

Type III Environmental Product Declaration No. 358/2022

# MST

*Your solutions*



## LED MODULES LINEAR, RECTANGULAR, ROUND AND OTHER SHAPES ON FLAT PRINTED CIRCUITS MADE OF PLASTIC AND ALUMINUM



Owner of the EPD:

MST Sp. z o. o. Sp. k.  
Address: Chrobrego 8,  
11-400 Kętrzyn, Poland  
Tel.: +48 89 755 27 00  
Website: <http://www.mst.pl/>  
Contact: Jacek Wysokowicz  
[jacek.wysokowicz@mst.pl](mailto:jacek.wysokowicz@mst.pl)

EPD Program Operator:

Instytut Techniki Budowlanej (ITB)  
Address: Filtrowa 1,  
00-611 Warsaw, Poland  
Website: <http://www.itb.pl>  
Contact: Michał Piasecki  
[m.piasecki@itb.pl](mailto:m.piasecki@itb.pl)  
[energia@itb.pl](mailto:energia@itb.pl)



ITB is the verified member of The European Platform for EPD program operators and LCA practitioner [www.eco-platform.org](http://www.eco-platform.org)

## BASIC INFORMATION

This declaration is the Type III Environmental Product Declaration (EPD) based on EN 15804+A2 and verified according to ISO 14025 by an external auditor. It contains the information on the impacts of the declared construction materials on the environment and their aspects verified by the independent body according to ISO 14025. Basically, comparison or evaluation of EPD data is possible only if all the compared data were created according to EN 15804+A2.

<b>Life cycle analysis (LCA):</b>	A1-A3, B6, C2-C4 and D modules in accordance with EN 15804 (Cradle-to-Gate with options)
<b>The year of preparing the EPD:</b>	2022
<b>Product standard:</b>	EN 62717:2017-11
<b>Service Life:</b>	minimum 50.000 h, 17 years (8h/day)
<b>PCR:</b>	ITB-PCR A
<b>Declared unit:</b>	1 kg
<b>Reasons for performing LCA:</b>	B2B
<b>Representativeness:</b>	Polish, European, 2021

## Type III Environmental Product Declaration No. 358/2022

### MANUFACTURER

MST Sp. z o. o. Sp. k. operates in the electronics industry and produces components for the lighting industry. MST arose from the management buyout of Philips Lighting electromagnetic ballasts factory in Kętrzyn (Poland). In 2011 Management Team purchased the factory and the MST brand from Philips. Company became a supplier for Philips of electromagnetic ballasts for HID lamps with Philips brand in Europe, Middle East and Africa.

MST produces its own branded products including LED modules covered by this EPD. In the end of 2013 company invested in equipment for production electronics and at the beginning of 2014. MST started own production of ignitors and LED boards. In 2018, company started production of LED drivers and driver for high power LED lamps. The company has a laboratory accredited by DEKRA in accordance with the ISO 17025, enabling testing and certification of products with the ENEC. Company has the ISO certificates: 9001, 14001, 18001. MST offers complete services related to the design and contract of the assembly of electronic components on printed circuit boards. Information on MST offer is available at: <http://www.mst.pl/en/products>

### PRODUCTS DESCRIPTION AND APPLICATION

LED modules are a light source with different parameters. They are to be built into lighting fixtures. They work when connected to a dedicated low-voltage power supply. The LED modules are designed for a broad range of indoor applications such as cell offices, open plan offices and meeting rooms of different sizes. Set of products covered by this EPD is shown in Table 1.

Table 1. Light products offered by MST Sp. z o. o. Sp. k. covered by EPD.

Module LED	Size [mm]	Thickness [mm]	Material PCB
LED Linear modules	length: 58/69/70/88/107/130/131/140/156/175/265/272/ 280/284/338/350/420/440/507/560/565/566/589/ 590/599/600/840/1110/1120/ 1140/1400 width: 8/10,5/11/13/16/19,8/20/23,6/24/26/27/28/33/35/ 40/46/53/55	0.3/1/1.5/1.6/2	Aluminum/ CEM1/ CEM3/ FR4
LED Round modules	diameter: 67/97/150/152/174/190/207/220/225/250/ 255/280/298/315/345/350/400/440/500/530/580/ 740/800/990/1080/1082	1/1.5/1.6	Aluminum/ CEM1/ CEM3/ FR4
LED Rectangular modules	length: 62/90/104/122/138/146/147/151/162/173/ 200/223/224/225/250/270/274/330/334/400/435/ 487/519/520/540 width: 45/47/48/50/62/72/75/150/173/201/204/ 222/225/237/250/259/261/270/271/330/400	1/1.5/1.6	Aluminum/ CEM1/ CEM3/ FR4
LED modules other shape (banana, pitchfork, HexLED, OctLED)	length: 72,84/190/208/316,06/348/420/535/563,1/ 654,2 width: 40/79,98/81/109,1/121/172/190/229,55/243	1/1.6	CEM3/ FR4



## Type III Environmental Product Declaration No. 358/2022

The detailed technical documents related to the Linear, Rectangular and Round LED products are available on MST website <http://www.mstechnology.pl/pl/products/doc/doc-catalogue>.

### Linear LED modules

#### Product description

- Long life-time: >50.000 hours
  - High colour rendering: CRI > 80
  - Color consistency of 3 SDCM
  - Re-workable push-in terminals enabling easy connection
  - Compliance and approval: CE, ENEC
  - Mechanical design according to Zhaga
  - Color temperature: 3000K = warm white; 4000K = neutral white
  - Case temperature  $T_c = 85^\circ\text{C}$
  - Tolerance range for optical and electrical data  $\pm 10\%$
  - Max. torque for fixing: 0,5Nm
- Typical values @  $I_f$  nom,  $T_p = 65^\circ\text{C}$   
( $T_p$ : temperature measured at  $T_c$  point)



### Rectangular LED modules

#### Product description

- Long life-time: >50.000 hours
  - High colour rendering: CRI > 80
  - Color consistency of 3 SDCM
  - Re-workable push-in terminals enabling easy connection
  - Compliance and approval: CE
  - Mechanical design according to Zhaga
  - Color temperature: 3000K = warm white; 4000K = neutral white
  - Case temperature  $T_c = 85^\circ\text{C}$
  - Tolerance range for optical and electrical data  $\pm 10\%$
  - Max. torque for fixing: 0,5Nm
- Typical values @  $I_f$  nom,  $T_p = 65^\circ\text{C}$   
( $T_p$ : temperature measured at  $T_c$  point)



### Round LED modules

#### Product description

- Long life-time: > 50.000 hours
  - High colour rendering: CRI > 80
  - Colour consistency of 3 SDCM
  - Re-workable push-in terminals enabling easy connection
  - Compliance and approval: CE
  - Colour temperature: 3000K = warm white; 4000K = neutral white
  - Case temperature  $T_c = 85^\circ\text{C}$
  - Tolerance range for optical and electrical data  $\pm 10\%$
  - Max. torque for fixing: 0.5Nm
- Typical values @  $I_f$  nom,  $T_p = 65^\circ\text{C}$   
( $T_p$ : temperature measured at  $T_c$  point)



## Type III Environmental Product Declaration No. 358/2022

### **LIFE CYCLE ASSESSMENT (LCA) – general rules applied**

#### **Unit**

The declared unit is 1 kg of product. The family of LED modules includes multiple product types (table 1) and is assembled on the manufacturing site of MST (Kętrzyn, Poland).

This EPD provides also a method to convert the environmental impacts (of 1 kg of average product) to a specific/selected LED product.

#### **System boundary**

The life cycle analysis of the declared products covers "Product Stage" A1-A3, B6, C2-C4+D modules in accordance with EN 15804 and ITB PCR A (cradle to gate with options). Energy and water consumption, emissions as well as information on generated wastes were inventoried and were included in the calculation. It can be assumed that the total sum of omitted processes does not exceed 5% of all impact categories. In accordance with EN 15804+A2, machines and facilities (capital goods) required for the production as well as transportation of employees were not included in LCA.

#### **Allocation**

The allocation rules used for this EPD are based on general ITB's document PCR A. In the aggregated module A1-A3, material losses in the assembly of the products in the factory are defined on the averaged specific values for the site. Input and output data from the production is inventoried and allocated to the production on the mass basis. The declaration covers a wide range of products. Their production resources and processing stages are basically similar, so it is possible to average the production by product weight so production is averaged for all products. Avoided burden approach is applied in the use of recycled and/or secondary raw materials, as well as loads and benefits beyond the system boundary from material recycling. No loads and benefits beyond the system boundary from energy recovery from the end of life of the product or packaging is included.

#### **System limits**

In the assessment, all available data from production have been considered, i.e. all raw materials/elements used as per assembly process, utilized thermal energy, and electric power consumption. Thus material and energy flows contributing less than 1 % of mass or energy have been considered. It can be assumed that the total sum of neglected processes does not exceed 5 % of energy usage and mass per module A, B, C or D. Machines and facilities required during production are neglected. The production of etiquettes, tape and glue was also not considered.

#### **Modules A1 and A2: Raw materials supply and transport**

The modules A1 and A2 represent the extraction and processing of raw materials and components and transport to the production MST's site. The mass dominant PCB aluminum and polymer based are imported (air, train and road freight). Other input elements are connectors, diodes and solder paste. For A2 module (transport) European averages for fuel data are applied. Modules LED based on PCB aluminum has density 2.66 gr/cm<sup>3</sup> and are composed of the materials provided in Table 2.

Type III Environmental Product Declaration No. 358/2022

Table 2. Materials of PCB Aluminium.

Materials	Weight %
Aluminum	65.8%
Copper	8.0%
Epoxy Resin	5.1%
Fibrous Glass	4.1%
Inorganic Pigment	2.3%
PA6	1.7%
Titanium dioxide	1.7%
Silica	0.7%
Silicone	0.6%
Acrylate Resin	0.3%
Tin	0.2%
Other ingredients	9.4%
Total	100.0%

Dominant in production are modules LED made on the basis of PCB polymers (CEM1/ CEM3/ FR4) with its density 2.26 gr/cm<sup>3</sup> (Table 3).

Table 3. Materials of PCB Plastics.

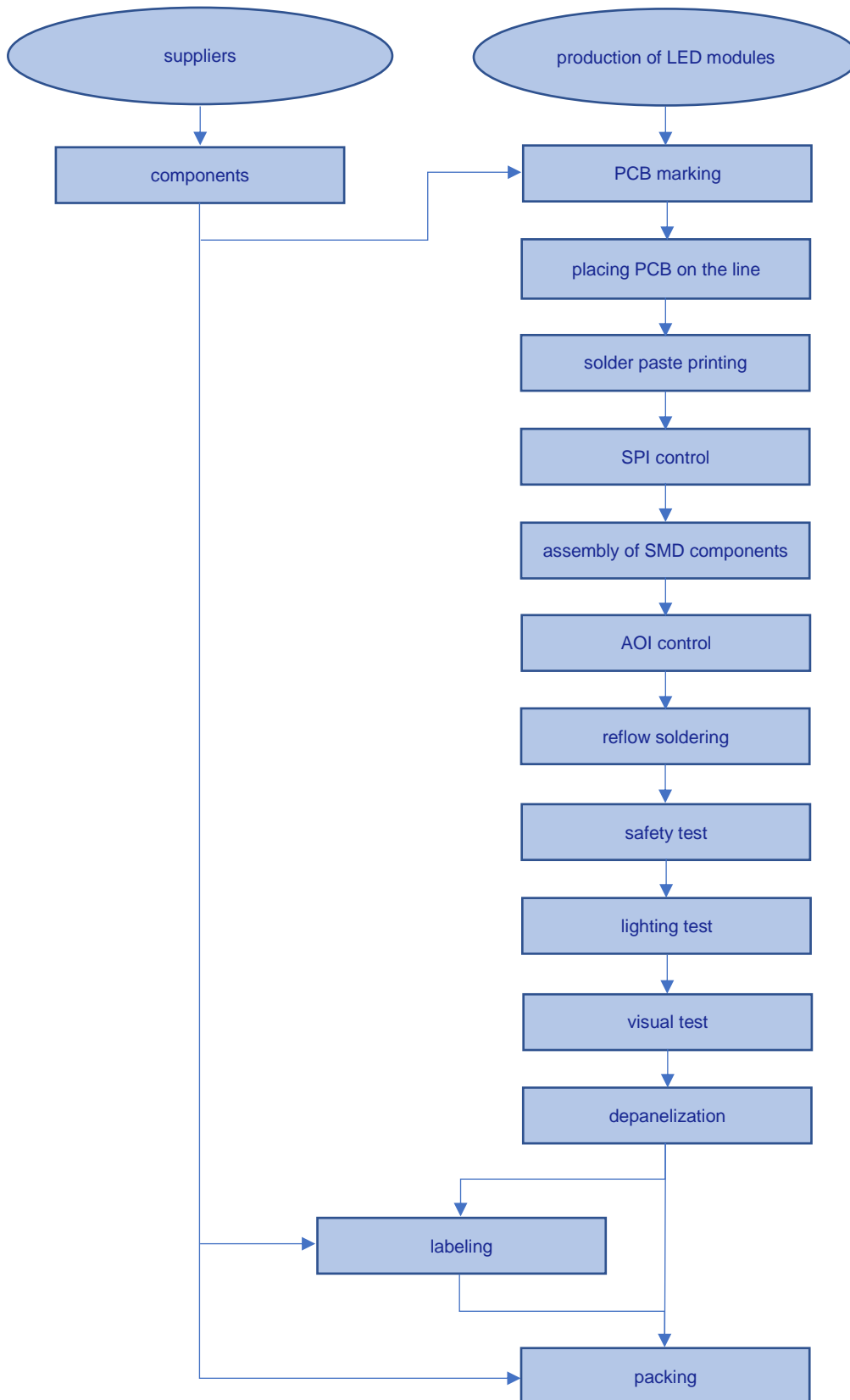
Materials	Weight %
Epoxy resin	46.1%
Silicon dioxide	32.3%
Copper	15.0%
PA6	1.3%
Silicone	1.1%
Tin	0.7%
Other ingredients	3.6%
Total	100.0%

**Module A3: Production**

The product specific manufacturing process line is presented in Figure 1. Electricity and gas are consumed in the process. Manufacturing of the product is partly done by Far East suppliers for the PCB elements. Other parts are made in Poland. The final assembly of the LED modules is implemented by MST (Kętrzyn, Poland).

## Type III Environmental Product Declaration No. 358/2022

Figure 1. A basic scheme of the steel product manufacturing process



## Type III Environmental Product Declaration No. 358/2022

### Module B6: Use stage

During the use-stage, consumption of electricity is taken into account. Total active time is 50,000 h (17 years, 8 h a day). Correction factors FCP/FD for dimming is 1/1. Electricity Mix is EU (Ecoinvent). The minimal nominal power required to produce light from the supply voltage is used for the calculation. As the EPD includes devices with different luminous flux, the B6 phase interaction values are given for 4 representative flux values: 2000lm, 4000lm, 550lm, 1100lm. Precise power consumption data for specific lighting solutions (if different) may be calculated separately.

### Modules C1-C4 and D: End-of-life (EOL)

The product is obliged to be professionally recycled in accordance with the EU Directive 2012/19/EU on waste of electric and electronic equipment (WEEE). The End of Life scenario is based on a material split and respective recycling rates. In the applied scenario, all electronic parts are assumed mainly to be recycled, plastics may be incinerated. The remaining parts are landfilled. The energy required for treatment of materials (e.g. shredding processes) is included. LED modules are disposed by the user (assumed 100% of products is collected. The collected end of life elements are disassembled with electronic parts (like diodes) going to recycling. Non-recycled content is disposed to the municipal waste stream or energy recovery where it undergoes separation, preparation and treatment according to the average European statistics. In the adapted end-of-life scenario, the de-constructed products are transported to recycling plant 120 km on > 10t lorry EURO 5. The recycling potential of materials is presented in table 4. Module D presents credits resulting from the recycling of the electronic elements, and energy recovered. The reused components made from virgin materials in the product stage, such as the diodes or connectors were assumed to replace similar components from raw materials.

Table 4. End-of-life scenario for the product components.

Material	Recycling %	Landfilling %	Energy recovery %
PCB aluminum	80	10	10
PCB plastic	80	10	10
Diodes	90	10	0
Connectors	80	20	0
Solder	100	0	0
Other	70	20	10

Electricity at end-of-life (module C) has been modelled using an average Polish electricity mix as the location where the product reaches end-of-life is unknown.

### Data collection period

The data for manufacture of the declared products refer to period between 01.01.2020 – 31.12.2020 (1 year). The life cycle assessments were prepared for Poland and Europe as reference area.

### Data quality

The data selected for LCA originate from ITB-LCI questionnaires completed by MST. No specific data collected is older than five years and no generic datasets used are older than ten years. The representativeness, completeness, reliability, and consistency are judged as good. The background data for the processes come from the following resources: (Ozkan 2018, PCB), database Ecoinvent v.3.8 (diodes, connectors, solder paste, cartoon, foil, transport, ESD, aluminium, plastics, and metals) and KOBIZE (Polish electricity mix and combustion factors for fuels). KOBIZE data is supplemented with Coinvents data on the national electricity mix impact where no specific indicator data is provided. Specific (LCI) data quality analysis was a part of the input data verification. The time related quality of the data used is valid (5 years).



## Type III Environmental Product Declaration No. 358/2022

### Assumptions and estimates

The impacts of the representative of the products were aggregated using weighted average.

### Calculation rules

LCA was performed using ITB-LCA tool developed in accordance with EN15804+A2. Emission of greenhouse gases was calculated using the IPCC 2013 GWP method with a 100-year horizon. Emission of acidifying substances, Emission of substances to water contributing to oxygen depletion, Emission of gases that contribute to the creation of ground-level ozone, Abiotic depletion, and ozone depletion emissions where all calculated with the CML-IA baseline method.

### Additional information

Polish electricity mix used is 0.698 kg CO<sub>2</sub>/kWh (KOBiZE 2021). European electricity mix used is 0.430kg CO<sub>2</sub>/kWh (Ecoinvent v3.8, RER). The product is compliant with the European Directive 2015/863 of 31 March 2015 on Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic equipment (RoHS) and regulation (EC) No 1907/2006 on the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH).

The EPD does not give information on release of dangerous substances to indoor air because the horizontal standards on measurement of release of regulated dangerous substances from construction products using harmonised test methods according to the provisions of the respective technical committees for European product standards are not available

## LIFE CYCLE ASSESSMENT (LCA) – Results

### Declared unit

The declaration refers to declared unit (DU) – 1 kg of the products manufactured by MST Sp. z o. o. Sp. k. The following life cycle modules (table 5) were included in the analysis.

Table 5. System boundaries for the environmental characteristic of the LED Modules products.

Environmental assessment information (MD – Module Declared, MND – Module Not Declared, INA – Indicator Not Assessed)																
Product stage			Construction process		Use stage							End of life				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport to construction site	Construction-installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction demolition	Transport	Waste processing	Disposal	Reuse-recovery-recycling potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
MD	MD	MD	MND	MND	MND	MND	MND	MND	MND	MD	MND	MND	MD	MD	MD	MD

## Type III Environmental Product Declaration No. 358/2022

### **The method of converting the environmental impact for any specific/selected LED product**

The LCA impacts in the table 6 are presented per unit mass of products - 1 kg (averaged for all products). In order to convert LCA to a specific product (presented in Table 1), specific product mass should be determined. Then the value of the LCA impact may be found on the proportion of the specific product mass and the impact of 1 kg (table 6).

The mass of the product (if unknown) should be determined from the volume of the product and its density. The volume should be calculated using the dimensions of the specific product provided in table 1 (length, width and thickness).

A first step in conversion process is to multiply the width [mm] \* length [mm] \* thickness [mm] and divide the result by 1000 to obtain the product volume in  $\text{cm}^3$ . To obtain the weight of a specific product in grams, second step is to multiply the calculated volume (in  $\text{cm}^3$ ) by the average density of the product, where the default density may be used approx.  $2.3 \text{ g} / \text{cm}^3$ . Final step to obtain the impact value of a specific product is: specific product mass should be multiplied by the LCA impact values from the table 6 but the obtained values must be divided by a 1000 (because unit conversion from kg to g).

## Type III Environmental Product Declaration No. 358/2022

Table 6. Life cycle assessment (LCA) results of the LED products manufactured by MST – environmental impacts (DU: 1 kg with specified luminous flux 550-2000lm)

Indicator	Unit	A1-A3	B6				C1	C2	C3	C4	D
			2000lm	4000lm	550lm	1100lm					
Global Warming Potential	eq. kg CO <sub>2</sub>	3.82E+01	2.37E+02	4.52E+02	6.02E+01	1.20E+02	6.98E-03	1.56E-03	3.01E-02	1.05E-03	-3.50E+00
Greenhouse potential - fossil	eq. kg CO <sub>2</sub>	9.21E-01	2.15E+02	4.10E+02	5.46E+01	1.09E+02	6.85E-03	1.56E-03	1.66E-02	1.05E-03	-3.45E+00
Greenhouse potential - biogenic	eq. kg CO <sub>2</sub>	9.52E-03	2.59E+01	4.94E+01	6.58E+00	1.32E+01	2.00E-04	9.17E-07	1.85E-02	1.04E-05	-3.51E-02
Global warming potential - land use and land use change	eq. kg CO <sub>2</sub>	2.54E+00	4.95E-01	9.45E-01	1.26E-01	2.52E-01	2.40E-06	8.13E-08	9.35E-06	2.38E-07	-6.29E-03
Stratospheric ozone depletion potential	eq. kg CFC 11	4.93E-08	1.05E-05	2.00E-05	2.66E-06	5.32E-06	1.40E-10	3.54E-10	9.15E-10	5.25E-10	-1.48E-07
Soil and water acidification potential	eq. mol H+	1.16E-01	1.10E+00	2.10E+00	2.80E-01	5.60E-01	7.60E-05	8.13E-06	4.40E-04	1.03E-05	-3.95E-02
Eutrophication potential - freshwater	eq. kg P	8.96E-04	2.31E-01	4.41E-01	5.88E-02	1.18E-01	1.30E-05	-1.81E-08	4.69E-06	6.50E-08	-3.55E-03
Eutrophication potential - seawater	eq. kg N	1.35E-03	2.09E-01	3.99E-01	5.32E-02	1.06E-01	1.10E-05	2.92E-06	4.35E-05	3.93E-06	-4.96E-03
Eutrophication potential - terrestrial	eq. mol N	1.26E-02	1.76E+00	3.36E+00	4.48E-01	8.96E-01	9.30E-05	3.33E-05	3.40E-04	4.25E-05	-4.54E-02
Potential for photochemical ozone synthesis	eq. kg NMVOC	3.27E-03	4.90E-01	9.35E-01	1.25E-01	2.49E-01	2.60E-05	8.54E-06	9.35E-05	1.23E-05	-1.17E-02
Potential for depletion of abiotic resources - non-fossil resources	eq. kg Sb	1.32E-04	5.14E-04	9.81E-04	1.31E-04	2.62E-04	3.34E-08	3.35E-10	3.51E-07	2.08E-09	-5.40E-04
Abiotic depletion potential - fossil fuels	MJ	1.09E+01	4.59E+03	8.77E+03	1.17E+03	2.34E+03	1.16E-01	1.56E-03	1.54E-02	3.35E-02	-4.28E+01
Water deprivation potential	eq. m <sup>3</sup>	3.65E-01	1.22E+02	2.33E+02	3.11E+01	6.22E+01	2.40E-03	2.92E-05	5.40E-03	1.25E-04	-1.45E+00



## Type III Environmental Product Declaration No. 358/2022

Table 8. Life cycle assessment (LCA) results of the LED modules products manufactured by MST - the resource use (DU: 1 kg)

Indicator	Unit	A1-A3	B6				C1	C2	C3	C4	D
			2000lm	4000lm	550lm	1100lm					
Consumption of renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.28E+00	8.03E+02	1.53E+03	2.04E+02	4.09E+02	8.60E-03	6.04E-05	1.31E-02	6.75E-04	-5.08E+00
Consumption of renewable primary energy resources used as raw materials	MJ	6.51E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-2.67E-01
Total consumption of renewable primary energy resources	MJ	1.35E+00	8.03E+02	1.53E+03	2.04E+02	4.09E+02	8.60E-03	6.04E-05	1.31E-02	6.75E-04	-5.34E+00
Consumption of non-renewable primary energy - excluding renewable primary energy sources used as raw materials	MJ	1.19E+01	4.59E+03	8.77E+03	1.17E+03	2.34E+03	1.16E-01	2.16E-02	8.99E-02	3.35E-02	-4.42E+01
Consumption of non-renewable primary energy resources used as raw materials	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Total consumption of non-renewable primary energy resources	MJ	1.19E+01	4.59E+03	8.77E+03	1.17E+03	2.34E+03	1.16E-01	2.16E-02	8.99E-02	3.35E-02	-4.42E+01
Consumption of secondary materials	kg	1.88E-03	3.52E-01	6.72E-01	8.96E-02	1.79E-01	1.06E-05	9.38E-07	1.46E-04	6.93E-06	6.42E-01
Consumption of renew. secondary fuels	MJ	5.51E-04	1.82E-03	3.47E-03	4.62E-04	9.24E-04	5.91E-08	1.21E-08	1.20E-05	2.18E-07	-2.25E-03
Consumption of non-renewable secondary fuels	MJ	2.21E-04	5.16E+00	9.86E+00	1.31E+00	2.63E+00	9.39E-05	0.00E+00	0.00E+00	0.00E+00	-2.21E-04
Net consumption of freshwater	m <sup>3</sup>	9.91E-03	3.85E+00	7.35E+00	9.80E-01	1.96E+00	3.15E-05	7.71E-07	1.25E-04	4.00E-05	-3.96E-02

## Type III Environmental Product Declaration No. 358/2022

Table 9. Life cycle assessment (LCA) results of the LED modules products manufactured by MST – waste categories (DU: 1 kg)

Indicator	Unit	A1-A3	B6				C1	C2	C3	C4	D
			2000lm	4000lm	550lm	1100lm					
Hazardous waste	kg	6.70E-02	1.60E+01	3.05E+01	4.06E+00	8.12E+00	1.20E-06	6.04E-06	1.15E-03	2.50E-06	-2.69E-01
Non-hazardous waste	kg	1.87E+00	1.03E+03	1.97E+03	2.63E+02	5.26E+02	6.24E-05	7.92E-05	3.49E-02	2.50E-01	-7.52E+00
Radioactive waste	kg	2.21E-05	7.04E-03	1.34E-02	1.79E-03	3.58E-03	8.70E-08	1.21E-6	4.10E-07	1.50E-09	-2.61E-05
Components for re-use	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Materials for recycling	kg	8.91E-05	3.29E-02	6.29E-02	8.39E-03	1.68E-02	1.20E-07	3.67E-08	7.80E-01	5.35E-08	-3.53E-04
Materials for energy recovery	kg	4.16E-06	2.81E-05	5.37E-05	7.15E-06	1.43E-05	1.05E-09	3.75E-10	1.45E-08	2.21E-04	-1.69E-05
Exported Energy	MJ	2.12E-01	3.85E+01	7.35E+01	9.80E+00	1.96E+01	3.46E-04	6.46E-06	2.80E-02	5.00E-05	-8.61E-01

## Type III Environmental Product Declaration No. 358/2022

### Verification

The process of verification of this EPD is in accordance with ISO 14025 and ISO 21930. After verification, this EPD is valid for a 5-year-period. EPD does not have to be recalculated after 5 years, if the underlying data have not changed significantly.

The basis for LCA analysis was EN 15804 and ITB PCR A	
Independent verification corresponding to ISO 14025 (sub clause 8.1.3.)	
<input checked="" type="checkbox"/> external	<input type="checkbox"/> internal
External verification of EPD: Halina Prejzner, PhD. Eng.	
LCA, LCI audit and input data verification: Michał Piasecki, PhD., D.Sc., Eng.	
LCA verification: Justyna Tomaszewska, PhD. Eng.	

Note: The declaration owner has the sole ownership, liability, and responsibility for the declaration. Declarations within the same product category but from different programmes may not be comparable. Declarations of construction products may not be comparable if they do not comply with EN 15804. For further information about comparability, see EN 15804 and ISO 14025

  
dr hab. inż. Michał Piasecki

**KIEROWNIK**  
Zakładu Fizyki Ciepłej, Akustyki i Środowiska  
  
dr inż. Agnieszka Winkler-Skalna

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- ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services
- ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines
- ISO 15686-1:2011 Buildings and constructed assets – Service life planning – Part 1: General principles and framework
- ISO 15686-8:2008 Buildings and constructed assets – Service life planning – Part 8: Reference service life and service-life estimation
- EN 15804:2012+A2:2019 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
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- Ozkan, Elif & Elginöz, Nilay & Germirli Babuna, Fatos. (2018). Life cycle assessment of a printed circuit board manufacturing plant in Turkey. Environmental Science and Pollution Research, 2018
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- World Steel Association 2017 Life Cycle inventory methodology report for steel products

**Instytut Techniki Budowlanej**

00-611 Warsaw, Filtrów 1

**Thermal Physics, Acoustics and Environment Department**

02-656 Warsaw, Ksawerów 21

# **CERTIFICATE № 358/2022**

## **of TYPE III ENVIRONMENTAL DECLARATION**

Product:

**LED modules linear, rectangular, round and other shapes on flat printed circuits made of plastic and aluminium**

Manufacturer:

**MST Sp. z o.o. Sp. k.**

ul. Chrobrego 8, 11-400 Kętrzyn, Poland

confirms the correctness of the data included in the development of  
Type III Environmental Declaration and accordance with the requirements of the standard

**EN 15804****Sustainability of construction works.****Environmental product declarations.****Core rules for the product category of construction products.**

This certificate, issued for the first time on 23<sup>rd</sup> August 2022 is valid for 5 years  
or until amendment of mentioned Environmental Declaration

Head of the Thermal Physic, Acoustics  
and Environment Department

  
Agnieszka Winkler-Skalna, PhD

Deputy Director  
for Research and Innovation

  
Krzysztof Kućzyński, PhD

Warsaw, August 2022