	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	2REA069475	B	EN	4/20



General Information

The products declared in this Environmental Product Declaration includes the following devices REF/REJ/REM601 from Relion 605 series, including related connectors, accessories, and packaging:

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

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. The relays are available in ready-made standard configurations for fast and easy setup but can also be tailored to meet customer-specific requirements with Secondary Current Transformer (CT) input and Sensor (SN) input as options.

General technical specifications for REF/REJ/REM601 are presented below.

	Description	Value
Width	Frame	130 mm
	Case	121.5 mm
Height	Frame	160 mm
	Case	151.5 mm
Depth	Case (CT)	151.5 mm
	Case (SN)	101.5 mm

Power supply	
Nominal auxiliary voltage Un	24...240 V AC, 50 and 60 Hz
	24-240 V DC
Burden of auxiliary voltage supply under quiescent (Pq)/operating condition	< 5.0 VA

Due to the configurable nature of the product, there is a significant variation within the series in terms of environmental impacts. A representative relay configuration is therefore selected as reference product and declared in this EPD. The reference product is a maximum version in terms of hardware which have all module slots filled; thus, the choice of reference product is conservative. Additionally, the results of the study can be extrapolated for other relay configurations according to EN 50693. The extrapolation rules are provided together with the results.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	EN	5/20

Slot	Module	CT with COM (reference product)
XK3	Communication	COM
XK9	Power supply	PSM
XK1, XK4	Binary Input	BI
XK2, XK10	Binary Output	BO
XK8	Analogue input	AIM_CT
XCPU	CPU	CPU
XDIS	Display	DIS
Product ID		REF/REJ/REM601
Weight (excl. packaging)		1.46 kg

The REF/REJ/REM601 from Relion 605 series protection and control relay is manufactured by ABB India manufacturing site located in Vadodara and sold globally.

The ABB manufacturing site in Vadodara, India, is also located in a cluster with other ABB plants. On average, the ABB plants in this location use ca 3.1 % renewable energy from own roof-mounted solar panels and ca 0.6% backup diesel generators. For the rest of the electricity, the national energy mix is used. The plant is also 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

ABB only performs final assembling and testing of the relays. ABB does not manufacture any parts or components themselves. Instead, this is outsourced and purchased from various suppliers globally. Most of the parts are purchased as sub-assemblies or ready modules.

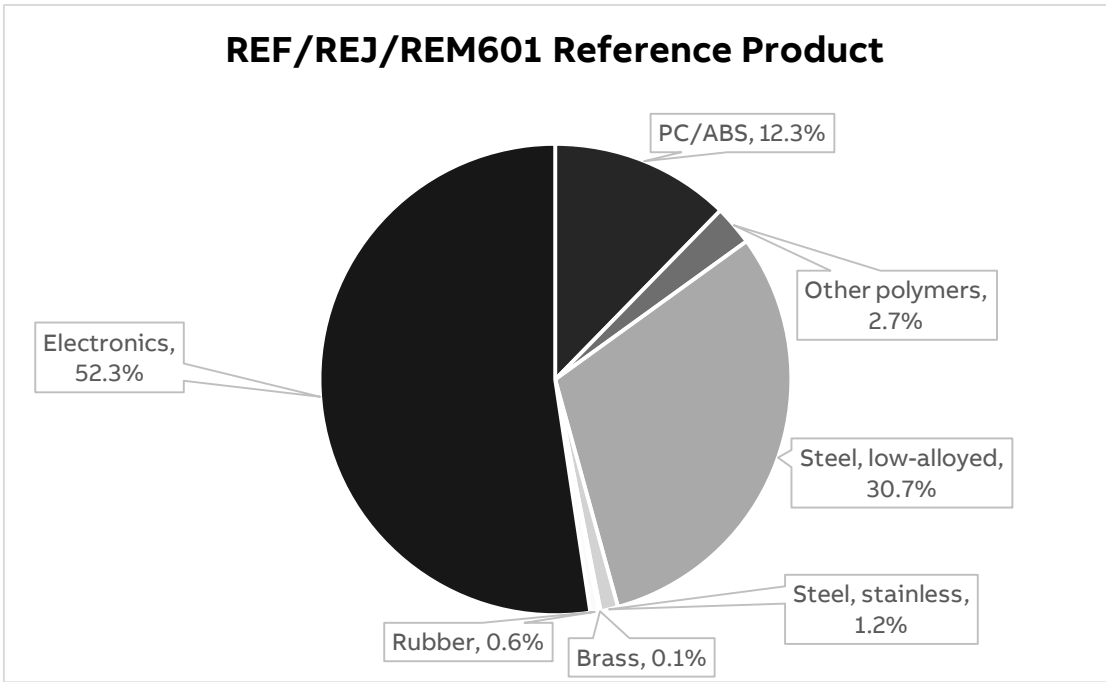
STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	EN	6/20



Constituent Materials

The REF/REJ/REM601 reference product weighs 1.46 kg, and the constituent materials are presented below. Stickers have been excluded as they are considered negligible to the overall environmental impacts. Due to the complex nature of the electronics, these are presented as a separate category, which includes printed wiring boards, electronic components, connectors, and cables. Electronics are typically composed of various plastics, copper, and precious metals

Materials	Name	Weight [g]	Weight [%]
Plastics	PC/ABS	181	12.3
	Other polymers	39	2.7
Metals	Steel, low-alloyed	449	30.7
	Steel, stainless	18	1.2
	Brass	2	0.1
Other	Rubber	9	0.6
	Electronics	766	52.3
Total		1463	100



The packaging materials and accessories of the relay weighs 2.98kg in total, of which 0.38 kg is the packaging of the relay, and 2.60 kg is the bulk packaging per relay (16 relays per box). The constituent materials are presented below.

	Description	Material	Weight [kg]	Weight [%]
Relay	Packaging box	Cardboard	0.18	6.1
	Box interior	Cardboard	0.21	6.9
	Subtotal		0.38	12.9
Bulk (1/16)	Packaging box Bulk	Cardboard	2.55	85.4
	Plastic straps	PET	0.05	1.7
	Subtotal		2.60	87.0
Total			2.98	100

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	EN	8/20



LCA Background Information

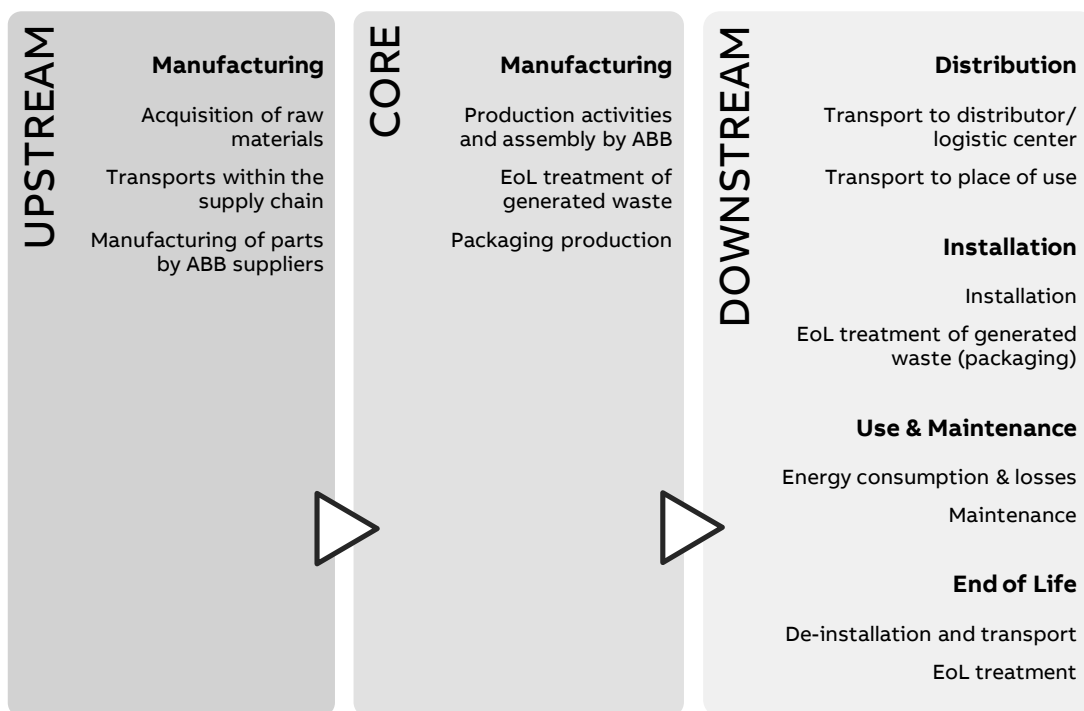
Functional Unit

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, during a service life of 10 years and with a use rate of 100 % in Europe. The reference flow is a single REF/REJ/REM601 from Relion 605 series protection and control relay, including related connectors, 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 of the REF/REJ/REM601 from Relion 605 series, an EEPS (Electronic and Electrical Products and Systems), is a “from cradle to grave” analysis. The figure below shows the product life cycle stages and the information considered in the LCA.



In terms of exclusions from the system boundary, the PCR EPDitaly007 refer to chapter 4.2.3.1 in the standard EN 50693 for products that can be easily replaced or recovered. In accordance with EN 50693, capital goods such as machinery, tools, buildings, infrastructure, packaging for internal transports, and administrative activities, which cannot be allocated directly to the production of the reference product, are excluded. Infrastructures, when present, such as in processes deriving from the ecoinvent database, have not been excluded. Scraps for metal working and plastic processes are also included when already defined in ecoinvent.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	EN	9/20

Temporal and geographical boundaries

In terms of temporal boundaries, all primary data collected from ABB are from 2022, which is considered a representative production year. Secondary data are provided by ecoinvent v3.8 which was released in 2021.

In terms of geographical boundaries, the materials and components used in the production of the REF/REJ/REM601 from Relion 605 series relays are globally sourced. The supply chains are often complex and can extend across multiple countries and continents. Therefore, materials with global representativeness are selected from ecoinvent. Thus, a conservative approach is adopted.

Data quality

Both primary and secondary data are used. The main sources for primary data are the bill of materials and technical drawings, while site specific foreground data are provided by ABB.

For all processes for which primary data are not available, generic data originating from the ecoinvent v3.8 database, “allocation, cut-off by classification”, are used. The LCA software used for the calculations is SimaPro 9.4.0.2.

Environmental impact indicators

The information obtained from the inventory analysis is aggregated according to the effects related to the various environmental issues. 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.

Allocation rules

The utility consumption and waste generation of ABB’s manufacturing site are allocated to the production of one relay by using allocation rules. Because the plant is focused on relay production, the total utility consumption and waste generation for 2022 is simply divided by the total output of relays during the same year. Moreover, utility consumption and waste generation deriving from offices and administrative activities are not excluded and thus, a conservative approach is adopted.

For the end-of-life allocation, the “Polluter Pays” principle is adopted according to what is defined in the CEN/TR 16970 standard, as required by the PCR EPDItaly007. This means, waste treatment processes are allocated to the product system that generates the waste until the end-of-waste state is reached. The environmental burdens of recycling and energy recovery processes are therefore allocated to the product system that generates the waste, while the product system that uses the exported energy and recycled materials receives it burden-free. However, the potential benefits and avoided loads from recovery and recycling processes are not considered because it is not required by EPDItaly007.

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, stickers and 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	2REA069475	B	EN	10/20



Inventory Analysis

Manufacturing stage

As seen from the constituent materials, low-alloyed steel and electronics are the most frequently used materials, followed by PC/ABS. Other polymers consist mainly of PET and adhesive which is used in membrane keyboard.

Using the ecoinvent database, the steels are mainly modelled with *Steel, low-alloyed {GLO} market for*. To account for the production activities of metal and plastic parts, Metal working, average and Injection molding are the most frequently used processes. Surface treatments are also included, and the most common surface treatments is *Zinc coat, coils {GLO} market for*.

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.

For the ABB manufacturing site, which is considered in the core manufacturing stage, utility consumption and waste generation are allocated to the production of one REF/REJ/REM601 relay according to the defined allocation rules. The packaging materials and accessories associated with the product are also considered in the core manufacturing stage.

Distribution

The transport distance from ABB's plant to the site of installation is assumed to be 19000 km international transport by Sea and 1000 km by lorry, as suggested in EN 50693. and the scenario is representative for Europe and globally.

Installation

Except for commissioning testing, the installation stage only implies manual activities, and no energy is consumed. However, commissioning testing is not considered because the time duration is negligible. Therefore, this phase only considers the end-of-life of the packaging materials.

The end-of-life scenario for packaging materials is based on Packaging waste by waste management operations by Eurostat (2020), which is representative for Europe. A transport distance of 100 km by lorry is assumed as actual location of disposal is unknown.

Use

The use stage considers the reference power consumption over the reference service life of 10 years as defined in the functional unit. This is calculated using the following formula:

$$E_{use}[\text{kWh}] = \frac{P_{use} * 8760 * RSL * \alpha}{1000} = \frac{2.4 \text{ W} * 8760 \text{ hours} * 10 \text{ years} * 100 \%}{1000} = 210.2 \text{ kWh}$$

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	EN	11/20

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 this 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. The emission factor of the energy mix is presented below.

Energy mix	Source	Amount	Unit
European energy mix; <i>Electricity, medium voltage {RER}/ market group for / Cut-off, S</i>	Ecoinvent v3.8	0.40	kg CO ₂ -eq./kWh

Maintenance is not considered because the REF/REJ/REM601 of Relion 605 series does 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.

The end-of-life scenario for the product is based on IEC/TR 62635 (Annex D.3), which is representative for Europe. A conservative approach is adopted by using the rates given for materials that go through a separation process, except for electronics for which selective treatment is assumed, and this includes the losses in the separation processes. A transport distance of 100 km by lorry is assumed as actual location of disposal is unknown.

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	EN	12/20



Environmental Indicators

REF/REJ/REM601 Reference Product

Product ID: REF601

Ordering code: REF601BD446BD1NH

Hardware: CT with Communication Card

Nominal power: 2.4 W at 110 V DC

Impact category	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing	Distribution	Installation	Use and maintenance	End-of-life	
GWP – total	kg CO ₂ eq.	1.35E+02	4.08E+01	8.29E+00	6.36E-01	2.10E-01	8.40E+01	1.58E+00
GWP – fossil	kg CO ₂ eq.	1.32E+02	4.05E+01	8.39E+00	6.36E-01	1.18E-02	8.11E+01	1.56E+00
GWP – biogenic	kg CO ₂ eq.	3.03E+00	2.11E-01	-9.98E-02	2.46E-04	1.98E-01	2.71E+00	1.68E-02
GWP – luluc	kg CO ₂ eq.	2.61E-01	6.48E-02	4.39E-03	3.62E-04	5.66E-06	1.91E-01	1.62E-04
ODP	kg CFC-11 eq.	7.50E-06	3.16E-06	1.73E-07	1.37E-07	2.42E-09	4.02E-06	1.28E-08
AP	mol H+ eq.	8.79E-01	3.87E-01	4.17E-02	1.23E-02	7.26E-05	4.37E-01	9.93E-04
EP – freshwater	kg P eq.	1.34E-01	4.81E-02	4.30E-03	3.06E-05	1.08E-06	8.11E-02	5.28E-05
EP – marine	kg N eq.	1.58E-01	6.83E-02	9.99E-03	3.18E-03	1.16E-04	7.56E-02	8.54E-04
EP – terrestrial	mol N eq.	1.54E+00	7.47E-01	9.17E-02	3.52E-02	2.61E-04	6.59E-01	3.47E-03
POCP	kg NMVOC eq.	4.05E-01	1.92E-01	2.35E-02	9.27E-03	9.95E-05	1.80E-01	8.82E-04
ADP – minerals and metals	kg Sb eq.	1.51E-02	1.49E-02	9.84E-06	1.52E-06	3.99E-08	1.92E-04	1.56E-06
ADP – fossil	MJ, net calorific value	2.37E+03	5.20E+02	1.01E+02	8.88E+00	1.67E-01	1.74E+03	1.75E+00
WDP	m ³ eq.	3.32E+01	1.29E+01	1.43E+00	2.15E-02	2.86E-03	1.88E+01	4.31E-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	2REA069475	B	EN	13/20

ENVIRONMENTAL PRODUCT DECLARATION

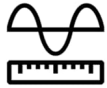
Resource use parameters	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
PENRE	MJ, low cal. value	2.35E+03	5.04E+02	1.01E+02	8.88E+00	1.67E-01	1.73E+03	1.75E+00
PERE	MJ, low cal. value	3.65E+02	5.41E+01	2.28E+00	9.41E-02	3.40E-03	3.09E+02	1.45E-01
PENRM	MJ, low cal. value	1.64E+01	1.64E+01	7.35E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PERM	MJ, low cal. value	7.03E+00	0.00E+00	7.03E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ, low cal. value	2.37E+03	5.20E+02	1.01E+02	8.88E+00	1.67E-01	1.73E+03	1.75E+00
PERT	MJ, low cal. value	3.72E+02	5.41E+01	9.31E+00	9.41E-02	3.40E-03	3.09E+02	1.45E-01
FW	m ³	1.95E+00	4.34E-01	3.30E-02	7.65E-04	9.41E-05	1.48E+00	1.54E-03
MS	kg	6.05E-01	1.62E-01	4.43E-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.

Waste production indicators	Unit	Total	UPSTREAM	CORE	DOWNSTREAM			
			Manufacturing		Distribution	Installation	Use and maintenance	End-of-life
HWD	kg	4.80E-03	4.13E-03	3.65E-05	1.61E-05	4.06E-07	6.15E-04	3.20E-06
NHWD	kg	1.24E+01	5.14E+00	7.39E-01	2.49E-01	5.92E-02	5.75E+00	4.90E-01
RWD	kg	1.44E-02	1.49E-03	7.56E-05	6.08E-05	1.05E-06	1.28E-02	7.03E-06
MER	kg	5.62E-01	0.00E+00	4.34E-02	0.00E+00	4.98E-02	0.00E+00	4.68E-01
MFR	kg	1.85E+00	1.13E-01	7.17E-01	0.00E+00	4.46E-01	0.00E+00	5.71E-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	1.74E+00	0.00E+00	1.51E-01	0.00E+00	2.26E-01	0.00E+00	1.36E+00
EEE	MJ	9.59E-01	0.00E+00	7.55E-02	0.00E+00	1.25E-01	0.00E+00	7.58E-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	2REA069475	B	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. This allows for estimating more precise impacts of other relay configurations. Changes in percentages per weight and watt are presented in tables in the following pages, which is based on a linear regression, and the following rules are established:

The upstream manufacturing stage, distribution stage, and end-of-life stage can be extrapolated based on the weight:

- Formula: $Value_{refproduct} * (1 - change\% * (1.46 - Weight))$

The use stage can be extrapolated based on the actual, measured power consumption:

- Formula: $Value_{refproduct} * (1 - change\% * (2.4 - Power))$

	Weight [kg]	Nominal Power [W] @ 110 V DC
REF/REJ/REM601 CT+COM* (Reference)	1.46	2.4
REF/REJ/REM601 CT	1.44	2.3
REF/REJ/REM601 SN+COM	1.29	2.8
REF/REJ/REM601 SN	1.27	2.7

*COM (Communication Module)

Example: A REF601 CT variant with weight of 1.44 kg and power consumption of 2.3 W.

- “GWP-total” in upstream = $40.8 \text{ kg CO}_2\text{-eq} * (1 - 8\% * (1.46 - 1.44)) = 40.7 \text{ kg CO}_2\text{-eq}$
- “GWP-total” in use stage = $84.0 \text{ kg CO}_2\text{-eq} * (1 - 41.7\% * (2.4 - 2.3)) = 80.5 \text{ kg CO}_2\text{-eq}$
- “ADP-fossil” in distribution = $8.88 \text{ MJ} * (1 - 53.1\% * (1.46 - 1.44)) = 8.78 \text{ MJ}$
- “ADP-fossil” in use stage = $1740 \text{ MJ} * (1 - 41.7\% * (2.4 - 2.3)) = 1667.4 \text{ MJ}$

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=2REA069615&LanguageCode=en&DocumentPartId=&Action=Launch>

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	EN	15/20

Impact category	Change per kg						Change per watt
	Upstream	Core	Distribution	Installation	Use and maintenance	End-of-life	Use and maintenance
GWP – total	7.7 %	-	53.1 %	-	-	125.7 %	41.7 %
GWP – fossil	8.1 %	-	53.1 %	-	-	127.3 %	41.7 %
GWP – biogenic	-62.4 %	-	53.1 %	-	-	-17.1 %	41.7 %
GWP – luluc	-3.7 %	-	53.1 %	-	-	62.3 %	41.7 %
ODP	3.3 %	-	53.1 %	-	-	66.9 %	41.7 %
AP	6.3 %	-	53.1 %	-	-	84.9 %	41.7 %
EP – freshwater	18.7 %	-	53.1 %	-	-	73.0 %	41.7 %
EP – marine	8.4 %	-	53.1 %	-	-	51.5 %	41.7 %
EP – terrestrial	-55.5 %	-	53.1 %	-	-	98.6 %	41.7 %
POCP	14.9 %	-	53.1 %	-	-	95.0 %	41.7 %
ADP – minerals and metals	19.3 %	-	53.1 %	-	-	48.6 %	41.7 %
ADP – fossil	8.0 %	-	53.1 %	-	-	67.8 %	41.7 %
WDP	33.7 %	-	53.1 %	-	-	97.9 %	41.7 %

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	2REA069475	B	EN	16/20

ENVIRONMENTAL PRODUCT DECLARATION

Resource use parameters	Change per kg						Change per watt
	Upstream	Core	Distribution	Installation	Use and maintenance	End-of-life	Use and maintenance
PENRE	4.6 %	-	53.1 %	-	-	67.8 %	41.7 %
PERE	8.5 %	-	53.1 %	-	-	61.0 %	41.7 %
PENRM	113.0 %	-	-	-	-	-	41.7 %
PERM	-	-	-	-	-	-	41.7 %
PENRT	8.0 %	-	53.1 %	-	-	67.8 %	41.7 %
PERT	8.5 %	-	53.1 %	-	-	61.0 %	41.7 %
FW	19.7 %	-	53.1 %	-	-	94.5 %	41.7 %
MS	-13.1 %	-	-	-	-	-	41.7 %
RSF	-	-	-	-	-	-	41.7 %
NRSF	-	-	-	-	-	-	41.7 %

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	27.1 %	-	53.1 %	-	-	78.0 %	41.7 %
NHWD	39.4 %	-	53.1 %	-	-	62.1 %	41.7 %
RWD	-	-	53.1 %	-	-	57.4 %	41.7 %
MER	-	-	-	-	-	134.4 %	41.7 %
MFR	-17.0 %	-	-	-	-	17.4 %	41.7 %
CRU	-	-	-	-	-	-	41.7 %
ETE	-	-	-	-	-	128.1 %	41.7 %
EEE	-	-	-	-	-	128.1 %	41.7 %

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	2REA069475	B	EN	17/20



Additional Environmental Information

Recyclability potential

The recyclability potentials of the REF/REJ/REM601 from Relion 605 series were calculated by dividing “MFR: material for recycling” in the end-of-life stage with the total weight of the products. As a result, the recyclability potentials are presented below:

	Recyclability Potential
REF/REJ/REM601 CT+COM (Reference Product)	38 %
REF/REJ/REM601 CT	40 %
REF/REJ/REM601 SN+COM	43 %
REF/REJ/REM601 SN	43 %

Additional Norwegian Requirements

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.

Electricity	Source	Amount	Unit
ABB IN energy mix; 96.3% National Energy Mix + 3.1% Solar generation + 0.6% Diesel backup generator	Ecoinvent v3.8	1.34	kg CO ₂ -eq/kWh

Dangerous substances

As part of ABB's values, and in alignment with the Supplier Code of Conduct, we seek to work with companies who contribute to a sustainable development and are ethically, socially, environmentally, and economically responsible.

ABB is responsible for ensuring that our products comply with legal requirements. There are also other sets of environmental requirements not necessarily originating from legislation, but which are of great importance as ABB customers are demanding compliance with them.

ABB Distribution Solutions has contacted suppliers of the REF/REJ/REM601 from Relion 605 series to collect component and material information. This information includes, but is not limited to:

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	EN	18/20

- Full Material Disclosure
- RoHS compliance certificate
- REACH compliance certificate
- Component lifecycle status

Thus, the purpose is to avoid chemicals, materials, and substances that

- may represent hazards to the environment, or
- the health of workers, customers, consumers, and other stakeholders, or
- could negatively influence end-of-life properties.

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	2REA069475	B	EN	19/20



References

- Parida, T. (2023). *REF/REJ/REM601 from Relion 605 series: Life Cycle Assessment Report* (Report No. 2REA069473, rev. A). ABB Switzerland Ltd, Group Technology Management.
- ecoinvent. ecoinvent v.3.8 (2021). <https://ecoinvent.org/the-ecoinvent-database/data-releases/ecoinvent-3-8/>
- European Committee for Standardization. (2019). *Product category rules for life cycle assessments of electronic and electrical products and systems* (EN 50693:2019).
- European Committee for Standardization. (2019). *Sustainability of constructions - Environmental product declarations* (EN 15804:2012+A2:2019).
- Eurostat. (2020). *Packaging waste by waste management operations*.
https://ec.europa.eu/eurostat/databrowser/view/ENV_WASPAC/default/table?lang=en
- ICMQ S.p.A. (2023). *PCR EPDIItaly007-Electronic and electrical products and systems*, rev. 3.0 (2023-01-13). EPDIItaly. <https://www.epditaly.it/en/view-pcr/>
- ICMQ S.p.A (2020). *Regulations of the EPDIItaly Programme Regulations*, rev. 5.2 (2020-02-16). EPDIItaly. https://www.epditaly.it/en/wp-content/uploads/2016/12/EPDITALY-Regulament_rev-5.2_EN.pdf
- International Electrotechnical Commission. (2012). *Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment*, Edition 1.0 (2012-10-1) (IEC/TR 62635).
- International Organization for Standardisation. (2006). *Environmental management - Life cycle assessment - Principles and framework* (ISO Standard No. 14040:2006).
<https://www.iso.org/standard/37456.html>
- International Organization for Standardisation. (2006). *Environmental management - Life cycle assessment - Requirements and guidelines* (ISO Standard No. 14044:2006).
<https://www.iso.org/standard/38498.html>
- PRé Sustainability. (2023). SimaPro (version 9.4.0.2) [computer software]. <https://pre-sustainability.com/solutions/tools/simapro/>
- SeaRates. (2022). *Shipping Distances & Time Calculator*.
<https://www.searates.com/services/distances-time>
- The Norwegian EPD Foundation/EPD-Norge. (2019). *General Programme Instructions 2019*, Version 3.0 (2019-04-24). <https://www.epd-norge.no/getfile.php/1328807-1674210696/Dokumenter/GPI%20Det%20norske%20EPD%20programmet%20approved240419%20-%20v5-20123.pdf>



Program Operator and publisher

The Norwegian EPD Foundation	Ph.	+47 23 08 80 00
Post Box 5250 Majorstuen,	email	post@epd-norge.no
0303 Oslo, Norway	web	www.epd-norge.no



Owner of the declaration

ABB Swizerland Ltd, Group Technology Management		
Brown Boveri Straße 6, 5400 Baden, Switzerland	web	www.abb.com



Author

Tushar Parida	Ph.	+91 9945509947
ABB Global Industries and Services Private Limited	email	tushar.parida@in.abb.com
Whitefield, Bangalore, India	web	www.abb.com

STATUS	SECURITY LEVEL	DOCUMENT ID.	REV.	LANG.	PAGE
Approved	Public	2REA069475	B	EN	20/20