# PRODUCT ENVIRONMENTAL PROFILE

## Environmental Product Declaration

### ABB CM Monitoring Relays


CM-MPS.41S

| | |
|---|---|
| REGISTRATION NUMBER<br>ABBG-00438-V01.01-EN | IN COMPLIANCE WITH PCR-ED4-EN-2021 09 06<br>SUPPLEMENTED BY PSR-0005-ED3.1-EN-2023 12 08 |
| VERIFIER ACCREDITATION NUMBER<br>VH51 | INFORMATION AND REFERENCE DOCUMENTS<br>www.pep-ecopassport.org |
| DATE OF ISSUE<br>02-2025 | VALIDITY PERIOD<br>5 years |
| INDEPENDENT VERIFICATION OF THE DECLARATION AND DATA, IN COMPLIANCE WITH ISO 14025: 2006 | |
| INTERNAL ☐ EXTERNAL ☒ | |
| THE PCR REVIEW WAS CONDUCTED BY A PANEL OF EXPERTS CHAIRED BY JULIE ORGELET (DDEMAIN) | |
| PEPS ARE COMPLIANT WITH XP C08-100-1 :2016 AND EN 50693:2019<br>THE COMPONENTS OF THE PRESENT PEP MAY NOT 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 STOTZ-KONTAKT GmbH, 69123 Heidelberg, Germany<br>www.abb.com |
| **Manufacturer name and address** | ABB STOTZ-KONTAKT GmbH - Site Hornberg, 78132, Hornberg, Baden-Württemberg Germany |
| **Company contacts** | EPD_ELSP@in.abb.com |
| **Reference product** | CM-MPS.41S Monitoring Relay |
| **Description of the product** | CM Monitoring relays monitor and detect operating conditions related to phase, current, voltage, frequency, temperature, liquid level, or insulation faults. These relays inform users about abnormal conditions, allowing them to take necessary corrective actions before severe and costly failures occur. Depending on the product model, monitoring relays are categorized into various product families. |
| **Functional unit** | The functional unit of the CM Monitoring relay is designed to monitor abnormal conditions and disconnect the circuit in the event of faults throughout a reference lifetime of 10 years. This product is considered an 'Active product' with 100% Use Rate in ON, 0% Use Rate in Standby and 0% Use Rate in OFF Mode.<br>Rated operational voltage [Ue]= 250 VAC<br>Rated operational current [Ie]= 4A<br>Number of Output Relays [Np]=2c/o<br>Terminal Type= Screw<br>Rated Control Supply Voltage [Uc]= 3x300-500V AC |
| **Other products covered** | Three-phase monitoring relays CM-PFS.Y, CM-PSS.xxY, CM-PVS.xxY, CM-PAS.xxY, CM-MPS.xxY, CM-MPN.xxY,<br>Single-phase current monitoring relays CM-SRS.xxY, CM-SFS.xxY<br>Single-phase voltage monitoring relays CM-ESS.xY, CM-EFS.xY<br>Insulation monitoring relays CM-IWS.xY, CM-IWN.xY, CM-IVN.Y<br>Temperature monitoring relays CM-TCS.xxY, CM-TCS.xxxY, CM-TCN.xxxY<br>Thermistor motor protection CM-MSS.xxY<br>Liquid level monitoring relays CM-ENS.xxY<br><br>x = placeholder for various sequences of numbers and letters that define features, power supply, and/or the number of output relays.<br>y = terminals type: S - screw connection, P: push-in / easy connect. |
| **Reference lifetime** | 10 years |
| **Product category** | Electrical, Electronic and HVAC-R Products, 3.15 Specific rules for the 'Other Equipment' family of PSR-0005-ed3.1- EN- 2023 12 08 |
| **Use Scenario** | The use phase has been modeled based on the sales mix data (2023), and the corresponding low voltage electricity countries mix. |
| **Geographical representativeness** | Raw materials & Manufacturing: [Europe / Global]<br>Assembly: [Germany]<br>Distribution / Use: [Global] specific sales mix<br>EoL: [Global] |
| **Technological representativeness** | Materials and processes data are specific to the production of CM Monitoring Relay |
| **LCA Study** | This study is based on the LCA study described in the LCA report 1SAC200438H0001 |
| **EPD type** | Product family declaration |
| **EPD scope** | "Cradle to grave" |
| **Year of reported primary data** | 2023 |
| **LCA software** | SimaPro 9.6.0.1 (2024) |
| **LCI database** | Ecoinvent v3.10 (2024) |
| **LCIA methodology** | EN 15804:2012+A2:2019 |

# 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 105 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 humane behavior.

# General Information

The ABB STOTZ-KONTAKT GmbH company was founded in 1891 and develops, manufactures, and sells products for the electrical installation and automation of buildings, machines and plants.
For the Smart Power, the company is the competence center for Manual Motor Starters, Overload relays, Mini Contactors, Installation Contactors, Monitoring Relay, Monitoring Relays, Motor Controller, Power Supplies, Interface Products and Safety Products.

- Heidelberg Workshop Smart Power is about 5000 sq. m.
- Hornberg Workshop is around 6500 sq.m.
- Employees 1000 person.
- Global R&D and product management are located at the factory.

ISO 9001:2015 - Quality Management Systems Heidelberg & Hornberg
ISO 45001:2018- Occupational Health and Safety Assessment Series- Heidelberg
ISO 50001:2018- Energy management systems- Heidelberg & Hornberg
ISO 14001:2015- Environmental management systems - Heidelberg

In the factory, the different components and subassemblies are assembled on the manufacturing line. Most of the components and subassemblies are produced by ABB's suppliers. These are assembled and tested as per the standards within the factory premises.

# CM Monitoring Relay product cluster

CM Monitoring relays monitor and detect operating conditions related to phase, current, voltage, frequency, temperature, liquid level, or insulation faults. These relays inform users about abnormal conditions, allowing them to take necessary corrective actions before severe and costly failures occur. Depending on the product model, monitoring relays are categorized into various product families.

**CM Monitoring Relays product rating:**

| CM Monitoring relays | Type | Rated operational voltage [Ue] | Rated operational current [Ie] | Number of Output Relays [Np] | Terminal Type | Rated Control Supply Voltage [Uc] |
|---|---|---|---|---|---|---|
| Three-phase monitoring relays | CM-MPS.41S | 250 VAC | 4 A | 2 c/o | Screw | 3x300-500 V AC |
| Three-phase monitoring relays | CM-MPS.xxY<br>CM-MPN.xxY<br>CM-PFS.xxY<br>CM-PVS.xxY<br>CM-PAS.xxY<br>CM-PSS.xxY | 250 VAC | 4 A | 2 c/o | Y = S -> Screw<br>Y= P -> Push-in | 160-300 V AC (L-L)<br>200-400 V AC (L-L)<br>200-500 V AC (L-L)<br>300-500 V AC (L-L)<br>350-580 V AC (L-L)<br>450-720 V AC (L-L)<br>530-820 V AC (L-L)<br>380 V AC (L-L)<br>400 V AC (L-L)<br>90-170 V AC (L-N)<br>180-280 V AC (L-N) |
| Single-phase current monitoring relays | CM-SRS.xxY<br>CM-SFS.xxY | 250 VAC | 4 A | .1x = 1c/o<br>.2x = 2c/o<br>.Mx = 2c/o | Y = S -> Screw<br>Y= P -> Push-in | 24 - 240 V AC/DC<br>110 - 130 V AC<br>220 - 240 V AC |
| Single-phase voltage monitoring relays | CM-ESS.xY<br>CM-EFS.xY | 250 VAC | 4 A | .1 = 1 c/o<br>.2 = 2 c/o | Y = S -> Screw<br>Y= P -> Push-in | 24 - 240 V AC/DC<br>110 - 130 V AC<br>220 - 240 V AC |
| Insulation monitoring relays | CM-IWS.xY | 250 VAC | 4 A | 1 c/o | Y = S -> Screw<br>Y= P -> Push-in | 24 - 240 V AC/DC |
| | CM-IWN.xY | | | 2 c/o | | |
| | CM-IVN.xY | | | - | | - |
| Temperature monitoring relays | CM-TCS.xxY,<br>CM-TCS.xxxY,<br>CM-TCN.xxxY | 250 VAC | 4 A | 2 c/o | Y = S -> Screw<br>Y= P -> Push-in | 24 - 240 V AC/DC |
| Thermistor motor protection | CM-MSS.xxY | 250 VAC | 4 A | as per datasheet | Y = S -> Screw<br>Y= P -> Push-in | 24-240 V AC/DC<br>24 V AC/DC<br>110-130 V AC, 220-240 V AC |
| Liquid level monitoring relays | CM-ENS.xxY | 250 VAC | 4 A | as per datasheet | Y = S -> Screw<br>Y= P -> Push-in | 24-240 V AC/DC<br>110-130 V AC<br>220-240 V AC |

Table 1: Technical characteristics of CM Monitoring Relays

**Reference Product:**
The reference product for the LCA of the complete range of CM Monitoring Relays is the CM-MPS.41S multifunctional three-phase monitoring relay.

# Constituent Materials

## CM-MPS.41S multifunctional three-phase Monitoring Relay

CM-MPS.41S Monitoring Relay weighs 152g including its installed accessories, paper documentation and packaging.

| Materials | Name | IEC 62474 MC | [g] | Weight % |
|---|---|---|---|---|
| Metals | Steel | M-119 | 17.2 | 11.3% |
| | Cu and Cu Alloys | M-121 | 11.1 | 7.3% |
| | Stainless Steel | M-100 | 2.8 | 1.8% |
| Plastics | Polyamide | M-258 | 49.0 | 32.1% |
| | Polyphenylenesulfide (PPS) | M-263 | 11.9 | 7.8% |
| | Polycarbonate | M-254 | 1.7 | 1.1% |
| | ASA | M-256 | 0.1 | <0.1% |
| Other | Others | N/A | 41.9 | 27.4% |
| | Paper/Cardboard | M-341 | 17.0 | 11.1% |
| Total | | | 152.7 | 100.0% |

Table 2: Weight of materials CM-MPS.41S Monitoring Relay

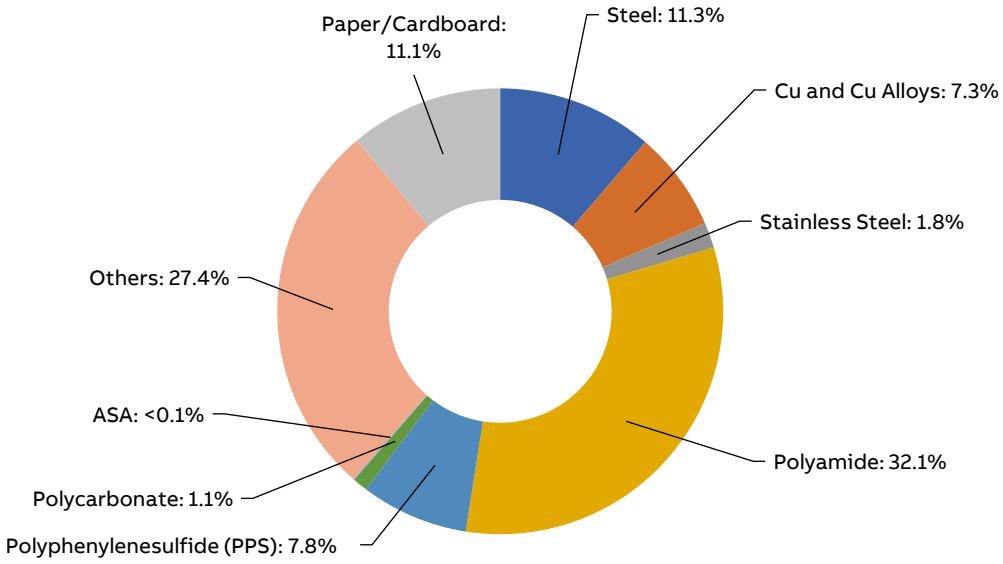


Figure 1: Composition of CM-MPS.41S Monitoring Relay

Packaging for reference product CM-MPS.41S Monitoring Relay weighs 16.95g, with the following substance composition:

| Material | CM-MPS.41S | Weight (g) |
|---|---|---|
| Corrugated Cardboard | 10.9% | 16.66 |
| Paper | 0.2% | 0.29 |
| **Total** | **11.1%** | **16.95** |

Table 3: Weight of packaging materials CM-MPS.41S Monitoring Relay

No cut-off criteria have been applied to the analysis of the product and its packaging. Additional packaging for semifinished products along the supply chain have been considered.

# LCA background information

## Functional unit and Reference Flow

The functional unit is the reference unit used to quantify the performance of the service delivered by a product to the user. The main purpose of the functional unit is to provide a reference to which inputs and outputs are related in the LCA.

The functional unit of the CM Monitoring relay is designed to monitor abnormal conditions and disconnect the circuit in the event of faults throughout a reference lifetime of 10 years. This product is considered an 'Active product' with 100% Use Rate in ON, 0% Use Rate in Standby and 0% Use Rate in OFF Mode. For technical specifications, please refer Table-1. The Reference Flow of the study is a single Monitoring Relay (including its packaging and accessories) with mass described in table 2.

## System boundaries and life cycle stages

The life cycle of CM Monitoring Relay , 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<br>Transport to manufacturing site<br>Components/parts manufacturing<br>Assembly<br>Packaging<br>EoL treatment of generated waste | Transport to distributor/ logistic center<br>Transport to place of use | Installation<br>EoL treatment of generated waste (packaging) | Usage<br>Maintenance | Deinstallation<br>Collection and transport<br>EoL treatment |

Table 5: 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 2023, which is a representative production year for production technology of CM Monitoring Relay at ABB STOTZ-KONTAKT GmbH Manufacturing Plant. The technological representativeness for the Secondary data is Ecoinvent v3.9[6].

The selected ecoinvent [6] 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 [6] 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 [6], allocation cut-off by classification, are used. The ecoinvent database available in the SimaPro software [7] 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 [3] the environmental impact indicators must be determined using the characterization factors and impact assessment methods specified in EN 15804:2012+A2:2019 [8].

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 CM Monitoring Relays line’s occupancy area for electricity apart from assembly processes, the whole production line is temperature regulated throughout the year. The allocation of the total amount of waste generated by the production line is also based on the same criterion.

The total number of operators was considered for water consumption. All these flows have been allocated and divided by the total number of CM Monitoring Relays produced in 2023.

## 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 the 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.

Application of grease lubricant on CM Monitoring Relays operating mechanism has been excluded since it is negligible. Surface treatments like galvanizing, silver plating as well as their related transport processes (back and forth from the finishing suppliers) have been considered in the LCA model. Packaging 10%, and for other processes 30% scrap rate has been used. For thermoplastic injection 10%, thermoset injection/molding 10% is used based on primary data.

## Energy Models

| LCA Stage | EN 15804:2012 +A2:2019 module | Energy model | Notes |
|---|---|---|---|
| Raw material extraction and processing | A1-A2 | Electricity, {RER}\| market group for \| Cut-off Electricity, {GLO}\| market group for \| Cut-off | Based on materials and supplier's locations |
| Manufacturing | A3 | ABB Green Electricity Mix | Specific Energy model for ABB Germany 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 2023 country sales mix |
| EoL | C1-C4 | Electricity, {GLO}\| market group for \| Cut-off | |

Table 6: Energy models used in each LCA stage.

** Please refer the use phase for further description

# 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, and marine distances using Distances & Time (Searates).

All primary data collected from ABB are from 2023, which was a representative production year. The ecoinvent cut-off by classification system processes [6] are used to represent the LCA model.

To improve both the inventory and modelling phase of the product, a specific modular dataset framework has been adopted. Raw materials and Manufacturing processes datasets from Ecoinvent database [6] have been clustered and listed inside two distinct mater data tables ABB Raw Materials and ABB Materials & Processes. Data used in the analysis is not older than 10 years.

## Manufacturing stage

CM-MPS.41S Monitoring Relay are composed of a multitude of components, all of which are made from of numerous materials. All CM Monitoring Relay 's components have been modelled according to their specific raw materials and manufacturing processes.

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 product before shipping them.

Most of the inputs to the products' manufacturing stage are already produced component parts from the supply chain. In the ABB manufacturing plant, the different components and subassemblies are assembled into CM Monitoring Relay. All the semi-finished and ancillary products are produced by ABB's suppliers.

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.

## Distribution

The transport distances from ABB manufacturing plant to the distribution centers (regional distribution centers / local sales organizations) have been calculated considering the specific 2023 sales mix data for CM Monitoring Relays product cluster (SAP ERP sales data as a source). The Distribution mix is representative of entire product cluster including reference product and products listed in the extrapolation tables.

The other parameter affecting the environmental impact for this LCA stage is total mass of the product (including its packaging). Different mass values for each specific configuration covered by this study have been considered in the model.

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]).

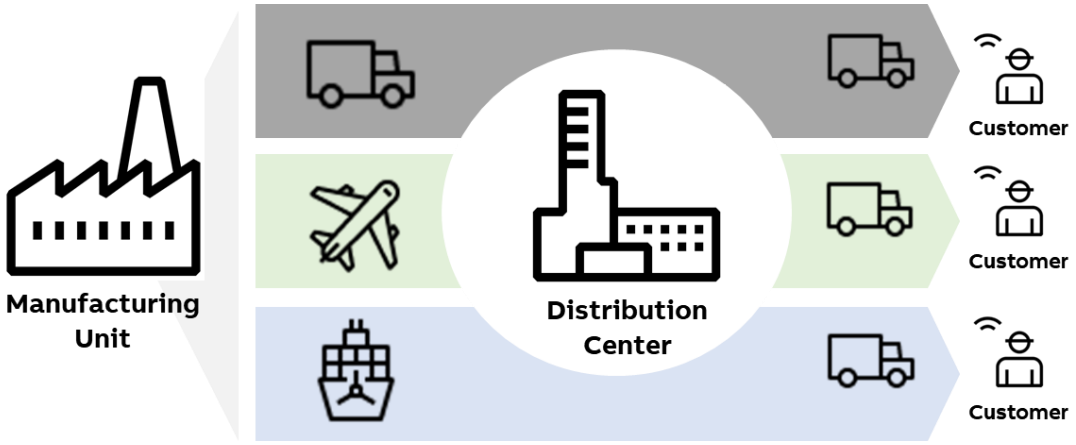


Figure 2: Distribution methodology.

## Installation

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

For the disposal of the packaging after installation of the Installation Contactor at the end of its life, a transport distance of 100 km (according to PSR[2]) was assumed. The chosen transportation datasets are from Ecoinvent [6].
The actual disposal site is unknown and is managed by the customer. The disposal scenario of the packaging was calculated based on the latest Eurostat data (EU-27) (2021) available. For non-European scope, the disposal scenario used is as per PSR[2].

## Use

Use and maintenance are modelled according to the PCR [1]. During the use phase, CM-MPS.41S Monitoring Relay dissipate some electricity due to power losses. They are calculated according to the data provided in the catalogue of CM Monitoring Relay and following the PCR [1] & PSR [2] rules:

| Parameters | | |
|---|---|---|
| Iu | [A] | 4 |
| Load rate | [%] | 100 |
| h/year | [h] | 8760 |
| RSL | [years] | 10 |
| Time operating coefficient | [%] | 100 |

Table 7: 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 product 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 was built based on the 2023 actual sales mix data for the entire entire CM Monitoring relays range (SAP ERP sales data as a source). This approach has

been taken since this list of countries will be the most representative also for the other products listed in the extrapolation tables.

From Ecoinvent [6] 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 [9]. The percentages for end-of-life treatments of materials are taken from IEC/TR 62635 [9].

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 CM-MPS.41S Monitoring Relay, 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).

| Impact category | Unit | Total | Manufacturing | Distribution | Installation | Use | End of Life |
|---|---|---|---|---|---|---|---|
| GWP-total | kg CO2 eq | 3.81E+01 | 3.42E+00 | 4.70E-01 | 1.53E-02 | 3.41E+01 | 8.76E-02 |
| GWP-fossil | kg CO2 eq | 3.72E+01 | 3.41E+00 | 4.70E-01 | 4.81E-04 | 3.32E+01 | 8.75E-02 |
| GWP-biogenic | kg CO2 eq | 8.31E-01 | -2.61E-03 | 6.28E-05 | 1.49E-02 | 8.18E-01 | 1.42E-04 |
| GWP-luluc | kg CO2 eq | 1.00E-01 | 5.66E-03 | 3.76E-05 | 1.55E-07 | 9.46E-02 | 1.89E-05 |
| ODP | kg CFC11-eq | 4.35E-07 | 6.38E-08 | 7.30E-09 | 7.36E-12 | 3.64E-07 | 3.79E-10 |
| AP | mol H+ eq | 2.01E-01 | 4.51E-02 | 1.98E-03 | 3.27E-06 | 1.54E-01 | 1.35E-04 |
| EP-freshwater | kg P eq | 2.38E-02 | 5.34E-03 | 8.30E-06 | 5.11E-08 | 1.84E-02 | 5.90E-06 |
| EP-marine | kg N eq | 3.70E-02 | 5.85E-03 | 7.90E-04 | 2.59E-06 | 3.03E-02 | 5.20E-05 |
| EP-terrestrial | mol N eq | 3.72E-01 | 6.32E-02 | 8.63E-03 | 1.40E-05 | 3.00E-01 | 4.43E-04 |
| POCP | kg NMVOC eq | 1.14E-01 | 1.88E-02 | 2.80E-03 | 4.30E-06 | 9.26E-02 | 1.49E-04 |
| ADP-m&m | kg Sb eq | 1.77E-03 | 1.50E-03 | 1.64E-07 | 1.05E-09 | 2.65E-04 | 4.78E-08 |
| ADP-fossil | MJ | 5.32E+02 | 4.60E+01 | 6.26E+00 | 4.92E-03 | 4.79E+02 | 4.01E-01 |
| WDP | m3 of equiv. depriv. | 8.04E+00 | 1.44E+00 | 1.01E-02 | 1.63E-04 | 6.59E+00 | 1.35E-03 |
| PENRE | MJ | 5.31E+02 | 4.45E+01 | 6.26E+00 | 4.92E-03 | 4.79E+02 | 4.01E-01 |
| PENRM | MJ | 1.50E+00 | 1.50E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| PENRT | MJ | 5.32E+02 | 4.61E+01 | 6.26E+00 | 4.92E-03 | 4.79E+02 | 4.01E-01 |
| PERE | MJ | 1.16E+02 | 4.92E+00 | 2.61E-02 | 1.26E-04 | 1.11E+02 | 1.82E-02 |
| PERM | MJ | 2.18E-01 | 2.18E-01 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| PERT | MJ | 1.16E+02 | 5.14E+00 | 2.61E-02 | 1.26E-04 | 1.11E+02 | 1.82E-02 |
| SM | kg | 3.14E-03 | 3.14E-03 | 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 | 6.48E+02 | 5.12E+01 | 6.29E+00 | 5.05E-03 | 5.90E+02 | 4.19E-01 |
| FW | m3 | 3.40E-01 | 4.31E-02 | 3.31E-04 | 7.17E-06 | 2.96E-01 | 7.11E-05 |
| HWD | kg | 1.53E-03 | 3.47E-04 | 4.32E-05 | 4.20E-08 | 1.14E-03 | 1.99E-06 |
| N-HWD | kg | 1.84E+00 | 2.38E-01 | 3.55E-02 | 8.58E-03 | 1.48E+00 | 7.11E-02 |
| RWD | kg | 1.72E-03 | 8.52E-05 | 5.15E-07 | 1.91E-09 | 1.63E-03 | 3.51E-07 |
| CfR | kg | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| MfR | kg | 6.45E-02 | 1.98E-02 | 0.00E+00 | 7.42E-03 | 0.00E+00 | 3.73E-02 |
| MfER | kg | 2.83E-02 | 6.66E-04 | 0.00E+00 | 8.47E-03 | 0.00E+00 | 1.91E-02 |
| 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. | 1.53E-06 | 2.32E-07 | 6.90E-09 | 4.00E-11 | 1.29E-06 | 2.24E-09 |
| IrHH | kBq U-235 eq | 7.13E+00 | 3.42E-01 | 2.12E-03 | 7.63E-06 | 6.78E+00 | 1.44E-03 |
| ETX FW | CTUe | 2.41E+02 | 1.30E+02 | 4.76E-01 | 5.08E-02 | 1.10E+02 | 6.41E-01 |
| HTX CE | CTUh | 7.13E-08 | 2.02E-08 | 5.57E-10 | 4.14E-12 | 5.04E-08 | 1.06E-10 |
| HTX N-CE | CTUh | 5.97E-07 | 2.30E-07 | 4.74E-09 | 3.42E-11 | 3.61E-07 | 1.48E-09 |
| IrLS | Pt | 1.33E+02 | 2.26E+01 | 7.78E-01 | 3.73E-03 | 1.09E+02 | 2.53E-01 |

Table 8: Impact indicators for CM-MPS.41S Monitoring Relay

| Impact category | Unit | CM-MPS.41S |
|---|---|---|
| Biogenic Carbon content of the product | kg | 1.08E-04 |
| Biogenic Carbon content of the associated packaging | kg | 3.31E-03 |

Table 9: Inventory flow other indicators

**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 |
| 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 |
| PENRM | 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 | Component for reuse |
| MfR | Materials for recycling |
| MfER | Materials for energy recovery |
| EN | Exported energy |

### Others 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 PEP covers different build configurations than the representative product. All the analyzed configurations have the same main functionality, product standards and manufacturing technology. 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.

For products other than the reference product, covered in this PEP, the environmental impacts for each phase of the lifecycles are obtained by multiplying the impacts of the reference product by the factors listed in the tables below.

## Manufacturing

| Product | GWP-total | GWP-fossil | GWP-biogenic | GWP-luluc | ODP | AP | EP-freshwater | EP-marine | EP-terrestrial | POCP | ADP-minerals & metals | ADP-fossil | WDP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CM-PFS.Y, CM-PSS.xxY CM-PVS.xxY, CM-PAS.xxY, CM-MPS.xxY; CM-SRS.xxY, CM-SFS.xxY; CM-ESS.xY, CM-EFS.xY; CM-IWS.xY; CM-MSS.xxY; CM-ENS.xxY; CM-TCS.xxY** | 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 |
| **CM-MPN.xxY; CM-IWN.xY, CM-IVN.Y;** | 1.41 | 1.41 | 1.71 | 1.33 | 0.94 | 1.34 | 1.32 | 1.36 | 1.33 | 1.38 | 1.21 | 1.42 | 1.53 |
| **CM-TCN.xxxY** | 1.98 | 1.98 | -1.89 | 1.80 | 1.68 | 1.76 | 1.69 | 1.85 | 1.79 | 1.86 | 1.55 | 1.96 | 1.82 |
| **CM-TCS.xxxY** | 0.93 | 0.93 | 0.63 | 0.98 | 0.94 | 0.92 | 0.85 | 0.89 | 0.88 | 0.89 | 0.79 | 0.93 | 0.91 |

Table 10: Extrapolation factors for CM Monitoring Relays -Manufacturing

## Distribution

| Product | GWP-total |
|---|---|
| **CM-PFS.Y, CM-PSS.xxY CM-PVS.xxY, CM-PAS.xxY, CM-MPS.xxY; CM-SRS.xxY, CM-SFS.xxY; CM-ESS.xY, CM-EFS.xY; CM-IWS.xY; CM-MSS.xxY; CM-ENS.xxY; CM-TCS.xxY** | 1.00 |
| **CM-MPN.xxY; CM-IWN.xY, CM-IVN.Y;** | 1.81 |
| **CM-TCN.xxxY** | 1.99 |
| **CM-TCS.xxxY** | 1.08 |

Table 11: Extrapolation factors for CM Monitoring Relays -Distribution

## Installation

| Product | GWP-total |
|---|---|
| **CM-PFS.Y, CM-PSS.xxY CM-PVS.xxY, CM-PAS.xxY, CM-MPS.xxY; CM-SRS.xxY, CM-SFS.xxY; CM-ESS.xY, CM-EFS.xY; CM-IWS.xY; CM-MSS.xxY; CM-ENS.xxY; CM-TCS.xxY** | 1.00 |
| **CM-MPN.xxY; CM-IWN.xY, CM-IVN.Y;** | 1.46 |
| **CM-TCN.xxxY** | 1.46 |
| **CM-TCS.xxxY** | 1.00 |

Table 12: Extrapolation factors for CM Monitoring Relays -Installation

## Use

| Product | Factor |
|---|---|
| **CM-PFS.Y, CM-PSS.xxY CM-PVS.xxY, CM-PAS.xxY, CM-MPS.xxY;<br>CM-SRS.xxY, CM-SFS.xxY;<br>CM-ESS.xY, CM-EFS.xY;<br>CM-IWS.xY;<br>CM-MSS.xxY;<br>CM-ENS.xxY;<br>CM-TCS.xxY** | 1.00 |
| **CM-MPN.xxY;<br>CM-IWN.xY, CM-IVN.Y;** | 2.57 |
| **CM-TCN.xxxY** | 1.43 |
| **CM-TCS.xxxY** | 2.43 |

Table 13: Extrapolation factors for CM Monitoring Relays -Use phase

## EoL

| Product | GWP-total | GWP-fossil | GWP-biogenic | GWP-luluc | ODP | AP | EP-freshwater | EP-marine | EP-terrestrial | POCP | ADP-minerals & metals | ADP-fossil | WDP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CM-PFS.Y, CM-PSS.xxY CM-PVS.xxY, CM-PAS.xxY, CM-MPS.xxY;<br>CM-SRS.xxY, CM-SFS.xxY;<br>CM-ESS.xY, CM-EFS.xY;<br>CM-IWS.xY;<br>CM-MSS.xxY;<br>CM-ENS.xxY;<br>CM-TCS.xxY** | 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 |
| **CM-MPN.xxY;<br>CM-IWN.xY, CM-IVN.Y;** | 1.86 | 1.86 | 4.69 | 1.94 | 1.90 | 1.91 | 1.95 | 1.88 | 1.89 | 1.89 | 1.87 | 1.91 | 1.82 |
| **CM-TCN.xxxY** | 2.04 | 2.03 | 2.19 | 2.43 | 2.25 | 2.29 | 2.45 | 2.15 | 2.18 | 2.19 | 2.11 | 2.30 | 1.89 |
| **CM-TCS.xxxY** | 1.13 | 1.13 | 0.67 | 1.25 | 1.18 | 1.20 | 1.26 | 1.16 | 1.16 | 1.16 | 1.13 | 1.20 | 1.06 |

Table 14: Extrapolation factors for CM Monitoring Relays -EoL

# Additional environmental information

According to the waste treatment scenario calculation in Simapro [7], based on the recycling rate in the technical report IEC/TR 62635 Edition 1.0 [9] Table D.6, the following recyclability potentials were calculated. The recyclability potential is calculated based on the product weight (excluding packaging).

| Recyclability potential | CM-MPS.41S |
|---|---|
| | 62.6% |

Table 15: Recyclability potential of CM-MPS.41S Monitoring Relay

# 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-ed3.1- EN- 2023 12 08” - SPECIFIC RULES FOR Electrical switchgear and control gear Solutions

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

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

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

[6] ecoinvent v3.10 (2024). ecoinvent database version 3.10 - (https://ecoinvent.org/)

[7] SimaPro Software version 9.6.0.1 - PRé Sustainability

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

[9] 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