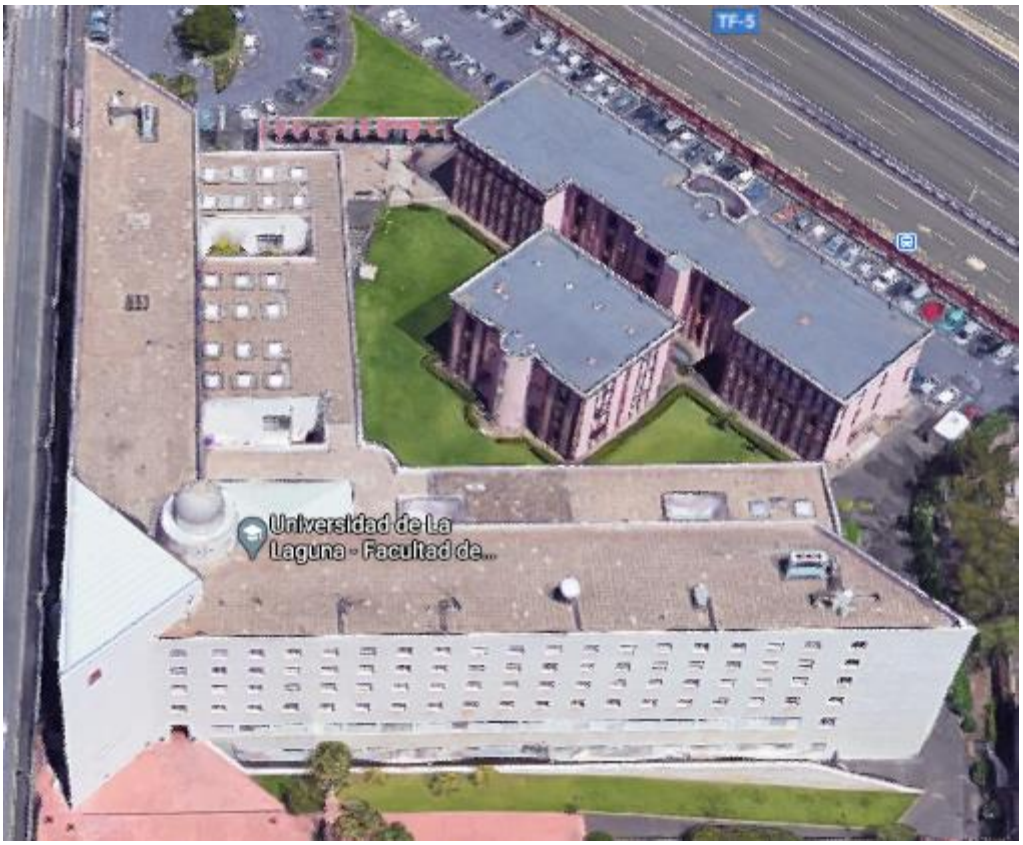
PHOTOVOLTAIC PLANT ON ROOFS OF THE SECTION OF PHYSICS AND MATH OF UNIVERSIDAD DE LA LAGUNA



Máster en Energías Renovables

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06, September 2020

Universidad de La Laguna

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ABSTRACT

The aim of this project is to describe the engineering aspects related to the execution of the 262,58 kWp/212 kWn photovoltaic installation on roofs that form the Physics and Mathematics Section. This photovoltaic plan will help reduce CO2 emissions and will achieve economic savings to the University of La Laguna,.

This project will use materials capable of optimizing the installation at its highest level, with modules of maximum efficiency and guarantee and with inverters that use optimizer technology, which reduces losses by shading, dirt or breakage of some module, in addition to obtaining the highest performance of each module running each of the optimizers with an mppt.

The results are very favourable, a photovoltaic plant that it can be amortized in 6 years and that provides savings of around 38,000 euros annually.

1. DESCRIPTIVE MEMORY

1.1. Background and Object of the Project

1.1.1. Background

The University of La Laguna has the mission of Promoting the social, cultural and economic development of the Canary Islands from knowledge, this public institution is composed of more than 25,000 people, among students, faculty and administration and services staff.

Its degree catalogue covers 45 Degrees, 21 Official Masters in Extinction and 30 in force, 52 Doctoral Programs and 25 Own Degrees. In addition, there are a total of 17,813 students enrolled in bachelor's degrees and 2918 in extinguishing degrees.

The ULL is in a process of internal renewal in which new information technologies and telematics education will be enhanced, centralized in its Virtual Teaching Unit.

In addition, this institution participates in the development of the Canary Islands energy transition plan that will focus on the decarbonisation of the economy following as a reference the objectives set by the European Union for the period 2021-2030, in the climate and energy sector

- 40% reduction in greenhouse gas emissions compared to 1990
- 32% share of renewable energy
- 32.5% improvement in energy efficiency

For this reason, it is proposed to carry out a photovoltaic installation on the roofs of the buildings that make up the physics and mathematics section of the University of La Laguna, providing renewable energy and an improvement of the energy efficiency of this section of the University of La Laguna, in addition to reducing the emission of greenhouse gases.

This installation will have a photovoltaic power of 262,58 kWp/212 kWn and will annually produce:

- 458,11 MWh of electric energy
- Reduction of 121,4 T CO2
- Equivalence to plant 5576 trees

1.1.2. Project Object

This project aims to clearly and sufficiently describe the engineering aspects related to the execution of the 262,58 kWp/212 kWn photovoltaic installation on roofs that form the physics and mathematics section, which are located on consolidated urban land. This photovoltaic installation will be owned by the University of La Laguna.

1.2. Installation Owner

University of La Laguna
CIF: Q3818001D

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1.3. Project Editor

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1.4. Situation and Location

The photovoltaic installation is located on the roofs of the buildings that make up the physics and mathematics section belonging to the faculty of science of the University of La Laguna.

This section is located in Av. Astrofísico Francisco Sánchez, S/N, 38206 in the Municipality of San Cristóbal de La Laguna, province of Santa Cruz de Tenerife.

The UTM coordinates of the midpoint of the photovoltaic plant are as follows:

- X: 370735,8 m
- Y: 3151317,6 m
- Bands: 28, R

1.5. Description of Building or Local Activity

The photovoltaic installation that is projected will be located on the different buildings that make up the physics and mathematics section of the ULL.

These buildings are dedicated to the teaching, research activity in laboratories and offices and various services such as library, computer rooms and dining room.

Due to the design of the roofs of these buildings there is a large area for the use of these for the production of electrical energy through the implementation of a photovoltaic system.

The roof with the largest flat surface is that of the main building of the physics and mathematics section, this building has a wing facing south and another wing to the east.

This building has two different heights, this has been taken into account, to avoid the shadows produced by the roofs at higher altitudes.

The surface available to locate the photovoltaic plant on the highest deck is 1659.05 m2, while, for lower-height roofs, for shading and obstacles over the roof, the available space is reduced to 376.26 m2.

The next largest available roof is the pumpkin building, with a height of 3 floors and an area of 771.52 m2.

Finally, the smallest roof is that of the building annexed to the pumpkin building, which has an altitude of 2 floors and an area of 264.49 m2.

All of them result in an area of 3071.32 m2 sufficient for the realization of a photovoltaic installation of 262.58 kWp.

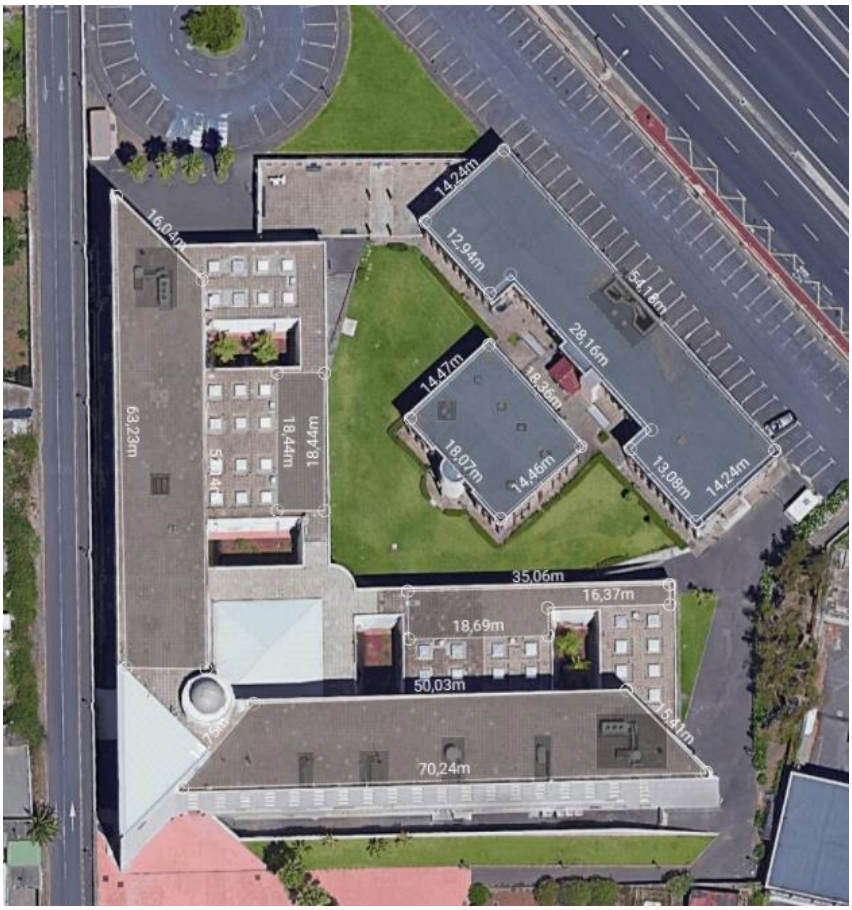


figure 1: dimensions of the roofs used for the photovoltaic plant

1.6. Applied Regulations

The regulations to be considered for the realization of a photovoltaic installation on deck are as follows:

- Real Decreto 244/2019, de 5 de abril, por el que se regulan las condiciones administrativas, técnicas y económicas del autoconsumo de energía eléctrica.

- Ley 24/2013 de 26 de diciembre, del sector eléctrico.
- Real Decreto 1955/2000, de 1 de diciembre, por el que se regulan las actividades de transporte, distribución, comercialización, suministro y procedimientos de autorización de instalaciones de energía eléctrica.
- Ley 82/1980, de 30 de diciembre, sobre Conservación de la Energía.
- Ley 21/1992, de 16 de julio, de Industria.
- Ley 31/1995, de 8 de noviembre, de Prevención de Riesgos Laborales.
- Real Decreto 2200/1995, de 28 de diciembre, por el que se aprueba el Reglamento de la infraestructura para la calidad y la seguridad industrial.
- Real Decreto 485/1997, de 14 de abril, sobre disposiciones mínimas en materia de señalización de seguridad y salud en el trabajo.
- Real Decreto 773/1997, de 30 de mayo, sobre disposiciones mínimas de seguridad y salud relativas a la utilización por los trabajadores de equipos de protección individual.
- Real Decreto 1627/1997, de 24 de octubre, por el que se establecen disposiciones mínimas de seguridad y de salud en las obras de construcción.
- Ley 54/1997, de 27 de noviembre, del Sector Eléctrico.
- Real Decreto – Ley 15/2018, de 5 de octubre, de medidas urgentes para la transición energética y la protección de los consumidores.
- Ley 11/1997, de 2 de diciembre, de regulación del Sector Eléctrico Canario.
- Resolución de 31 de mayo de 2001 por la que se establecen el modelo de contrato tipo y modelo de facturas para instalaciones solares fotovoltaicas conectadas al a red de baja tensión.
- Real Decreto 614/2001, de 8 de junio, sobre disposiciones mínimas para la protección de la salud y seguridad de los trabajadores frente al riesgo eléctrico.
- Reglamento Electrotécnico para Baja Tensión (REBT), aprobado por el RD 842/2002, de 2 de agosto, del Ministerio de Ciencia y Tecnología.
- Ley 51/2002, de 27 de diciembre, de reforma de la Ley 39/1988, de 28 de diciembre, Reguladora de las Haciendas Locales.
- Real Decreto-Ley 2/2003, de 25 de abril, de medidas de reforma económica.
- Real Decreto 436/2004, de 12 de marzo, por el que se establece la metodología para la actualización y sistematización del régimen jurídico y económico de la actividad de producción de energía eléctrica en régimen especial.
- Real Decreto 314/2006, de 17 de marzo, por el que se aprueba el Código Técnico de la Edificación.

- Real Decreto-Ley 7/2006, de 23 de junio, por el que se adoptan medidas urgentes en el sector energético.
- Orden de 25 de mayo de 2007 (B.O.C. número 121, de 18 de junio de 2007), por la que se regula el procedimiento telemático para la puesta en servicio de instalaciones eléctricas de baja tensión.
- Real Decreto 1110/2007, de 24 de agosto, por el que se aprueba el Reglamento unificado de puntos de medida del sistema eléctrico.
- Decreto 141/2009, de 10 de noviembre, por el que se aprueba el Reglamento por el que se regulan los procedimientos administrativos relativos a la ejecución y puesta en servicio de las instalaciones eléctricas en Canarias.
- Resolución de la Dirección General de Energía del Gobierno de Canarias, de febrero de 2010, sobre tarado de desconexión por mínima frecuencia en instalaciones fotovoltaicas conectadas a red.
- Real Decreto 1699/2011, de 18 de noviembre, por el que se regula la conexión a red de instalaciones de producción de energía eléctrica de pequeña potencia.
- Real Decreto 842/2013, de 31 de octubre, por el que se aprueba la clasificación de los productos de construcción y de los elementos constructivos en función de sus propiedades de reacción y de resistencia frente al fuego.
- Real Decreto 110/2015, de 20 de febrero, sobre residuos de aparatos eléctricos y electrónicos.
- Ley 39/2015, de 1 de octubre, del Procedimiento Administrativo Común de las Administraciones Públicas.
- Real Decreto 187/2016, de 6 de mayo, por el que se regulan las exigencias de seguridad del material eléctrico destinado a ser utilizado en determinados límites de tensión Fomento de la Autogeneración de Energía Eléctrica, aprobado por el RD 907/1982, de 2 de abril.
- Municipal Ordinances of the Municipality of San Cristobal de La Laguna.

1.6.1. Type of Installation According to Regulations

The installation shall be part of the mode of self-consumption installation WITHOUT surpluses which, according to Royal Decree 244/2019, would be "Self-consumption installations connected to the distribution or transport network that have an anti-discharge system (according to ITC-BT-40) such as to prevent the injection of surplus electrical energy into the transport or distribution network."

This installation will be considered as individual self-consumption with connection inside the consumer network.

1.7. Installation Components

1.7.1. Photovoltaic Modules

The installation will consist of 691 LG brand photovoltaic modules, LG38Q1C-V5 (Neon R) or equivalent, monocrystalline silicon with an efficiency of 22%, with dimensions of 1016x1700x40 mm and with a nominal power of 380 Wp (-0/+3)

Positive tolerances of 1.3% ensure power in modules equal to or greater than nominal, while helping to minimize parameter dispersion losses and improve system performance.

figure 2: photovoltaic modules

The most relevant panel technical characteristics are those shown in the table below:

Material/Type	Monocristalino/Tipo N
Manufacturer	LG
Cell Configuration	60 (6x10)
Dimensions Module	1.700 x 1.016 x 40 mm
Weight	17.5 kG
Connection Box	IP68 con 3 Diodos de Bypass
Wiring	1.000 mm x 2EA
Connector	MC4/MC

table 1: general data photovoltaic module

Model	LG380Q1C-V5
Max. Power (Pmax)	380 W
Mpp Voltage (Vmpp)	37,4 A
MPP Current (Impp)	10,17 A
Open Circuit Voltage (Voc)	42,9 V
Short Circuit Current (Isc)	10,84 A
Module Efficiency	22%
Power Tolerance	0% / +3%

table 2: electrical properties of photovoltaic modules under stc conditions

1.7.2. Inverter

1.7.2.1. Photovoltaic Inverter

Several three-phase network connection inverters, SolarEdge, SE17k, SE25K and SE30K models or equivalents, will be available for conversion of DC current from photovoltaic modules to AC.

figure 3: photovoltaic inverter

For Inverter, the characteristics are:

MODELO	SE17K	SE25K	SE30K
SALIDA			
Nominal Power	17000 VA	25000 VA	30000 VA
AC Output Voltage	380/220; 400/230 Vac		
AC Frequency	50/60 Hz		
ENTRADA			
Max. DC Power	22950 W	33750 W	45000 W
Without Transformer	Si		
Maximum Input Voltage	900 Vdc		
Nominal DC input voltage	750 Vdc		
Maximum input current	23 Adc	27 Adc	43,5 Adc
Maximum Inverter Efficiency	98,00%	98,30%	
European Weighted Efficiency	97,70%	98,00%	98,00%

table 3: characteristics of photovoltaic inverter

1.7.2.2. Optimizers

SolarEdge inverter technology, unlike other inverters on the market that monitor and operate through strings, it makes use of optimizers, which allow monitoring and operation at the module level. Compared to conventional technology, each optimizer functions as an mppt tracker for each photovoltaic module, thus resulting in an optimization of the performance of the photovoltaic plant, the optimizers to be used will be those of the Solaredge brand, model P801, these optimizers allow the connection of two modules for each optimizer.

figure 4: optimizer p801

The most noteworthy features of this optimizer are the following:

SALIDA	
Maximum Output Current	15 Adc
Maximum Output Voltage	85 Vdc
ENTRADA	
Rated Imput DC Power	800 W
Absolute Maximum Input Voltage	125 Vdc
MPPT Operating Range	12,5-105 Vdc
Maximum Short Circuit	11,75 Adc
Maximum Efficency	99,50%
Weighted Efficiency	98,60%

table 4: technical features optimizer p801

1.7.3. Monitoring

Monitoring of the photovoltaic installation will be carried out through the manufacturer's internet portal or equivalent, by connecting the inverter to the customer's internal communications network.

1.7.4. Support Structure

The support structure is the element responsible for attaching the photovoltaic modules to the cover and providing them with the appropriate inclination with respect to the horizontal plane to maximize the use of solar radiation.

Photovoltaic modules are installed on a concrete structure of the brand SOLARBLOC. It is characterized by being reinforced concrete, has a high resistance to chemical and atmospheric agents granting it great durability. On the other hand, these structures counteract the wind loads that can originate on the modules installed on it.

figure 5: concrete structure

L The orientation in which the structure will be placed will vary depending on the cover where the photovoltaic modules are placed.

In the case of the roofs of the physics and mathematics building the structure will be 0ºS with an inclination of 15º with respect to the horizontal.

While in the case of the pumpkin building and its annex building, the orientation of the structure will be 48ºS and 15º with respect to the horizontal.

figure 6: distribution of modules on roofs

The structure will comply with the regulations and comply with the moments of resistance to overturning and displacement.

For added safety, a WEBER FLEX PU or similar adhesive cord will be applied between the block and the surface where it will be installed, in order to increase the strength of the structure.

1.7.5. Wiring

Installation in all areas of Wiring, guards, tubes and other factors relating to interconnection elements shall comply with the low voltage electrotechnical regulation. Calculations and sizing have been carried out in accordance with that regulation.

All conductors will be copper, and their section will be sufficient to ensure that voltage drops in cables, splices and protective boxes are less than 1.5% of the system's working voltage in any operating condition.

1.7.5.1. DC Wiring

All continuous wiring shall be double insulated and suitable for outdoor, air or buried use in accordance with UNE 21123.

Class 5 insulated class ZZ-F, PRYSMIAN brand, P-SUN 2.0 or equivalent, with insulation voltage 0.6/1KV, 1x10mm2 section that are indicated for your electrical power generation installations based on photovoltaic solar energy, shall be used to be installed indoors or outdoors, both in fixed and mobile installation.

Wires from the end of each string to the end of each row of modules will run into the air, subject to the module frame.

Connections shall be watertight, using Multi-Contact MC4 or equivalent terminals, splices, connections, systems and devices with IP65 degree of protection in accordance with current regulations on outdoor installations as specified in the ITC BT-30.

The wiring will be held behind the modules and in PVC corrugated tube brand LEXMAN of O25 mm, resistant to UVA rays, according to UNE-EN 50085, while running on cover, false ceilings and areas not visible.

In the event that the wiring runs, in visible areas 60x40mm PVC gutter resistant to UVA rays was used, according to UNE-EN 50085, brand Legrand or equivalent.

1.7.6. Cableado corriente alterna (CA)

1.7.6.1.1. Inverter – Photovoltaic Alternating Current Protection Box

Flexible insulated copper cable of type RV-K, Prysmian brand, Retanax Flex model or equivalent, with insulation voltage 0.6/1 kV, 50mm2 section according to UNE 21123, being lying under PVC tray with watertight lid of 100x75 mm resistant to UVA rays, according to UNE-EN 50085.

1.7.6.1.2. Photovoltaic Alternating Current Protection Box – Electric busbar

Flexible insulated copper cable of type RV-K, Prysmian brand, Retanax Flex model or equivalent, with insulation voltage 0.6/1 kV, 50mm2 section according to UNE 21123, being lying under PVC tray with watertight lid of 60x40 mm resistant to UVA rays, according to UNE-EN 50085.

1.7.6.1.3. Electric Busbar – Section of Physics and Mathematics Protections Overview

Flexible insulated copper cable of type RZ1-K, Prysmian brand, Protech Evolution Cca model or equivalent, with insulation voltage 0.6/1 kV, 400 mm2 section according to UNE 21123, being lying under PVC tray with watertight lid of 60x40 mm resistant to UVA rays, according to UNE-EN 50085.

1.7.6.2. Grounding

The grounding facility shall comply with itc-BT-18 and Article 15 of Royal Decree 1699/2011 of 18 November. It shall consist of a protection conductor of type RV-K (AS) 0.6/1 kV Cu 10 mm2, prysmian brand, Retanax model or equivalent, in accordance with UNE21123, which will join the photovoltaic modules together, a protection conductor of type RV-K Cu 25 mm2, brand Prysmian model Retanax or equivalent, for the additional grounding of the photovoltaic inverter and for protection, in accordance with standard 21123, for the protection driver of the terminal box of the photovoltaic inverter.

The main ground line shall consist of a conductor of type RV-K 0.6/1kV Cu 200 mm2, Prysmian brand, Retanax model or equivalent, in accordance with UNE21123, which will be attached to a grounding composed of polypropylene arch with fence and registration cap (screwed) casting, verification bridge, 150

mm2 bare copper cable as ground conductor and copper steel pike for grounding.

1.7.6.3. Photovoltaic DC Protections

To accommodate the output line protections of the strings of the photovoltaic modules, an envelope will be provided for each inverter, next to this one with IP65 degree of protection. The selected enclosure is of the brand ABB, model MISTRAL65 or equivalent, with transparent front cover and dimensions of 320x435x155 mm.

The following protection elements shall be provided inside the enclosure:

- Two fuses for each string of modules that connect to the inverter inputs, one for the line that brings the positive of the string and one for the negative of the line carrying the negative of the string, the chosen brand is Phoenix Contact, model FUSE 10, 3x85 or equivalent.

Nominal Current	16 A
Nominal Voltage	1500 V DC
Regulation	IEC 60269-6
Type	Cilíndrico
Dimensions	10.3x85 mm

table 5: fuse characteristics

- Lightning currents, type 1 and 2 surge discharger, Phoenix Contact brand and Val-MB-T1-T2-PV model.

Maximum Voltage	1500 V DC
Short-Circuit Resistance	2000 A
Level of Protection	< 4,5 kV
Reaction Time	< 25 ns
Regulation	EN 50539-11 2013

table 6: type 1 and 2 surge discharger features

1.7.6.4. Enveloping Alternating Current Protections of photovoltaics

To accommodate the protections of the output line of the photovoltaic inverter, an envelope will be provided for each inverter, along with a degree of protection IP65. The selected enclosure is of the brand ABB, model MISTRAL 65 or equivalent, with transparent front cover and dimensions of 320x435x155 mm.

The following protection elements will be provided inside the enclosure:

- Magnetothermal switch, Scheneider Electric brand, Acti 9 iC40 model or equivalent

Nominal Current	100 A
Curve Code	C
Cutting Power	10 kA acorde a EN/IEC 60898-1
Number of Poles	3P+N
Sectioning power	According to EN/IEC 60947-2

table 7: automatic switch features

- Differential switch, Scheneider Electric brand, Vigi C120 model

Nominal Current	125 A
Protection Class	A
Sensitivity	300 mA
Number of Poles	4P
Standard	EN 61009

table 8: diferential switch features

1.7.6.5. General Automatic Switch in General Protections Box

In the general table of protections where the photovoltaic installation will be connected, considering that this is the main table from the counter associated with the Physics and Mathematics Section and therefore, will serve the other subframes connected to it, an automatic general switch will be installed, whose function is to completely disconnect the photovoltaic plant, in case of short circuit to protect the equipment that composes it.

The features of the automatic general switch, Schneider Electric brand, NSX630N 4P4D model, or equivalent are:

Nominal Current	630 A
Nominal Voltage	690 V
Cutting Power	50 kA acorde a EN/IEC 60947-2
Number of Poles	4P
Sectioning Power	Si acorde a EN/IEC 60947-2

table 9: features automatic general switch

1.8. Solution Adopted

Photovoltaic modules have been distributed on the cover as set out in the accompanying graphic documentation. These modules shall be installed on the structure with the inclination and orientation shown in the table. The separation between rows of the modules has been calculated to ensure that there are no shadows in the photovoltaic plant.

Although, for the latitude in which the photovoltaic installation is located, the ideal inclination differs, the inclination of the table has been chosen, the performance losses are less than 1% compared to the ideal one and in this way the sail effect is reduced and allows us a greater photovoltaic power capacity.

With regard to the deviation in orientation in the pumpkin building and its annex building, this solution has been adopted as it allows the installation of a greater number of photovoltaic modules, simplifies installation and maintenance work and, losses in solar radiation capture are well compensated by the increase in power and, therefore, electricity generation.

Instalación Solar Autoconsumo				
Photovoltaic Plant	Photovoltaic Modules	Brand	LG	Power
		Model	NEON R LG38Q1C-V5	**262,6 kW$_p$**
		Nº Modules	691	
		Power	380 W$_p$	
	Inverters	Brand	Solaredge	Nº Inverters
		Model	SE17K	1
			SE25K	3
			SE 30K	4
		Power	212 kWn	
	Structure	Type	Concrete	
		Tilt	15º	
		Orientation	Varios	

table 10: solution adopted

1.9. Implementation Program

The implementation phases of the project are as follows:

- Collection of the material
- Rethinking the support structure
- Placement of the support structure
- Mounting photovoltaic modules
- Placement of the photovoltaic inverter and the AC protection envelope.
- Placing pipelines on deck
- DC and AC wiring
- Grounding wiring
- Performing operational tests
- Construction direction

1.10. Documentation

For the authorization of the photovoltaic installation of this project, the following administrative procedures will be carried out:

- Run photovoltaic installation
- Application for commissioning at the Industry Ministry

2. CALCULATION MEMORY

2.1. Setting up the Photovoltaic System

In this section, the electrical distribution of the photovoltaic modules to be placed in the input strings to the inverter shall be calculated and defined. The optimal electrical configuration will be sought to compatibilized the components of the photovoltaic installation and thus ensure its operation as a generator. The electrical characteristics of the modules are found in the tables 1 and 2 and will be those used for calculation.

2.1.1. Strings

Photovoltaic generators have their maximum voltage at the beginning of the day, when irradiance is low and room temperature is minimal. It is at this time of day that it is reasonable to assume that the temperature of the module cells will match the ambient temperature.

In order to calculate the maximum number of modules that can be attached in series, it will be considered, as mentioned above, that the start of the day will be the start of the inverter start and, therefore, the start will start with the open circuit point of the generator.

For parallel modules we must take into account that it depends on the maximum current, which in turn depends on the irradiance at the chosen location. The technical characteristics of the panel are calculated with standard module measurement conditions for irradiance values of 1000 W/m2, ambient temperature of 25 ºC and an Air Mass (AM) of 1.5. However, these values in CEM do not have to match the actual site values.

IEC 60364-7-712 states that the design of the components of a photovoltaic system must be sized for 125% of the expected short-circuit current. The maximum current will depend on irradiance, so the photovoltaic installation should be sized considering an irradiance of 25% greater than those specified in EMU and therefore 1250 W/m2.

In the case of the technology of the inverters used, which instead of operating like the rest of traditional inverters, by strings lines. These work by using optimizers in each module, acting as individual mppts.

Therefore, the module string of each inverter must respect the power, intensity, and voltage of each optimizer. The optimizers will then adjust these parameters so that the total string, produces at any moment the maximum power allowed, taking into account the maximum voltage and intensity values of the inverter.

To know the total value of modules in series and parallel, we will take into account the characteristics of the modules and optimizers, found in tables 2 and 5, respectively.

According to the data sheet of the optimizers and photovoltaic modules.

OPTIMIZERS	
Maximum String Power (Pmax)	13.500 W
Maximum Input Current (Imax)	11,75 A
Absolute Maximum Voltage (Vmax)	125 Vdc

Photovoltaic Modules	
Maximum Power (Pmod)	380 W
Short-circuit current (Isc)	10,84 A
Open Circuit Voltage (Voc)	42,9 Vdc

table 11: data for strings calculation

Total modules by string: $\frac{Pmax}{Pmod} = \frac{13.500}{380} = 35{,}52 \cong 35$

Maximum modules per optimizer: $\frac{Vmax}{Voc} = \frac{125}{42{,}9} = 2{,}91 \cong 2$

Maximum modules in parallel per optimizer: $\frac{Imax}{Isc} = \frac{11{,}75}{10{,}84} = 1{,}08 \cong 1$

Consequently, we get that the longest string that can be made per inverter is 35 modules in series, where each optimizer will control two modules, reaching a total of 18 optimizers and with the impossibility of paralleling between them.

Taking this configuration into account, we perform the string configuration shown in the PLANES section of this project.

2.2. Distance between Modules

To avoid the projection of shadows on photovoltaic modules, the necessary separation between rows of modules or between a row and an obstacle that may exist on the roof (parapets, chimneys, tanks, stairs, etc.) will be saved.

The minimum distance d, measured on the horizontal, between rows of modules or between a row and an obstacle of height h that can cast shadows, must be at least equal to h*k, with k being a dimensional factor to which, in this case, the value of 1/tan(61° – latitude).

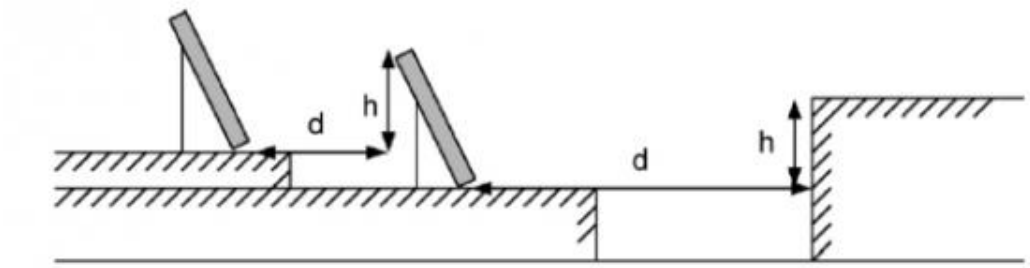


figure 7: representation of distance between photovoltaic modules and obstacles on roofs

In the case that we are occupied, for the latitude of the place we have the following elements that can cause shadows on the photovoltaic modules:

Cover/skylight parapet.

Parapet/skylight height (h): 0.79 m

Minimum spacing (d): 0.63 m

Parapet/skylight height (h): 1.00 m

Minimum spacing (d): 1.57 m

The arrangement of the modules has been established avoiding any shadow projection that may cause production or safety problems in the plant.

The minimum distance for vertical modules with an inclination of 15o at the latitude of the site is 0.69 m, with the chosen separation of 0.7 m is sufficient.

2.3. Fixing Structure Support

The type of anchorage for a photovoltaic module will depend on its location and the forces acting on it as a result of the wind pressure to which it is subjected. The action of the wind that poses a risk is that which exerts traction forces, which will always be more dangerous than compression forces.

To perform the necessary ballast sizing, reference has been made to the worst weather condition recorded in the municipality of Las Palmas. According to the State Meteorology Agency (AEMET), this corresponds to a storm on 28 December 2005 in which wind gusts of up to 113km/h (31.4m/s) were recorded. Although, for added safety, we will take a maximum value of 130 km/h(45m/s).

The following figure depicts the force exerted by the wind:

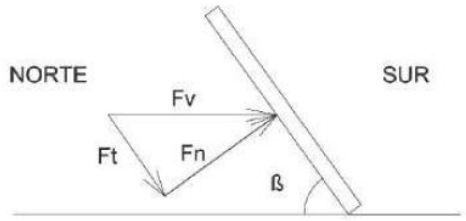


figure 8: wind force (fv: wind force, fn: normal wind force, ft: tangential wind force, β: tilt angle)

The component normal to the photovoltaic module will be determined as it is the one that really affects the stability of the structure. To calculate this force we will make use of the following expression:

$$F_n = P * S * sin^2\beta$$

Where:

P: Wind pressure (N/m2)
S: Surface affected by wind force (m2)

The following expression is used for the calculation of wind pressure:

$$P = \frac{g}{16} * v^2$$

Where:

g: gravity acceleration (m/s2)
v: wind speed (m/s)

It calculates the baling of the support structure of the photovoltaic modules, after discounting the weight of the photovoltaic module and that of the structure, and introducing a safety factor

STRUCTURE	
S	1,72 m2
β	15º
g	9,81 m/s2
v	45 m/s
P	1241,58 N/m2
Fn	143,65 N

table 12: wind loads

It will not be necessary to place ballast to the structure, since, the concrete blocks already meet the requirements to avoid slipping and overturning.

2.3.1. Checking the Cover Resistance

The roof is reinforced concrete and according to building standards, it corresponds to an "use overload" of 100kg/m2. As the photovoltaic installation weighs about 71.7 kg/m2, it can be concluded that the reinforced concrete structure of the roof has sufficient strength for the installation of the projected photovoltaic system.

2.4. Wiring

All conductors will be copper, and their section will be sufficient to ensure that voltage drops in cables, splices and protective boxes are less than 1.5% of the system's working voltage in any operating condition.

The initial minimum section of the cable will be calculated for each cable length considered and based on the maximum assigned voltage drop, using the following expressions:

For direct current stretch Strings to String Box or inverter:

$$S = \frac{(Return + 2L) * p_{90} * I_{máx}}{\delta(\%) * U}$$

For dc current:

$$S = \frac{2L * p_{90} * I_{máx}}{\delta(\%) * U}$$

For three-phase alternating current:

$$S = \frac{\sqrt[2]{3} * L * p_{90} * I_{máx}}{\delta(\%) * U}$$

Where:

S: Cable section (mm2)
Return: Return cable length in the section under consideration
L: Longitud del cable (m2)

Imax: expected maximum intensity in the section under consideration (A)
p_{90}: Copper resistivity at 90ºC
$\delta(\%)$: Wire voltage drop
U: Nominal Voltage (V)

2.5. Continuous Current Wiring

Using the equation described above, in the case of string of modules further away from the inverter, therefore, with longer wiring length and the one with the greatest voltage drop will have, that is, the most unfavourable case, we will get the maximum section value in direct current

This string consists of 35 modules in series, with a maximum intensity of 10.84 A and a voltage of 1000 Vdc, the return length of the wiring is 36.66 m and a length of 152.69 m, according to previous equations:

$$S = \frac{(Return + 2L) * p_{90} * I_{máx}}{\delta(\%) * U} = \frac{(36{,}66 + 2 * 152{,}69) * 0{,}0237 * 9{,}78}{1{,}5\% * 1000} = 5{,}285$$

Once the minimum section is found, the immediately higher commercial section cable is chosen and finally the actual voltage drop obtained for that section is calculated. In this case, the immediately higher commercial section is 6 mm2.

With the commercial section established, and operating in the previous equation, we will get the voltage drop for the new section and therefore the electrical losses for this section. In this case it would look like this:

$$\delta(\%) = \frac{(Return + 2L) * p_{90} * I_{máx}}{S * U} = \frac{(36{,}66 + 2 * 152{,}69) * 0{,}0237 * 9{,}78}{6 * 1000} = 1{,}32\%$$

2.6. Alternate Current Wiring

The actual power of a tranche shall be calculated by adding up the installed power of the receivers it feeds, and applying the appropriate concurrency and coefficients imposed by the REBT.

2.6.1. Calculation of Intensities

We will determine the intensity by application of the following expression:

Three-phase distribution:

$$I = \frac{P}{\sqrt{3} * V * cos\,(\varphi)}$$

Where:

V: Composite voltage, between active wires (V)
P: Power (W)
I: Current Intensity (A)
Cos (φ): Power Factor

2.6.2. Section Calculation

Three different methods will be used to calculate and check the cable section:

- Heating
- Limitation of voltage drop in installation (electrical moments)
- Limiting the voltage drop in each section

2.6.2.1. *Heating Calculation*

It shall apply to the heating calculation set out in UNE 20.460-94/5-523. The maximum intensity that must circulate through a cable so that it does not deteriorate is marked by Table 52-C20 of that standard.

The maximum permissible intensity is affected by a number of factors such as ambient temperature, grouping of several cables, sun exposure, etc. which generally reduce their value.

The ambient temperature factor is achieved from tables 52-D1 and 52-N2. The factor per grouping, from tables 52-E1, 52-N3, 52-N4 A and 52-N4 B. If the cable is exposed to the sun, or it is a minerally insulated, bare and accessible cable, we will apply a 0.9 directly. If it is a tube-buried installation, we will apply 0.8 to the values in table 52-N1.

For the calculation of the section, we will divide the calculation intensity by the product of all the corrective factors, and look in the table for the corresponding section for the resulting value. To determine the maximum permissible intensity of the cable, we will look in the same table for the intensity for the adopted section, and multiply it by the product of the corrective factors.

2.6.2.2. Method of Electric Moments

This method will allow us to limit the voltage drop, in the part of the interior installation, to 3.00% for lighting and 5.00% for force. In the case of individual derivation for a single user, the maximum allowable voltage drop will be 1.50%. To run it, we will use the following formula:

Three-phase distribution:

$$S = \frac{\lambda}{K * U_n * \delta};\ \lambda = L_i * P_i$$

Where:

S: Wire Section (mm2)
λ: Virtual Length (m)
K: Conductivity
δ: Voltage Drop (V)
U_n: Phase-Neutral Voltage
L_i: Length from the stretch to the receiver
P_i: Power consumes by the receiver

2.6.2.3. *Voltage Drop*

Once the section is determined, we will calculate the voltage drop in the section by applying the following formulas:

Three-phase distribution:

$$\delta = \frac{P * L}{K * S * U_n}$$

Where:

S: Wire Section (mm2)
K: Conductivity
δ: Voltage Drop (V)
U_n: Phase-Neutral Voltage
L: Length from the stretch to the receiver (m)
P: Calculation power (W)

2.6.3. Section and Voltage Drop

Applying the above three methods, we obtain the values of intensity, section of wiring and voltage drop for the most unfavourable case, the one with the greatest power and wiring length, which will result in the wiring with greater section and we will use this for the rest of the cases, since, it will be worth the same wiring and we will optimize the costs of the installation making use of the economy of scale.

	Power	Voltage	Current	Wires		Voltage Drop	Voltage Drop
				Length	Section		
Wires	**W**	**V**	**A**	**m**	**mm²**	**V**	**%**
From Inverter to CA Protections	30.000	400	93,75	1	50	0,03	0,01
CA Protections to Bus Bar	30.000	400	93,75	124,25	50	4,24	1,06
Bus Bar to General Protections	212.000	400	662,50	1	400	0,03	0,01
TOTAL							1,08

table 13: maximum permissible intensity values, length and section of ac wiring and voltage drop.

2.7. Protections

The protections necessary for the protection of equipment and persons interacting with the photovoltaic installation will be used. Protections are sized by the criterion of intensities:

$$Ic < In < Imáx$$

Where:

Ic: Wire Current
In: Nominal Current
Imax: Maximum Wiring Current

2.7.1. CA Protections

Magnetothermal and differential switches will be available in an enclosure next to the inverter, while an automatic general switch will be installed in the general protection box.

2.7.1.1. Magnetothermal Switch

MAGNETOTHERMAL SWITCH	
Ic (A)	93,75
Imax (A)	188
In (A)	100

table 14: calibre automatic switch

2.7.1.2. Diferential Switch

In the differential switch we will take a sensitivity of 300 mA, suitable for places of public concurrence, and high power installations and machinery, according to low voltage regulations this will be at least type A, this level of protection being enough.

DIFERENTIAL SWITCH	
Ic (A)	93,75
Imax (A)	188
In (A)	125

table 15: calibre differential switch

2.7.1.3. Automatic General Switch

AUTOMATIC GENERAL SWITCH	
Ic (A)	530
Imax (A)	749
In (A)	630

table 16: calibre automatic general switch

2.7.2. DC Protections

Fuses and surge discharger will be available in an enclosure next to the inverter.

2.7.2.1. Fuses

Considering that the maximum string intensity will be the short-circuit intensity of the photovoltaic modules, which is 10.46 A, with 16 A fuses installed, will be sufficient to protect the installation.

2.7.2.2. Type 1 and 2 Surge Discharger

As for the surge discharger has been chosen from 1500 Vdc, since, the strings are limited to 1000 Vdc by the optimizers and a 1000 Vdc surge discharger, would be at its operating limit.

2.8. Calculation of Electric Power Production

2.8.1. Solar Radiation

The sources of radiation data that have been consulted to estimate the energy production of the photovoltaic installation. The data are obtained from:

• Solar map of the Instituto Tecnológico de Canarias (ITC).

The following table presents the horizontal surface global irradiation (IGH) data, extracted from this source.

Horizontal global radiation January (Wh/m2)	3094,3
Horizontal global radiation February (Wh/m2)	4218,5
Horizontal global radiation March (Wh/m2)	5257
Horizontal global radiation April (Wh/m2)	5491
Horizontal global radiation May (Wh/m2)	6348
Horizontal global radiation June (Wh/m2)	6928,8
Horizontal global radiation July (Wh/m2)	6836
Horizontal global radiation August (Wh/m2)	6471,3
Horizontal global radiation September (Wh/m2)	5666,3
Horizontal global radiation October (Wh/m2)	4373,2
Horizontal global radiation November (Wh/m2)	3120,5
Horizontal global radiation December (Wh/m2)	2724,3

table 17: horizontal global irradiation

2.8.2. Losses on Orientation and Tilt

The above irradiation data provide us with horizontal global irradiation (IGH), before applying the tilt and orientation losses of the photovoltaic installation, we need to know the optimal global irradiation (OPTIMUM IG). For the latitude in which the Canary Islands is located (28º), this irradiation corresponds to an optimal angle of inclination of approximately (25º) and south orientation.

IG (kWh/m2)	K (25º)	Optimum IG(kWh/m2)
3,09	1,2	3,71
4,22	1,15	4,85
5,26	1,08	5,68
5,49	1	5,49
6,35	0,95	6,03
6,93	0,93	6,44
6,84	0,95	6,49
6,47	1,01	6,54
5,67	1,09	6,18
4,37	1,19	5,20
3,12	1,25	3,90
2,72	1,24	3,38

table 18: optimal global irradiance

2.8.2.1. *Tilt and Orientation Correction Factor*

Because the layout of the photovoltaic installation is not in the optimal tilt and orientation conditions seen above, it is necessary to know the losses that occur due to the actual orientation and inclination of the installation.

In the installation we find two situations of inclination and orientation.

Orientation: 0ºS ; Tilt: 15º ; Loss factor: 0.1%

Orientation: 48ºSO ; Tilt: 15º ; Loss factor: 2.4%

Based on this factor and the irradiation available in the area, the incident solar irradiation on the facility will be as follows:

	Global Horizontal Raditation (kWh/m2)	
	Orientation 0º, Tilt 15º	Orientation 48º, Tilt 15º
January	3,71	3,64
February	4,85	4,75
March	5,67	5,56
April	5,49	5,38
May	6,02	5,91
June	6,44	6,31
July	6,49	6,36
August	6,53	6,41
September	6,17	6,05
October	5,20	5,10
November	3,90	3,82
December	3,37	3,31

table 19: monthly irradiance values corrected

2.8.2.2. *Installation Performance Ratio*

Known the power of the installation and the incident solar irradiation, also we have to take into account the internal losses that occur in the photovoltaic installation (Shades, dirt, etc) and that are defined in the calculation of the Performance Ratio, value that informs us of the performance of the photovoltaic installation.

These losses appear in the figure 9.

2.8.3. Electric Power Production

Based on the data set out in the previous sections and taking into account the total power of the photovoltaic installation, the following power production values have been obtained from the installation.

With the parameters previously calculated, we get the following loss diagram and the annual production of the system.

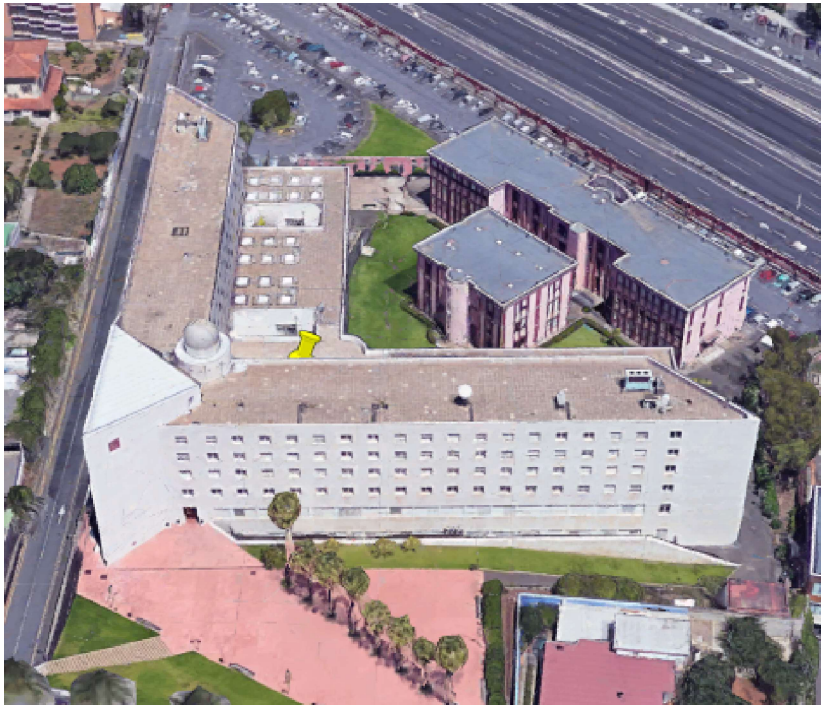
figure 9: annual production of the protovoltaic installation and loss factor

Resulting in 458,11 Mwh per year and a performance ratio of 90,22%. In a common photovoltaic installation, this value would be above average, in terms of performance, but it is totally logical, because we have photovoltaic modules with lower annual degradation and therefore less loss of peak power, we also have the use of optimizer technology, which reduces losses due to dirt, shading, degradation of modules to a minimum. Thus, giving rise to this performance ratio value.

3. PLANS

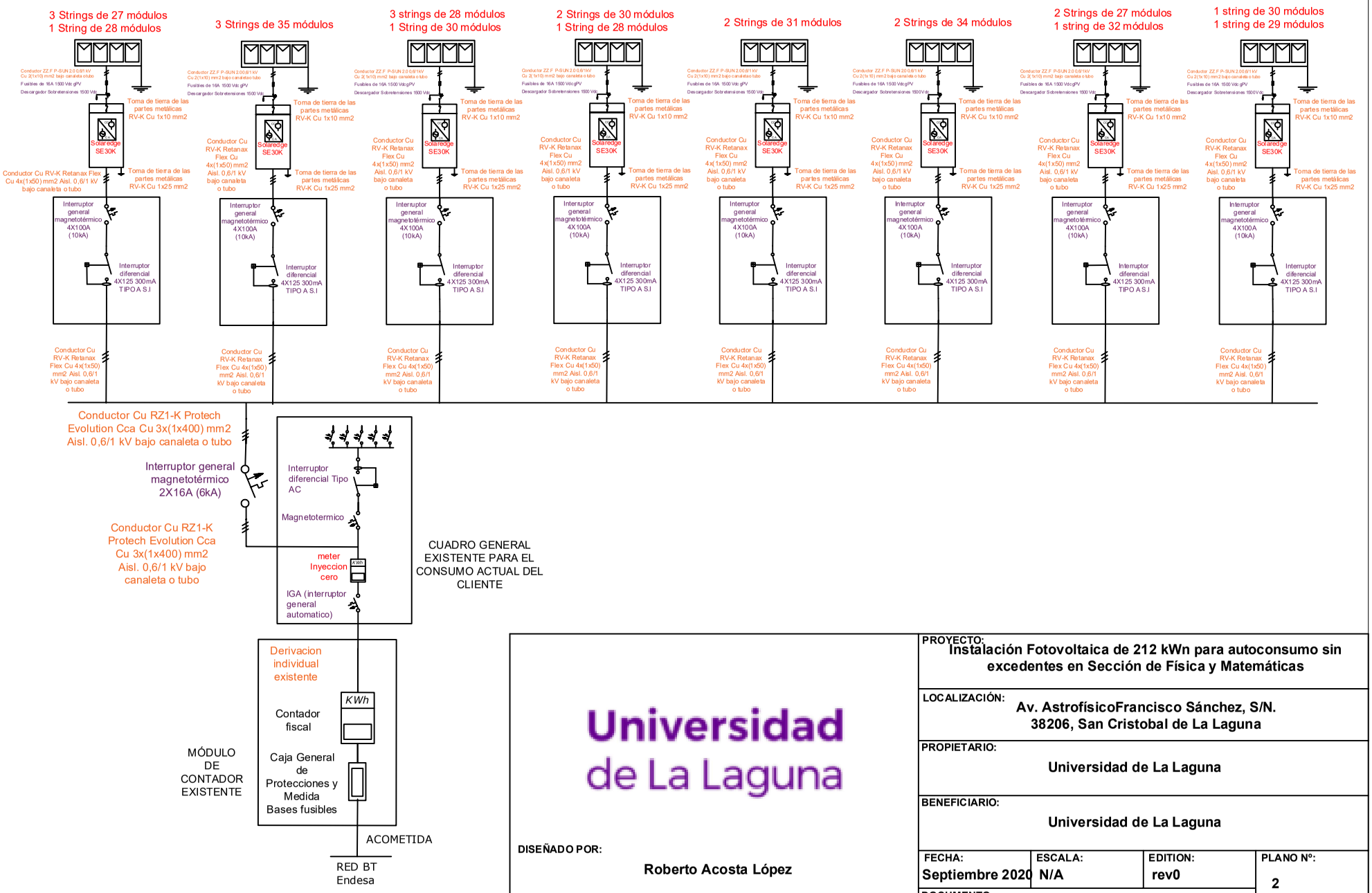
Islas Canarias, Tenerife

Av. Astrofísico Fransico Sánchez, S/N. 38206 San Cristóbal de La Laguna



Coordenadas UTM:
X: 370.735,8 m
Y: 3.151.317,6 m
Banda: R, Uso: 28

Universidad de La Laguna	PROYECTO: Instalación Fotovoltaica de 212 kWn para autoconsumo sin excedentes en Sección de Física y Matemáticas			
	LOCALIZACIÓN: Av. Astrofísico Francisco Sánchez, S/N. 38206, San Cristóbal de La Laguna			
	PROPIETARIO: Universidad de La Laguna			
	BENEFICIARIO: Universidad de La Laguna			
DISEÑADO POR: Roberto Acosta López	FECHA: Septiembre 2020	ESCALA: N/A	EDITION: rev0	PLANO Nº: 1
	DOCUMENTO: Situacion			



Universidad de La Laguna

DISEÑADO POR: Roberto Acosta López

PROYECTO: Instalación Fotovoltaica de 212 kWn para autoconsumo sin excedentes en Sección de Física y Matemáticas

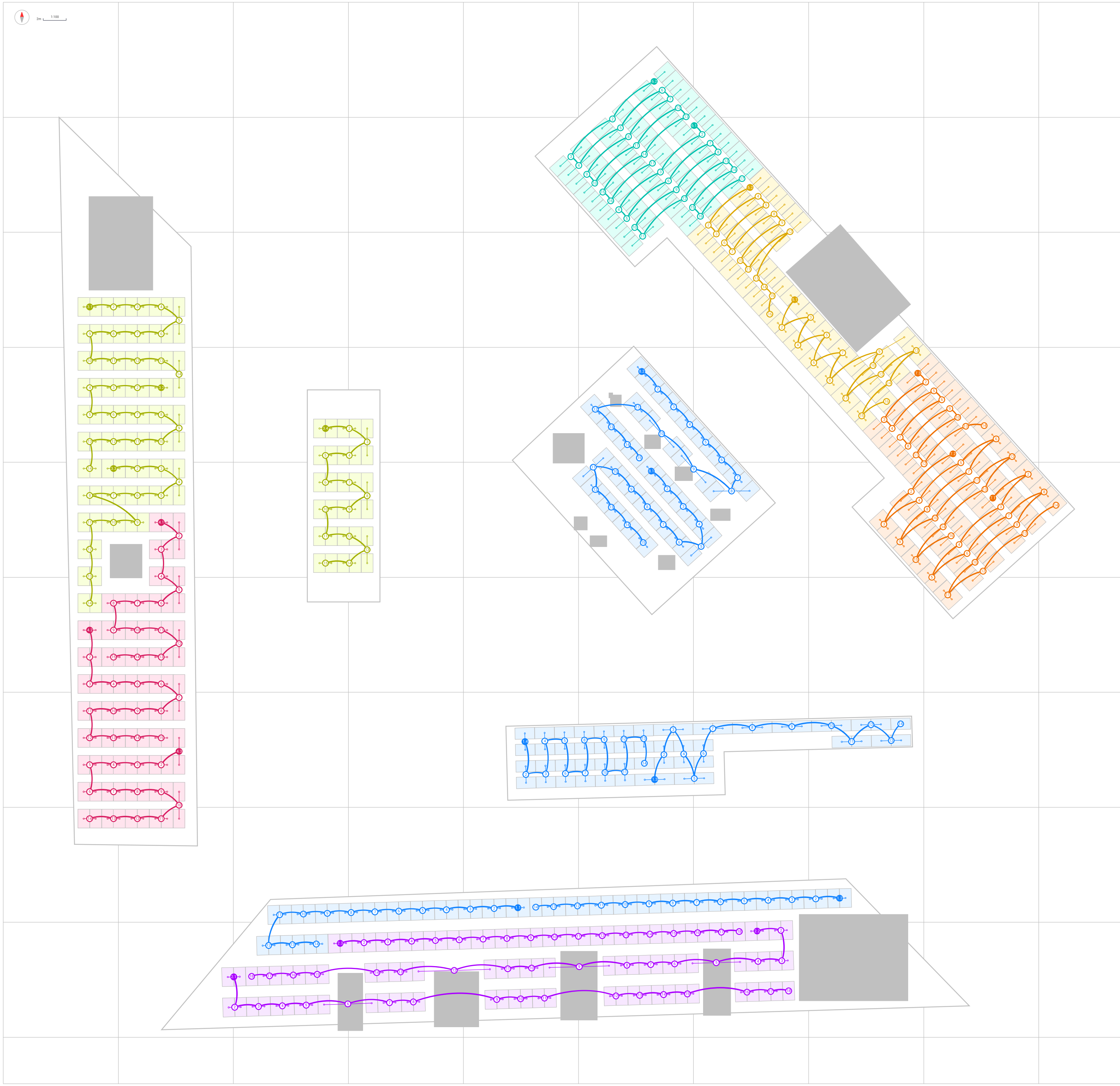
LOCALIZACIÓN: Av. AstrofísicoFrancisco Sánchez, S/N. 38206, San Cristobal de La Laguna

PROPIETARIO: Universidad de La Laguna

BENEFICIARIO: Universidad de La Laguna

FECHA:	ESCALA:	EDITION:	PLANO Nº:
Septiembre 2020	N/A	rev0	2

DOCUMENTO: Esquema Unifilar



solaredge

FACULTAD DE CIENCIAS
STRING DESIGN REPORT

Address: San Crist   bal de La Laguna, 38203, Spain | Aug 26, 2020

1 SE30K (from Oct. 2020) 138%
- 1.1 14 x P801 28
- 1.2 14 x P801 27
- 1.3 14 x P801 27
- 1.4 14 x P801 27

2 SE30K (from Oct. 2020) 133%
- 2.1 18 x P801 35
- 2.2 18 x P801 35
- 2.3 18 x P801 35

3 SE30K (from Oct. 2020) 144%
- 3.1 14 x P801 28
- 3.2 14 x P801 28
- 3.3 14 x P801 28
- 3.4 15 x P801 30

4 SE30K (from Oct. 2020) 111%
- 4.1 15 x P801 30
- 4.2 15 x P801 30
- 4.3 14 x P801 28

5 SE25K 94%
- 5.1 16 x P801 31
- 5.2 16 x P801 31

6 SE25K 103%
- 6.1 17 x P801 34
- 6.2 17 x P801 34

7 SE25K 131%
- 7.1 14 x P801 27
- 7.2 16 x P801 32
- 7.3 14 x P801 27

8 SE17K 132%
- 8.1 15 x P801 30
- 8.2 15 x P801 29

4. MEASUREMENTS AND BUDGET

Measuraments

Units	Concept	Measurement
ud	Photovoltaic module LG NEON R LG38Q1C-V5	691
ud	Solaredge SE 30K inverter	4
ud	Solaredge SE 25K inverter	3
ud	Solaredge SE 17K inverter	1
ud	Concrete structure 15o	726
ud	Optimizer P801	351
ud	Enveloping DC and AC protections	16
ud	Fuse 16 A, 1500 Vdc	46
ud	Type 1 and 2 Surge Discharger	23
ud	Magnetothemic switch 100 A, 4 poles	8
ud	Differential Switch 100 A, 4 Poles, Type A	8
ud	General Automatic Switch 630 A, 4 Poles	1
ud	Pre-assembled Bus Bar Box	1
m	Wire type ZZ-F Prysmian, P-Sun 2.0, 0.6/ 1KV, 1x10 mm2	2736,32
m	Wire type RV-K Prysmian, Retanax Flex, 0.6/ 1KV, 1x10 mm2	342,04
m	Wire type RV-K Prysmian, Retanax Flex, 0.6/ 1KV, 1x50 mm2	2976
m	Wire type RV-K Prysmian, Retanax Flex, 0.6/ 1KV, 1x25 mm2	992
m	Wire type RZ1-K Prysmian, Protecth Evolution Cca, 0.6/ 1KV, 1x400 mm2	1
m	Wire type RV-K Prysmian, Retanax Flex, 0.6/ 1KV, 1x200 mm2	1
m	PVC gutter 60x40 mm	850
m	PVC gutter 100x75 mm	200
m	PVC Corrugated Tube O25 mm	1221,52

Budget - Chapter of Materials

Units	Concept	Measuremen	Price	Subtotal
ud	Photovoltaic module LG NEON R LG38Q1C-V5	691	210,00 €	145.110,00 €
ud	Solaredge SE 30K inverter	4	1.574,23 €	6.296,92 €
ud	Solaredge SE 25K inverter	3	1.349,15 €	4.047,45 €
ud	Solaredge SE 17K inverter	1	1.085,70 €	1.085,70 €
ud	Concrete structure 15o	726	15,46 €	11.223,96 €
ud	Optimizer P801	351	40,45 €	14.197,95 €
ud	Enveloping DC and AC protections	16	35,56 €	568,96 €
ud	Fuse 16 A, 1500 Vdc	46	3,25 €	149,50 €
ud	Type 1 and 2 Surge Discharger	23	156,04 €	3.588,92 €
ud	Magnetothemic switch 100 A, 4 poles	8	131,26 €	1.050,08 €
ud	Differential Switch 100 A, 4 Poles, Type A	8	48,93 €	391,44 €
ud	General Automatic Switch 630 A, 4 Poles	1	1.063,98 €	1.063,98 €
ud	Pre-assembled Bus Bar Box	1	226,87 €	226,87 €
m	Wire type ZZ-F Prysmian, P-Sun 2.0, 0.6/ 1KV, 1x10 mm2	2736,32	2,78 €	7.606,97 €
m	Wire type RV-K Prysmian, Retanax Flex, 0.6/ 1KV, 1x10 mm2	342,04	1,10 €	376,24 €
m	Wire type RV-K Prysmian, Retanax Flex, 0.6/ 1KV, 1x50 mm2	2976	3,97 €	11.814,72 €
m	Wire type RV-K Prysmian, Retanax Flex, 0.6/ 1KV, 1x25 mm2	992	2,56 €	2.539,52 €
m	Wire type RZ1-K Prysmian, Protecth Evolution Cca, 0.6/ 1KV, 1x400 mm2	1	167,96 €	167,96 €
m	Wire type RV-K Prysmian, Retanax Flex, 0.6/ 1KV, 1x200 mm2	1	18,70 €	18,70 €
m	PVC gutter 60x40 mm	850	2,05 €	1.742,50 €
m	PVC gutter 100x75 mm	200	4,89 €	978,00 €
m	PVC Corrugated Tube O25 mm	1221,52	0,33 €	403,10 €
	TOTAL MATERIALS			214.649,45 €

Budget - Labour Chapter

Units	Concept	Measurement	Price	Subtotal
Hours	Structure assembly (2 Officers + 4 Assistants)	76,8	62,50 €	4.800,00 €
Hours	Assembly of Modules (2 Officers + 4 Assistants)	19,2	62,50 €	1.200,00 €
Hours	Mounting inverters (2 Officers + 4 Assistants)	24	62,50 €	1.500,00 €
Hours	Electrical mounting (2 Officers + 4 Assistants)	64	62,50 €	4.000,00 €
Hours	Run Photovoltaic Plant(2 Officers)	8	22,50 €	180,00 €
Hours	Construction Directorate (Industrial Technical Engineer)	48	12,50 €	600,00 €
Hours	Engineering	10	11,25 €	112,50 €
TOTAL		250		12.392,50 €

Budget - Other Cost Chapter

Units	Concept	Measurement	Price	Subtotal
ud	Crane	1	1.260,00 €	1.260,00 €
ud	Transport	1	2.650,00 €	2.650,00 €
km	Displacement	361,6	0,90 €	325,44 €
ud	Legalization	1	2.100,00 €	2.100,00 €
TOTAL				6.335,44 €
TOTAL				233.377,39 €

5. PROFITABILITY STUDY

5.1. Electric Consumption

The consumption data for where the photovoltaic installation will be located are then collected:

Month	Consumption (kWh)
January	177.560
February	185.962
March	183.696
April	204.154
May	207.336
June	194.971
July	197.383
August	112.221
September	180.943
October	201.795
November	185.855
December	183.269
Total	2.215.145

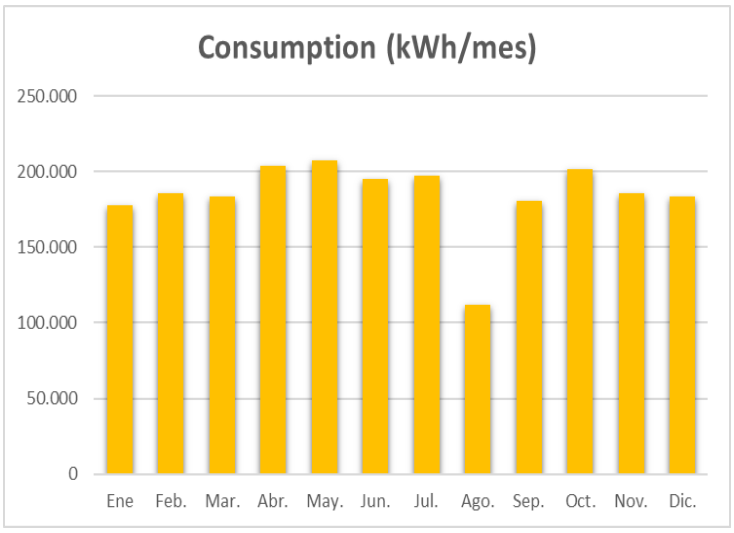


table 20: annual consumptions of the year 2013 (most up to date data that available)

5.2. Photovoltaic Generation

Production has been obtained in paragraph 2.8. in Calculation Memory

The following productions are calculated for the installed power:

Month	Generation (kWh)
January	30.196,70
February	31.247,02
March	43.063,12
April	44.376,02
May	47.264,40
June	45.951,50
July	44.638,60
August	44.376,02
September	37.286,36
October	33.610,24
November	29.408,96
December	26.783,16
Total	**458.110,00**

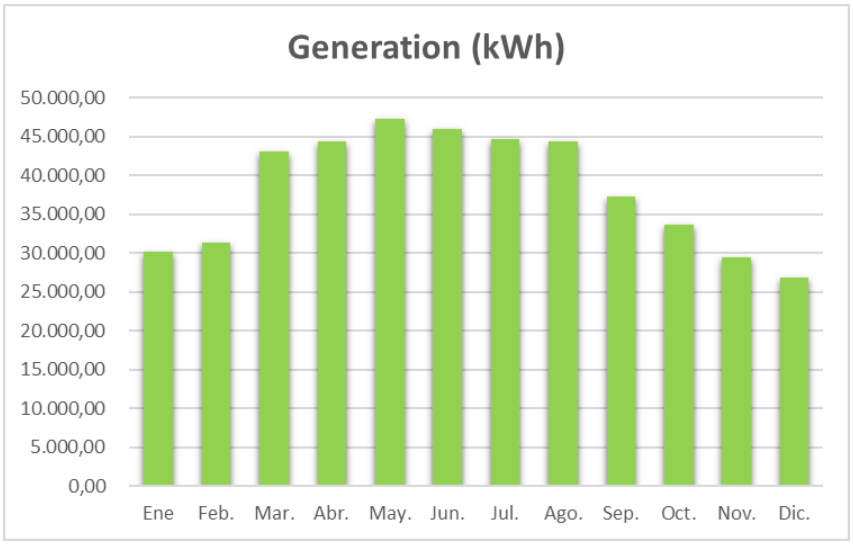


table 21: annual production of the photovoltaic installation

5.3. Economic Report

For profitability calculation, the company's consumptions are taken as a guide. In this case you have a 3.1a rate, with three distinct periods (P1, P2, P3). Only the variable term of the electric bill and not the fixed term of power has been taken into account., i.e. the savings will be over the kWh of the invoice.

For calculation purposes, two premises have been taken:

1. Global consumption (3 periods): To know the impact of savings on the overall invoice count and,
2. Photovoltaic plant generation schedules: To know the price of energy and calculate the savings.

5.3.1. Electric Contract

	TARIFA 3.1A																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Invierno	P3	P3	P3	P3	P3	P3	P3	P2	P2	P2	P2	P2	P2	P2	P2	P2	P2	P1	P1	P1	P1	P2	P2	P3
Verano	P3	P3	P3	P3	P3	P3	P3	P3	P2	P2	P2	P2	P2	P2	P2	P2	P2	P2	P1	P1	P1	P1	P2	P2
Fines de semana	P3	P3	P3	P3	P3	P3	P3	P3	P3	P3	P3	P3	P3	P3	P3	P3	P3	P2	P2	P2	P2	P2	P2	P3

table 22: monthly distribution of billing periods

	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Invierno	P2	P2	P2	P2	P2	P2	P2	P2	P2	P2	P1	P1	P1	P1
Verano	P3	P2	P2	P2	P2	P2	P2	P2	P2	P2	P2	P1	P1	P1
Fines de sem	P3	P3	P3	P3	P3	P3	P3	P3	P3	P3	P2	P2	P2	P2

table 23: monthly distribution of billing periods in solar production hours

To calculate the savings, an invoice weight is estimated during production hours. Hours where 100% of the savings are concentrated.

This average solar rate represents the value of energy in the hours of sunshine in which the plant is producing. For its calculation, the rates that the electricity company charges the customer are accurate, and the distribution of hourly sections of each month. Being a 3.1A rate, we have price in winter and summer. The weight of each day has been weighted in the total to make it as realistic as possible.

Due to the unavailable of electricity bill, an unfavourable value has been chosen for this study of the price of electricity resulting in lower profitability, the weighted price of electricity is simulated at 0.0881 /kWh, being as follows:

	Winter	Summer
Hours of generation	8-19	8-21
Annual average	0,083 €	0,085 €
Weighted Price		0,0840 €
Tax percentage	5,1127%	
Tax	0,0043 €/kWh	
Final Price	0,0881 €/kWh	

table 24: energy price in photovoltaic generation

5.4. Savings

5.4.1. Monthly consumption and savings with photovoltaic generation (Energy Term)

Savings (solar coverage) are calculated assuming an instant self-consumption of 100%, the consumption in huge elevated, so the energy generate by the photovoltaic plant will be consume in its totality.

Month	Consumption (kWh)	Generation (kWh)	Self-consumption (kWh)	Grid (kWh)	Solar (%)
Jan.	177.560	30.197	30.197	147.363	17,0%
Feb.	185.962	31.247	31.247	154.715	16,8%
Mar.	183.696	43.063	43.063	140.633	23,4%
Apr.	204.154	44.376	44.376	159.778	21,7%
May	207.336	47.264	47.264	160.072	22,8%
Jun.	194.971	45.952	45.952	149.020	23,6%
Jul.	197.383	44.639	44.639	152.744	22,6%
Aug.	112.221	44.376	44.376	67.845	39,5%
Sep.	180.943	37.286	37.286	143.657	20,6%
Oct.	201.795	33.610	33.610	168.185	16,7%
Nov.	185.855	29.409	29.409	156.446	15,8%
Dec.	183.269	26.783	26.783	156.486	14,6%
Saving	**2.215.145**	**458.202**	**458.202**	**1.756.943**	**21,3%**

table 25: annual consumption and savings

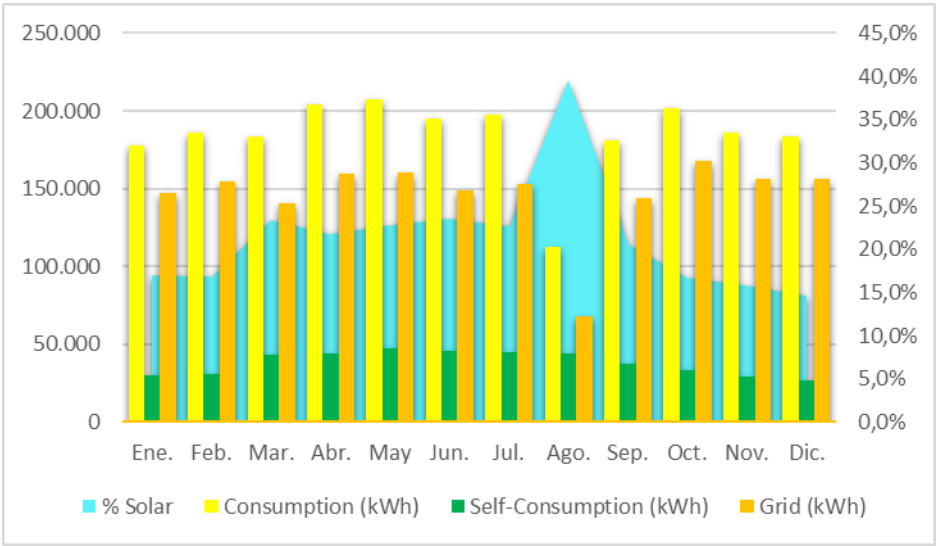


figure 10: annual consumption and production

5.4.2. Invoice Savings (Energy Term)

Month	Bill	Saving	Bill With Photovoltaic	Saving
Ene.	15.643,0 €	2.660,33 €	12.982,71 €	17,01%
Feb.	16.383,3 €	2.752,86 €	13.630,39 €	16,80%
Mar.	16.183,6 €	3.793,86 €	12.389,76 €	23,44%
Abr.	17.986,0 €	3.909,53 €	14.076,44 €	21,74%
May	18.266,3 €	4.163,99 €	14.102,31 €	22,80%
Jun.	17.176,9 €	4.048,33 €	13.128,62 €	23,57%
Jul.	17.389,4 €	3.932,66 €	13.456,78 €	22,62%
Ago.	9.886,7 €	3.909,53 €	5.977,14 €	39,54%
Sep.	15.941,1 €	3.284,93 €	12.656,15 €	20,61%
Oct.	17.778,1 €	2.961,06 €	14.817,08 €	16,66%
Nov.	16.373,8 €	2.590,93 €	13.782,90 €	15,82%
Dic.	16.146,0 €	2.359,60 €	13.786,40 €	14,61%
TOTAL	**195.154,27 €**	**40.367,61 €**	**154.786,67 €**	**21,3%**

table 26: consumption and saving of the total invoice

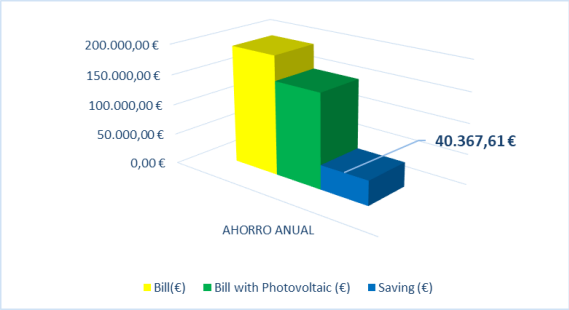


figure 11: annual saving

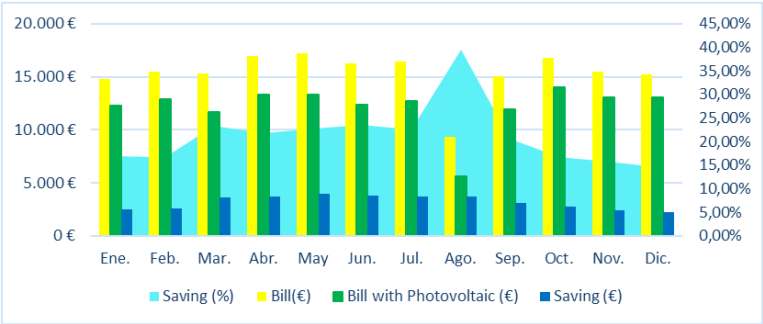


figure 12: monthly saving

5.5. Offer Price

The cost of building and supplying the materials for the Photovoltaic plant Physics and Mathematics Section of the University of La Laguna, with a peak power of 262.58 kWp amounts to:

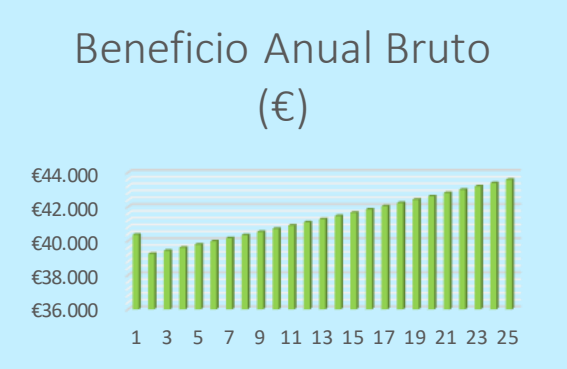
Price: 233.377,39 € EUR
Rate: 0,89 €/W_p

5.6. Profitability

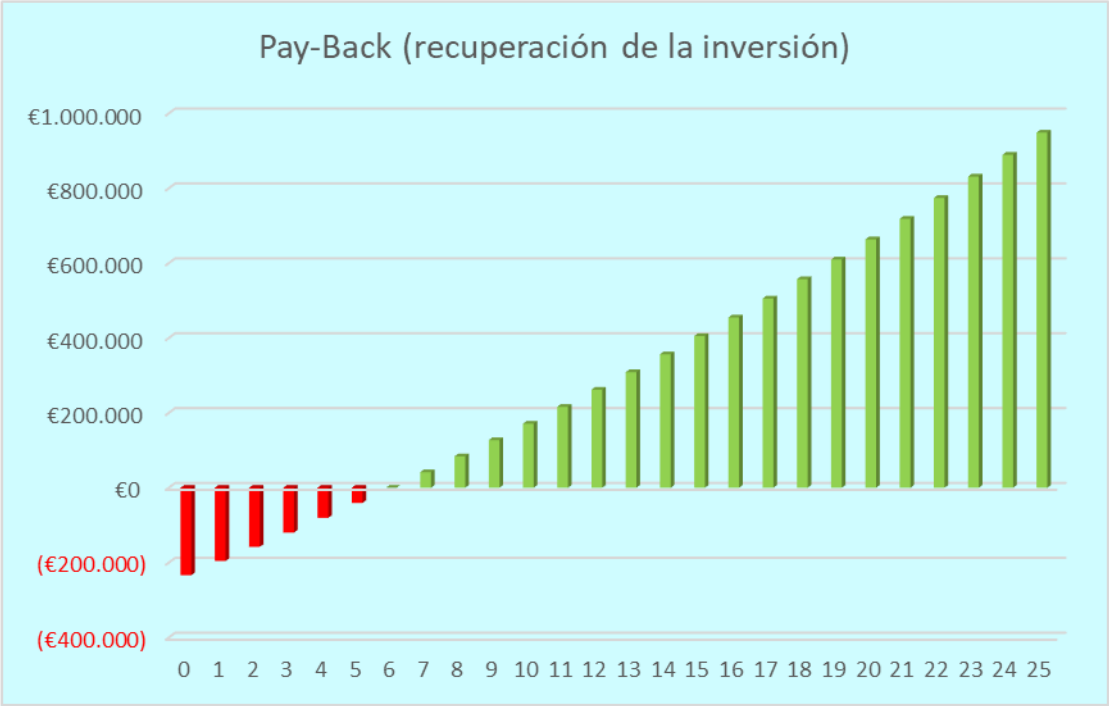
PROFITABILITY

SECCIÓN FÍSICA Y MATEMÁTICAS - ULL

Peak Power	262,58 kWp
Price of electricity	0,890 €/Wp
Budget	233.696,20 €
TIR	16,88%
1st year degradation	2,00%
Annual degradation	0,50%
Annual Cost	1.300,00 €
Inflation Costs	1,50%
Inflation Energy	1,00%
Electric Tariff	0,088 €/kWh



YEAR	%Modules Efficiency Losses	Tariff	Saving	Annual Cost	Gross Annual Profit	Pay-Back
0	100%	0,0881 €/kWh			-233.696,20 €	
1	98,00%	0,0890 €/kWh	40.367,61 €		40.367,61 €	-193.328,59 €
2	97,50%	0,0899 €/kWh	40.567,42 €	1.319,50 €	39.247,92 €	-154.061,17 €
3	97,00%	0,0908 €/kWh	40.768,23 €	1.339,29 €	39.428,94 €	-114.612,44 €
4	96,50%	0,0917 €/kWh	40.970,04 €	1.359,38 €	39.610,65 €	-74.981,69 €
5	96,00%	0,0926 €/kWh	41.172,84 €	1.379,77 €	39.793,07 €	-35.168,24 €
6	95,50%	0,0935 €/kWh	41.376,64 €	1.400,47 €	39.976,17 €	4.828,63 €
7	95,00%	0,0945 €/kWh	41.581,46 €	1.421,48 €	40.159,98 €	45.009,62 €
8	94,50%	0,0954 €/kWh	41.787,29 €	1.442,80 €	40.344,49 €	85.375,43 €
9	94,00%	0,0964 €/kWh	41.994,13 €	1.464,44 €	40.529,69 €	125.926,77 €
10	93,50%	0,0973 €/kWh	42.202,00 €	1.486,41 €	40.715,60 €	166.664,33 €
11	93,00%	0,0983 €/kWh	42.410,90 €	1.508,70 €	40.902,20 €	207.588,83 €
12	92,50%	0,0993 €/kWh	42.620,84 €	1.531,33 €	41.089,50 €	248.700,96 €
13	92,00%	0,1003 €/kWh	42.831,81 €	1.554,30 €	41.277,51 €	290.001,44 €
14	91,50%	0,1013 €/kWh	43.043,83 €	1.577,62 €	41.466,21 €	331.490,96 €
15	91,00%	0,1023 €/kWh	43.256,90 €	1.601,28 €	41.655,61 €	373.170,24 €
16	90,50%	0,1033 €/kWh	43.471,02 €	1.625,30 €	41.845,72 €	415.039,98 €
17	90,00%	0,1043 €/kWh	43.686,20 €	1.649,68 €	42.036,52 €	457.100,87 €
18	89,50%	0,1054 €/kWh	43.902,45 €	1.674,43 €	42.228,02 €	499.353,64 €
19	89,00%	0,1064 €/kWh	44.119,76 €	1.699,54 €	42.420,22 €	541.798,97 €
20	88,50%	0,1075 €/kWh	44.338,16 €	1.725,04 €	42.613,12 €	584.437,59 €
21	88,00%	0,1086 €/kWh	44.557,63 €	1.750,91 €	42.806,72 €	627.270,18 €
22	87,50%	0,1097 €/kWh	44.778,19 €	1.777,18 €	43.001,01 €	670.297,46 €
23	87,00%	0,1108 €/kWh	44.999,84 €	1.803,83 €	43.196,01 €	713.520,12 €
24	86,50%	0,1119 €/kWh	45.222,59 €	1.830,89 €	43.391,70 €	756.938,88 €
25	86,00%	0,1130 €/kWh	45.446,44 €	1.858,35 €	43.588,09 €	800.554,43 €
26	85,50%	0,1141 €/kWh	45.671,40 €	1.886,23 €	43.785,17 €	844.367,48 €
27	85,00%	0,1153 €/kWh	45.897,48 €	1.914,52 €	43.982,95 €	888.378,73 €
28	84,50%	0,1164 €/kWh	46.124,67 €	1.943,24 €	44.181,43 €	932.588,87 €
29	84,00%	0,1176 €/kWh	46.352,99 €	1.972,39 €	44.380,60 €	976.998,62 €
30	83,50%	0,1187 €/kWh	46.582,43 €	2.001,97 €	44.580,46 €	1.021.608,66 €


Pay-Back (recuperación de la inversión)
€1.000.000
€800.000
€600.000
€400.000
€200.000
€0
(€200.000)
(€400.000)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

6. CONCLUISIONS

This master's degree project explain the execution and development of a photovoltaic plant on roof of Physics and Math Section of University of La Laguna, the generation and power data are:

- Power: 262,58 kWp/ 212 kWn
- Energy: 458,11 MWh annually

With these data, the Physics and Math Section will obtain annually:

- Reduction of CO2: 121,4 T
- Equivalent tree planted: 5576
- Economic Saving: 40.367,61 €

Apart of these data, other relevant data obtained, are:

- Photovoltaic Cost Plant: 0,89 €/Wp
- ROI (Return of Investment): 16,88%
- Payback: 6 years

In conclusion, this project is useful to a first approach to improve the Physics and Math Section and demonstrate that is viable and that it will have good results, in an economic and an environmental way.

Moreover, this project help the university of La Laguna to achieve the objectives mark by the European Union for the period 2021-2030.

ANNEXES

Annex 1: Specifications

Annex 2: Basic Health and Safety Study

Annex 3: Datasheets

SPECIFICATIONS

CONTENT

SPECIFICATIONS

1.1. OBJECT

This Particular Technical Conditions Sheet, which is part of the documentation of this reference project and which will govern the works for the realization of this reference project, determines the minimum acceptable conditions for the execution of Photovoltaic Electrical Installation connected to the network, as stipulated by ROYAL DECRETO 842/2002 of August 2 approving the Electrotechnical Regulation for Low Voltage, DECREE 141/2009, of November 10, approving the Regulation regulating administrative procedures relating to the execution and commissioning of electrical installations in the Canary Islands, REAL DECRETO 314/2006 of March 17, testing the Technical Building Code (Section HE 5 Minimum Photovoltaic Contribution of Electric Power), as well as the ORDER of October 13, 2004, which approves the particular rules for the liaisons facility of the company Endesa Electric Distribution , S.L., in the territorial area of the Autonomous Community of the Canary Islands.

In any event, such particular rules may not establish technical criteria contrary to the current regulations referred to in this project, or require specific trademarks, nor establish technical specifications that favor the implementation of a single manufacturer or represent a disproportionate economic cost to the user.

The doubts raised in its application or interpretation will be elucidated by the Engineer-Director of the work. Just by intervening in the work, it is assumed that the installer and the subcontractors know and admit this Specification.

1.2. FIELD OF APPLICATION

This Particular Technical Condition Sheet refers to the supply, installation, testing, testing, verification and maintenance of materials necessary in the assembly of photovoltaic electrical installations connected to the low voltage electrical grid, extending to all mechanical, electrical and electronic systems that are part of this installation regulated by DECRETO 141/2009, 10 November, set out above, in order to ensure the safety of people, social welfare and environmental protection, and it is necessary for such photovoltaic electrical installations to be designed, built, maintained and retained in such a way as satisfy the basic purposes of functionality, i.e. use or suitability for use, and safety, a concept that includes structural safety , fire safety and safety of use, so that normal use of the installation does not pose any risk of accident to persons and fulfils the purpose for which it is designed and constructed.

In certain cases, solutions other than those required in this Technical Conditions Specification may be adopted, by their very nature or technological development, provided that their need is sufficiently justified, are also approved by the Engineer-Director and do not imply a reduction in the minimum quality requirements specified therein.

In addition, and by application of the provisions of the CTE-DB-HE-5, this area extends to those buildings that exceeds the limits of application set out in the following table, which are required to incorporate solar energy capture and transformation systems by photovoltaic procedures:

For connected installations, even if these are not carried out at a distribution company's connection point, the technical conditions a resulting from RD 1699/2011, as well as all those applicable aspects of the current legislation, shall apply.

Tabla 1.1 Ámbito de aplicación

Tipo de uso	Límite de aplicación
Hipermercado	5.000 m^2 construidos
Multitienda y centros de ocio	3.000 m^2 construidos
Nave de almacenamiento	10.000 m^2 construidos
Administrativos	4.000 m^2 construidos
Hoteles y hostales	100 plazas
Hospitales y clínicas	100 camas
Pabellones de recintos feriales	10.000 m^2 construidos

1.3. APPLICATION REGULATION

In addition to the Particular Technical Conditions contained in this Fold, the following rules and regulations shall apply for the purposes of ensuring the quality, functionality, efficiency and durability of the networked photovoltaic installation and shall be observed at all times during its execution:

Real Decreto 1955/2000, de 1 de diciembre, por el que se regulan las actividades de transporte, distribución, comercialización, suministro y procedimientos de autorización de instalaciones de energía eléctrica.

Ley 82/1980, de 30 de diciembre, sobre Conservación de la Energía.

Ley 21/1992, de 16 de julio, de Industria.

Ley 31/1995, de 8 de noviembre, de Prevención de Riesgos Laborales.

Real Decreto 2200/1995, de 28 de diciembre, por el que se aprueba el Reglamento de la infraestructura para la calidad y la seguridad industrial.

Real Decreto 485/1997, de 14 de abril, sobre disposiciones mínimas en materia de señalización de seguridad y salud en el trabajo.

Real Decreto 773/1997, de 30 de mayo, sobre disposiciones mínimas de seguridad y salud relativas a la utilización por los trabajadores de equipos de protección individual.

Real Decreto 1627/1997, de 24 de octubre, por el que se establecen disposiciones mínimas de seguridad y de salud en las obras de construcción Ley 54/1997, de 27 de noviembre, del Sector Eléctrico.

Ley 11/1997, de 2 de diciembre, de regulación del Sector Eléctrico Canario. Reglamento Electrotécnico para Baja Tensión (REBT), aprobado por el RD 842/2002, de 2 de agosto, del Ministerio de Ciencia y Tecnología.

Ley 51/2002, de 27 de diciembre, de reforma de la Ley 39/1988, de 28 de diciembre, Reguladora de las Haciendas Locales.

Real Decreto-Ley 2/2003, de 25 de abril, de medidas de reforma económica.

Real Decreto 436/2004, de 12 de marzo, por el que se establece la metodología para la actualización y sistematización del régimen jurídico y económico de la actividad de producción de energía eléctrica en régimen especial.

Real Decreto 314/2006, de 17 de marzo, por el que se aprueba el Código Técnico de la Edificación.

Real Decreto-Ley 7/2006, de 23 de junio, por el que se adoptan medidas urgentes en el sector energético.

Orden de 25 de mayo de 2007 (B.O.C. número 121, de 18 de junio de 2007), por la que se regula el procedimiento telemático para la puesta en servicio de instalaciones eléctricas de baja tensión. Real Decreto 1110/2007, de 24 de agosto, por el que se aprueba el Reglamento unificado de puntos de medida del sistema eléctrico.

Decreto 141/2009, de 10 de noviembre, por el que se aprueba el Reglamento por el que se regulan los procedimientos administrativos relativos a la ejecución y puesta en servicio de las instalaciones eléctricas en Canarias.

Orden de 16 de abril de 2010, por la que se aprueban las Normas Particulares para las Instalaciones de Enlace, en el ámbito de suministro de Endesa Distribución Eléctrica, S.L.U. y Distribuidora Eléctrica del Puerto de La Cruz, S.A.U., en el territorio de la Comunidad Autónoma de Canarias.

Resolución de la Dirección General de Energía del Gobierno de Canarias, de Febrero de 2010, sobre tarado de desconexión por mínima frecuencia en instalaciones fotovoltaicas conectadas a red.

Real Decreto 1699/2011, de 18 de noviembre, por el que se regula la conexión a red de instalaciones

Resolución de 31 de mayo de 2001 por la que se establecen el modelo de contrato tipo y modelo de facturas para instalaciones solares fotovoltaicas conectadas al a red de baja tensión.

Real Decreto 614/2001, de 8 de junio, sobre disposiciones mínimas para la protección de la salud y seguridad de los trabajadores frente al riesgo eléctrico. de producción de energía eléctrica de pequeña potencia.

Real Decreto 842/2013, de 31 de octubre, por el que se aprueba la clasificación de los productos de construcción y de los elementos constructivos en función de sus propiedades de reacción y de resistencia frente al fuego.

Real Decreto 110/2015, de 20 de febrero, sobre residuos de aparatos eléctricos y electrónicos.

Ley 39/2015, de 1 de octubre, del Procedimiento Administrativo Común de las Administraciones Públicas.

Real Decreto 187/2016, de 6 de mayo, por el que se regulan las exigencias de seguridad del material eléctrico destinado a ser utilizado en determinados límites de tensión Fomento de la Autogeneración de Energía Eléctrica, aprobado por el RD 907/1982, de 2 de abril.

Municipal Ordinances of the Municipality of San Cristóbal de La Laguna.

And other rules or regulations that apply to you.

Unless they are requirements whose compliance is bound by the current legislation, in case of discrepancy between the content of the documents mentioned above, the criterion

corresponding to which it has a subsequent date of application will apply. With the same caveat, it shall apply preferably, with respect to the above documents, as expressed in this Particular Technical Conditions Sheet.

1.4. CHARACTERISTICS, COMPONENTS, QUALITIES AND GENERAL CONDITIONS OF THE ELECTRICAL MATERIALS OF THE INSTALLATION

1.4.1. DEFINITION AND CLASSIFICATION OF ELECTRICAL INSTALLATIONS

According to Article 3 of Decree 141/2009, any set of equipment and associated circuits intended for the production, conversion, processing, transmission, distribution or use of electrical energy is defined as "electrical installation". In addition, according to Article 3 of Decree 141/2009, they are grouped and classified into:

Low voltage installation is an electrical installation whose rated voltage is below 1 kV (U<1 kV).

Medium voltage installation is an electrical installation whose rated voltage is greater than or equal to 1 kV and less than 66 kV (1 kV x U < 66 kV). High voltage installation is an electrical installation whose rated voltage is equal to or greater than 66 kV (U x 66 kV).

1.5. CONSTITUENT COMPONENTS AND PRODUCTS OF THE PHOTOVOLTAIC INSTALLATION CONNECTED TO THE ELECTRICITY GRID

1.5.1. GENERAL

A grid-connected solar photovoltaic installation consists of a set of components responsible for capturing solar radiation, generating electrical energy in the form of DC and adapting it to the characteristics that make it usable by consumers connected to the AC distribution network. This type of photovoltaic installations work in parallel with the rest of the generation systems they supply to the distribution network.

The components or systems that make up the photovoltaic solar installation connected to the grid are as follows:

a) Photovoltaic generator system

b) Power conditioning system or inverter

c) System of protections, safety, manoeuvre, measurement and auxiliary elements.

The power conditioning system is responsible for transforming the energy in the form of dc current into alternating current, which will meet all those requirements and conditions of safety and guarantee so that its operation does not cause alterations in the network or decrease its safety, being equipped with the corresponding protection functions.

1.5.2. PHOTOVOLTAIC GENERATOR

Generically the installation will have a Photovoltaic Generator consisting of photovoltaic modules (PV) for the direct conversion of solar radiation into electrical energy, without any intermediate passage.

These modules in turn are made up of silicon photovoltaic cells interconnected with each other and properly protected from external agents

1.5.2.1. PHOTOVOLTAIC MODULES

Also referred to as "photovoltaic plate" or "photovoltaic panel" is a complete, environmentally protected set of solar cells interconnected and mounted between two sheets of glass, containing between 60 and 72 solar cells which can be connected to each other in series and/or parallel to obtain the desired voltage (12V, 24V, etc.).

Photovoltaic panels or modules are characterized by the parameter called "Peak Power" being that maximum power of the photovoltaic panel expressed in CEM.

All photovoltaic modules that integrate the installation will be of the same model, or in the case of different models, their design must fully guarantee compatibility between them and the absence of negative effects on the installation for this reason.

In exceptional cases where unqualified modules are used, it shall be duly justified and provide documentation on the tests and tests to which they have been subjected. In any case, any product that does not meet any of the above specifications must have the express approval of the Optional Directorate of the work. In all cases, the current mandatory rules must be met.

All modules must meet the UNE Standards for crystalline silicon modules or thin layer photovoltaic modules, as well as be qualified by a recognized laboratory, which will be accredited by the presentation of the corresponding official certificate.

The photovoltaic module will clearly and indelible carry the model and name or logo of the manufacturer, as well as an individual identification or serial number traceable to the date of manufacture.

Its structure consists of the following elements:

• Encapsulating, consisting of a material that must have a good transmission to radiation and a low degradability to the action of the sun's rays.

• Tempered glass outer cover, which, apart from facilitating light transmission to the maximum, must withstand the most adverse weather conditions and withstand sudden changes in temperature.

• Back cover, usually consisting of several opaque layers that reflect the light that has passed between the interstitials of the cells, causing them to re-influence them.

• Metal frame, usually made of aluminum, which ensures rigidity and sealing to the assembly, and which carries the necessary elements for mounting the panel on the support structure.

• Terminal box: incorporates the terminals for module connection.

• Protective diode: prevent damage from partial shadows on the panel surface.

Modules that meet the following technical characteristics shall be used:

a) Incorporate bypass diodes to prevent possible breakdowns of cells and their circuits by partial shading and will have an IP65 degree of protection.

b) Side frames (if any) shall be made of aluminum or stainless steel.

c) Maximum power and short-circuit current relating to standard conditions, falling within the range of 10 % of the corresponding catalogue nominal values.

The generator structure will be grounded.

The modules will be Class II and have a minimum protection level of IP65. For safety reasons and to facilitate the maintenance and repair of the generator, the necessary elements (fuses, switches, etc.) will be installed for disconnection, independently and in both terminals, of each branch of the rest of the generator.

1.5.3. INVERTER

They are electronic devices that convert the DC to alternating (AC), based on the use of electronic devices that act as switches allowing to interrupt the currents and reverse their polarity and therefore:

• Use AC receivers in isolated installations of the network.

• Connect the FV systems to the electrical distribution network.

The basic characteristics of the inverters will be as follows:

a) Operating principle: power source. b) Self-switched type.

c) Automatic tracking of the generator's maximum power point.

d) It will not work in island or isolated mode.

The power of the inverter will be at least 80% of the actual peak power of the photovoltaic generator. Its fundamental parameters are determined by:

a) Voltage and input current of the inverter, which must be adapted to that of the generator.

b) Maximum power that can provide the waveform at the output (pure or modified sine, etc.).

c) Working frequency and efficiency, close to 85%.

d) Phase voltage/s in the mains

e) Reactive output power of the inverter (for installations greater than 5 kWp).

Investors shall comply with Community Directives on Electrical Safety and Electromagnetic Compatibility (both shall be certified by the manufacturer), incorporating protections against:

• Alternate short circuits.

• Out-of-range mains voltage.

• Out-of-range network frequency.

• Surges, by means of varistors or the like.

• Disturbances present in the network such as microcuts, pulses, cycle defects, absence and return of the network, etc.

The inverter will have the necessary signals for its correct operation and will incorporate the essential automatic controls that ensure its proper supervision and use.

The inverter shall incorporate at least the following manual controls:

• General inverter on/off.

• Connecting and disconnecting the inverter to the AC interface. It may be external to the inverter.

Inverters shall be guaranteed for operation under the following environmental conditions: between 0oC and 40oC in temperature and between 0% and 85% relative humidity.

1.5.4. DRIVERS

They shall be those indicated in the documents of this project and shall at all times comply with the general requirements laid down in the ICT-BT-19 of the REBT.

These will be copper and will alwaysnbe insulated, except for whichthey are mounted on insulators, as indicated in the ICT-BT-20 of the REBT.

The copper used in the manufacture of cables or making connections of any type or class will meet the specifications contained in the corresponding UNE Standard and the REBT, being of pure commercial type, of uniform quality and mechanical resistance and free of any mechanical defect.

Placing conductors other than those specified in the electrical schemes of this project is not supported. In the absence of a particular type of such drivers on the market, substitution with another shall be authorised by the Optional Directorate.

The necessary conductors shall be copper and shall have the appropriate section to reduce voltage drops and heating and must also be sufficient to support the maximum permissible intensity in each of the sections. Specifically, for any working condition, the conductors shall have section values such that the voltage drop in them is less than those indicated below:

• Maximum voltage drops in DC part, 1.5%.

• Maximum voltage drops in the AC part, 1.5 % taking as a reference the voltages corresponding to junction boxes.

The maximum permissible intensities shall be governed in their entirety by the provisions of the corresponding UNE Standard.

The positives and negatives of each group of photovoltaic modules will be conducted separately and protected in accordance with current regulations.

The entire AC and DC cable length will be included. It must be of the necessary length to generate no effort in the various elements or possibility of coupling by the normal transit of persons. All continuous wiring shall be in accordance with the unE standard applicable to it. The REBT shall be respected at all times as regards cable conductions.

For heights relative to the ground less than 2.5 m, the wiring will run in tube, which will be put to the ground of the system.

1.5.5. SUPPORT STRUCTURE

The support structure of photovoltaic modules shall withstand wind and snow overloads with these installed, as indicated in the Technical Building Code (CTE) on Structural Safety.

The design and construction of the structure and the module fixing system, will allow the necessary thermal expansions, without transmitting loads that may affect the integrity of the modules, following the manufacturer's instructions. The clamping points for the photovoltaic module shall be sufficient in number, taking into account the support area and relative position, so that no push-ups are produced in the modules higher than those permitted by the manufacturer and the approved methods for the module model.

The structure design shall be carried out for the orientation and inclination angle specified for the photovoltaic generator, taking into account the ease of assembly and disassembly, and the possible need for element substitutions.

The structure will be superficially protected against the action of environmental agents. Drilling in the structure shall be carried out before proceeding, where appropriate, to the galvanizing or protection of the structure.

The screws shall be as indicated in basic document DB SE-A "Structural Safety- Steel".

Module clamping stops and the structure itself will not cast shadow on the modules. In the case of integrated roof installations that sometimes make the roof of the building, the structure and sealing between modules shall comply with the requirements indicated in the corresponding part of the Technical Building Code and other applicable regulations.

The support structures necessary to assemble the modules, both on a flat surface (terrace) and integrated on roof, shall be provided in compliance with the provisions of "Conditions to be met with regard to the Orientation and inclination and shadows of the photovoltaic generator" of this Specification, on shadows. All accessories and benches and/or anchors shall be included.

The calculation and characteristics of the supporting structure are obtained from what is indicated in the BASIC Document DB SE-A "Structural-Steel Safety"

1.5.6. SYSTEM OR SET OF PROTECTIONS

All installations shall comply with Royal Decree 1699/2011 (Article 14) on protections in photovoltaic installations connected to the Low Voltage network and with the one-line scheme shown in the Resolution of 31 May 2001.

Therefore, the installation will incorporate all the elements and characteristics necessary to guarantee at all times the quality of the electricity supply, so that they comply with the Community directives of Electrical Safety in Low Voltage and Electromagnetic Compatibility.

All necessary elements of safety and protections specific to individuals and photovoltaic installation shall be included, ensuring protection against direct and indirect contacts, short circuits, overloads, as well as other elements and protections resulting from the application of

current legislation. In particular, Class II protection or equivalent insulation shall be used in the DC part of the installation in the case of an accessible site. Outdoor materials shall have at least one degree of IP65 protection.

The installation must allow disconnection and disconnection of the inverter, both in the DC and AC part, to facilitate maintenance.

In three-phase network connections the protections for maximum and minimum frequency interconnection (51 and 49 Hz respectively) and maximum and minimum voltage (1.1 Um and 0.85 Um respectively) will be for each phase.

In addition, all installations shall comply with Royal Decree 1699/2011 (Article 16) on harmonics and electromagnetic compatibility in photovoltaic installations connected to the low voltage network.

1.5.6.1. GROUNDING

All installations shall comply with Royal Decree 1699/2011 (Article 15) on the grounding conditions of the installations.

All masses of the photovoltaic installation, both in the continuous and alternating sections, will be connected to a single earth. This land shall be independent of that of the neutral of the distribution company, taking into account the Low Voltage Regulation.

Grounding shall be established:

- From the FV generator: support structure and metal frame.
- From the installation corresponding to the alternating consumptions.
- The surface of the protective conductor shall be at least that of the corresponding phase conductor

1.5.6.2. PROTECTIONS AGAINST DIRECT CONTACTS

This protection is to take measures to protect people from hazards that may arise from contact with the active parts of electrical materials.

Unless otherwise indicated, the means to be used are usually:

• Insulation protection of the active parts.

• Protection by means of barriers or enclosures.

• Protection by means of obstacles.

• Out-of-range push-away protection.

Complementary protection by residual differential current devices

This protective measure is intended only to complement other measures to protect against direct contacts. The use of differential-residual current devices, whose assigned operating differential current value is less than or equal to 300 mA, is recognized as a supplementary

protection measure in the event of failure of another protection measure against direct contacts or in the event of recklessness of users.

Where differential currents are expected to be non-sine (such as in interventional radiology rooms), the residual differential current devices used shall be Class A which ensure disconnection for sine alternating currents as well as for pulsating dc currents.

The use of such devices does not in itself constitute a complete protective measure and requires the use of one of the protective measures set out in paragraphs 3.1 to 3.4 of low voltage.

Differential

They offer effective protection against both direct and indirect contacts. They consist of:

• Toroidal transformer

Electromechanical relay

• Connection and disconnection mechanism

• Auxiliary test circuit.

When the vector sum of the intensities passing through the transformer is nonzero, in the secondary of the transformer a voltage is induced that causes the excitation of the relay resulting in the disconnection of the switch. For opening to occur, the leakage current must be higher than the sensitivity current of the differential.

1.5.6.3. PROTECTIONS AGAINST INDIRECT CONTACTS

Automatic power cut-off protection

Automatic power cutting after failure is intended to prevent a sufficient value contact voltage from being maintained for such a time that it can result in a risk.

There must be adequate coordination between the grounding scheme of the facility used from among those described in the REBT ITC-BT-08 and the characteristics of the protective devices.

Automatic power cutting is prescribed when a dangerous effect may occur on persons or pets in case of defect, due to the value and duration of the contact voltage.

The following describes the most significant aspects that protection systems must gather based on the different connection schemes of the installation, according to ITC-BT-08 and that the corresponding UNE standard.

Devices of the type are used:

• Maximum current protection devices, such as fuses, automatic switches.

• Differentials

Employment protection of Class II or Equivalent Insulation Protection

This protection is ensured by:

• Use of equipment with double or reinforced insulation (Class II).

• Factory-built appliance assemblies with equivalent insulation (double or reinforced).

• Additional insulation mounted in the course of electrical installation and isolating electrical equipment that has only a main insulation.

• Reinforced insulation mounted in the course of the electrical installation and isolating the active parts discovered, when the use of double insulation is not possible by construction.

1.5.6.4. PROTECTIONS AGAINST OVERLOADS, SHORT CIRCUITS AND SURGES

• Overloads, short circuits: fuses and magnetothermal (Pías).

• Network surges (by storms, etc.): varistors (on panels)

Varistors provide reliable and economical protection against high voltage transients that can be produced, for example, by lightning, switching or electrical noise on DC or AC power lines.

1.5.6.5. ELECTRIC DRIVERS

The conductors and cables shall have the characteristics indicated in the project documents and shall at all times comply with the general requirements set out in the ICT-BT-19 of the REBT.

Placing conductors other than those specified in the electrical schemes of this project is not supported. In the absence of a particular type of such drivers on the market, substitution with another will have to be authorised by the Optional Directorate.

These will be copper and will always be isolated. The copper used in the manufacture of cables or making connections of any type or class will meet the specifications contained in the corresponding UNE Standard and the REBT, being of pure commercial type, of uniform quality and mechanical resistance and free of any mechanical defect.

1.5.6.6. PROTECTIVE DRIVERS

They are used to electrically attach the masses of an installation to certain elements in order to ensure protection against indirect contacts. In the grounding circuit, the protective conductors shall join the masses to the ground conductor.

Your section will be determined by the ICT-BT-19 Table 2 values.

In its installation or assembly, it will be taken into account: In other cases, they are also called protective conductors, those conductors that join the masses: the net neutral or a protection relay.

In all cases the protective conductors that are not part of the power channel shall be copper.

Where the protective conductor is common to multiple circuits, the section of that conductor should be sized according to the larger section of the phase conductors.

Conductors can be used as protective conductors on multiconductor cables, insulated or bare conductors that have a common envelope with active conductors, or bare or insulated separate conductors.

When the installation consists of parts of factory-mounted assembly envelopes or prefabricated pipes with metal envelope, these enclosures can be used as protective conductors if they meet, simultaneously, the following three conditions:

- Its electrical continuity should be such that it is not affected by mechanical, chemical or electrochemical deterioration.

- Its conductibility should be at least the same as that resulting from the application of this paragraph.

- They must allow the connection of other protection conductors in any default bypass.

The outer cover of minerally insulated cables can be used as the protective conductor of the corresponding circuits, if they simultaneously satisfy the above conditions (a) and (b). Other ducts (water, gas or other types) or metal structures cannot be used as protective conductors (CP or CPN).

Protective conductors should be adequately protected against mechanical, chemical and electrochemical deterioration and against electrodynamic stresses.

Connections must be accessible for verification and testing, except in boxes sealed with filler material or in non-removable boxes with watertight seals.

No appliance shall be interspersed with the protective conductor, although detachable connections may be used for testing using appropriate tools.

1.5.6.7. DRIVER IDENTIFICATION

The conductors of the installation must be easily identified, especially as regards the neutral conductor and the protective conductor. This identification shall be made by the colours which have their insulation or by inscriptions on it, when non-colourable insulation is used. The neutral conductor shall be identified by the light blue color and the protective conductor by the double yellow-green color. Phase conductors will be identified by brown or black colors.

Where three different phases are considered necessary, the grey color may be used for the third phase.

1.5.6.8. PROTECTIVE TUBES

Protective tubes and fittings may be metallic, non-metallic or composite and in any case shall be made of a corrosion and acid resistant material, and at the same time non-flame propagator, as stipulated in the ITC-BT-21 of the REBT for indoor or receiving installations. They may be rigid, curved, flexible or buried, according to the UNE Standards applicable to them.

With regard to its dimensions and threads, the provisions of each of the UNE Standards applicable to them shall be provided for.

The minimum inner diameter of the tubes shall be determined and declared by the manufacturer.

Depending on the type of installation, minimum outer diameters and all minimum characteristics (compression resistance, impact resistance, minimum and maximum installation and service temperatures, water penetration resistance, bending resistance, corrosion resistance, tensile strength, flame propagation resistance, suspended loads, etc.) of tubes in fixed surface pipes , tubes in recessed pipes, aerial or air-piped pipes and pipes in buried pipes shall be defined by the TABLES of the ITC-BT-21 of the REBT. The installation and commissioning of the protective tubes must comply with the following or, if not, the requirements of the UNE Standard applicable to it and in the ITC- BT-19 and ITC-BT-20.

The tubes shall be joined together by class-appropriate fittings to ensure the continuity of the protection they provide to the conductors. Records (which may also be used as junction and bypass boxes) shall be available in sufficient quantity, at maximum distances of 15 m, to allow easy entry and removal of conductors, and shall go by brushes.

Connections between conductors shall be made inside the appropriate boxes, with appropriate dimensions, of insulating material and non-flame propagator. Under no circumstances may conductors be joined by splicing or by simple twisting or winding derivatives, but they will have to be joined by connecting terminals or connection strips.

Plotting will be done along vertical and horizontal lines parallel to the edges of the walls that limit the location where the installation takes place.

Vertical brushes will separate at least 20 cm. Of fences, its depth will be 4 cm. and its maximum width twice the depth. If there are frictions parallel to both sides of the wall, they will be separated by 50 cm. They will be covered with mortar or plaster. The conductors shall be attached to the bypass boxes, which shall be separated 20 cm. from the ceiling, their lids shall be attached to the stop and the insulating tubes shall be inserted at least 0.5 cm. into them. In metal tubes without internal insulation, account should be taken of the possible effects of water condensation inside for which their layout must be chosen appropriately. The use of metal tubes as protective or neutral conductors is strictly prohibited.

Those metal tubes that are accessible will be grounded and their electrical continuity will be guaranteed at all times. When mounting with flexible metal tubes, the maximum distance between two groundings shall in no circumstances exceed more than 10 m. The pipelines shall be protected from heat by means of heat protection screens or by conveniently moving the electrical installation away from possible heat sources or by selecting the one that supports the harmful effects that may arise.

As regards the fixed mounting conditions for surface tubes, they must comply with the specifications set out in paragraph 2.2 of ITCBT- 21 of the REBT. In addition, with regard to the fixed mounting conditions for fitted tubes, they must comply with the specifications set out in paragraph 2.3 of the ITC-BT-21 of the REBT.

Likewise, the air mounting conditions are established, and these must comply with the specifications set out in paragraph 2.4 of itCBT- 21 of the REBT

1.5.6.9. PROTECTIVE CHANNELS

It shall consist of a profile of perforated or unperforated walls whose purpose is to accommodate the electriccondor ctors and shall be closed with a detachable lidaccording to ITCBT- 01, in accordance with the provisions of the UNE Standards applicable to it.

To ensure the continuity of its protection characteristics, its assembly will be carried out following the instructions provided by the manufacturer.

Its minimum characteristics, for surface installations, shall be those set out in Table 3.2 of the ITC-BT-21 of the REBT.

The installation and commissioning of the protective channels must comply with the following or otherwise the requirements of the UNE Standard that apply to it and in the ITC- BT-19 and ITC-BT-20.

Its layout will preferably be done following the vertical and horizontal walls parallel to the edges of the walls that limit the place where the electrical installation is executed.

Channels with electrical conductivity will be connected to the ground network to ensure their electrical continuity.

Channels may not be used as protective or neutral conductors, except as provided for in ITC-BT-18 for prefabricated type conductors.

1.5.6.10. GENERAL PROTECTION BOXES (CGP)

Only General Protection Boxes (GSC) may be used in this project in accordance with the technical specifications provided by the electricity supplying company and approved by the competent authority, in particular as set out in paragraph 5 of the current Special Rules for the Liaison Facilities of the supplying company.

THE GSPs shall consist of an insulating, sealable envelope containing essentially the connecting terminals and the bases of the fuse cutters for all phase or polar conductors, which shall be of the type

NH with connection terminals and a removable connection to the left of the phases for neutral.

The CGP shall have a system by which the lid, in an open position, is attached to the body of the box without hindering the completion of work inside. In cases where the cover is attached by hinges, its opening angle shall be greater than 90o.

The lids shall be closed by triangular head devices, 11 mm on the side. In the event that the locking devices are screws they must be unmissable.

All these devices shall have a hole of at least 2 mm in diameter for the passage of the sealed wire.

They shall be fitted with circuit-cutting fuses in all phase or polar conductors, with cutting power at least equal to the short-circuit current provided at the point of their installation. Once installed they will have a degree of protection IP43 and IK 08, according to UNE standards that apply to it, being also of sealable type.

In any case, they will comply with the requirements of the ITC-BT-13 of the REBT.

1.5.6.11. SMALL MATERIAL AND SEVERAL

All the small material to be used in the facilities will be of appropriate characteristics for the purpose that it must fulfill, of good quality and preferably of brand and type of accredited solvency, reserving the Optional Directorate the power to fix the models or brands that it dees most convenient.

Under no circumstances shall splices or connections mean the introduction into the circuitof an electrical resistance higher than that offered by a meter of the driver being used.

1.5.7. CONTROL AND ACCEPTANCE OF THE ELEMENTS AND EQUIPMENT THAT MAKE UP THE NETWORKED PHOTOVOLTAIC INSTALLATION

The Optional Directorate shall ensure that all materials, products, systems and equipment forming part of the electrical installation are of quality marks (UNE. EN, CEI, CE, AENOR, etc.), and have the documentation proving that their mechanical and electrical characteristics comply with current regulations, as well as certificates in accordance with UNE, EN, CIS, EC or other standards that are required of you by regulations or by prescription of the designer and as specified in this Specification.

The Optional Directorate may also require samples of the materials to be used and their quality certificates, tests and laboratory tests, rejecting, withdrawing, dismantling or replacing within any stage of the installation the products, elements or devices that it seems to harm to any degree the appearance, safety or goodness of the work.

Where appropriate, tests should be carried out for the receipt of the products or verifications for the fulfilment of their corresponding technical requirements, depending on their use, they may be carried out by sampling or other method indicated by the competent bodies of the Autonomous Communities, in addition to the verification of the supply documentation in all cases, and must be provided or included, together with the equipment and materials , the indications necessary for proper installation and use must be marked with the following minimum indications:

• Identification of the manufacturer, legal representative or responsible for its marketing.

• Make and model.

• Assigned voltage and power (or intensity).

• Any other indication regarding the specific use of the material or equipment, assigned by the manufacturer.

The authorized contractor or installer shall provide the user with a document-packing slip containing the supply of components, materials and manuals for the use and maintenance of the installation. This document will be signed in duplicate by both parties, each retaining one copy. The manuals delivered to the user will be in Spanish to facilitate their correct interpretation. Before the commissioning of all the main elements (modules, inverters, etc.) they must have passed the factory operating tests, from which timely minutes will be lifted to be attached with the quality certificates.

Specifically, for each type element, these indications for their correct identification will be as follows:

Photovoltaic Generator:

• Identification, according to project specifications.

Quality Badge: Quality Brand AENOR

approved by the Ministry of Industry, Trade and Tourism (MICT), meeting the specifications referred to in the UNE Standards for crystalline silicon modules, or for thin layer photovoltaic modules, as well as being qualified by a recognized laboratory, which will be accredited by presenting the corresponding official certificate.

The manufacturer's model and name or logo shall be clearly visible and indelible, as well as an individual identification or serial number traceable to the date of manufacture.

Any module that presents manufacturing defects such as breakages or stains in any of its elements, as well as lack of alignment in cells or bubbles in the encapsulant, will be rejected.

Inverter:

The inverter shall be labelled with at least the following information:

• Nominal power (VA)

• Rated input voltage (V)

• Rated output voltage (VRMS) and frequency (Hz)

• Manufacturer (name or logo) and serial number

• Polarity and terminals

Equivalent quality requirements will be ensured for other types of investors.

Counters and equipment:

• Identification: according to project specifications.

• Quality badge: Types approved by the MICT.

General distribution tables:

• Quality badge: Types approved by the MICT.

Appliances and small electrical equipment for low voltage installations:

• Quality badge: AENOR brand approved by the Ministry of Industry.

Electrical cables, cable accessories, etc.

• Quality badge: AENOR mark approved by the MICT.

All other components of the installation must be received on site in accordance with the manufacturer's documentation, quality marking, the regulations if any, project specifications and the indications of the Optional Directorate during the execution of the works.

In addition, materials not specified in this project that are to be used for the realization of this project will have a quality mark and may not be used without prior knowledge and approval of the Optional Directorate.

1.6. OF THE EXECUTION OR ASSEMBLY OF THE INSTALLATION

1.6.1. GENERAL CONSIDERATIONS

Low Voltage electrical installations shall be carried out by authorized electrical installers for the exercise of this activity, in accordance with DECRETO 141/2009 and ITC Technical Instructions of the REBT and shall be carried out in accordance with the provisions of this Special Technical Conditions And the current regulations.

The Optional Directorate will reject all parts of the facility that do not meet the requirements for them, forcing the authorized installer or Contractor to replace them in their charge.

All applicable legal provisions on occupational safety and health shall always be complyed with. The photovoltaic installation will incorporate all the elements and characteristics necessary to guarantee at all times the quality of the power supply.

The operation of photovoltaic installations shall not cause damage, decreases in safety conditions or alterations greater than those accepted by the applicable regulations.

In addition, the operation of these installations may not give rise to hazardous working conditions for the maintenance and operation personnel of the distribution network.

The transport, handling and use of the materials shall be done in such a way that their characteristics are not altered, or their shapes or dimensions deteriorate.

Outdoor materials shall be protected against environmental agents, in particular against the effect of solar radiation and moisture.

All necessary elements of safety and protections specific to individuals and photovoltaic installation shall be included, ensuring protection against direct and indirect contacts, short circuits, overloads, as well as other elements and protections resulting from the application of current legislation.

In addition, photocopies of the technical specifications provided by the manufacturer of all components that make up the installation will be included.

For reasons of safety and operation of the equipment, the indicators, labels, etc. of these will be in Spanish language.

1.6.2. INITIAL CHECKS

It will be verified that all the elements and components of the photovoltaic installation coincide with its development in the project, and the other way around will be redefined in the presence of the Optional Directorate. The various components of the installation shall be marked by Authorized Installer and in the presence of the Optional Directorate.

When marking the installation lines, the minimum separation of 30 cm shall be taken into account with the installation of water supply or plumbing.

The assembly of the elements shall be governed in accordance with the ITC-BT-40 of the REBT.

1.6.2.1. LAYOUT

At the beginning of the work, it will be necessary to indicate with the plans of this project, on the ground, the movement of land, if necessary, location of the shoes, sn sled, support structure, panels, etc.

1.6.3. INSTALLING PHOTOVOLTAIC MODULES

Photovoltaic modules shall be mounted in such a way as to maximize direct exposure to sunlight and remove or minimize shadows, and installations with reduced angles of inclination that could cause dirt to build up on the glass and edges of the frame should be avoided. Support frames or specialized mounting kits made of anodized aluminium or stainless steel shall be used for fixing.

Particular attention should be paid in the assembly phase to prevent dirt from accumulating on the module surface as it may cause active solar cells to become shaded and electrical performance to be reduced.

In the case of systems mounted on roofs and roofs, a space on the back of the module must be respected to allow proper ventilation.

For the purpose of accommodating the thermal expansion or expansion of frames, it will also be necessary to leave adequate space between photovoltaic modules.

The rear surface of the module should always be left free of external objects or elements of the structure that may come into contact with it, especially if the module is subject to mechanical load.

You must ensure that the modules are not exposed to winds or snowfall that exceed the maximum allowable load and are not subjected to excessive force due to thermal expansion of the support structure.

The fixing system of the modules must be of the "vandal"type. The foundation can be both horizontal and vertical without affecting the installation of the supports of the structures.

The support structures of the modules may be made of anodized aluminum with high resistance to atmospheric agents, thus allowing a long life of the support elements, even in saline environments.

If the module has a connection box it must not be used to hold or transport the module. Particular attention should be paid not to climb or step on its surface.

It will avoid dropping the module or hitting it by dropping other objects on it, as well as avoiding damaging or scratching the rear surface of the module at all times.

In order to maintain the manufacturer's guarantees, no parts or labels installed by the manufacturer may be disassembled, modified or removed.

The frame and glass of the module shall also be avoided. Paint and adhesives should not be applied to the rear surface of the module.

If the glass or rear material of a module is broken, it cannot be repaired or used, as contact with any surface of the module or frame may result in electric shock and must be replaced.

Broken or damaged modules must be handled with care and disposed of properly. Broken glass can have edges and cause wounds if not handled with proper protective equipment.

They should be mounted only in dry weather and with dry tools. They should not be handled when they are wet unless you use appropriate protective equipment.

For roofing installations, the modules must be mounted on a fire-resistant cover approved for this type of installation. Subsequently, the modules will be connected electrically, connecting the photovoltaic field(s), by electrical channeling, to the inverter or inverters, to transform it into alternating current, with voltage and mains frequency, for injection into it. These pipelines will comply with what is required in the REBT Low Voltage Electrotechnical Regulation, in their TECHNICAL Instruction ITC-BT-07, designing the lines, using the heating and voltage drop criteria.

1.6.3.1. INVERTER INSTALLATION

The inverters shall be placed at the network connection point, which the distribution company has previously indicated.

The following considerations shall be observed before installation:

Its location should be away from direct sunlight and in an ambient temperature range between 0 and 40oC.

For assembly, a vertical solid surface or parament will be selected firmly enough to support its weight, requiring an additional cooling space suitable for heat dispersion.

Its position will be marked on the parament and the holes will be made for clamping, placing and tightening the screws.

The connection of the AC part will be performed and then with the photovoltaic panel (DC part) respecting its polarity, always connecting the positive pole (+) of the photovoltaic panel to the positive DC pole (+) of the inverter, and the negative pole (-) of the photovoltaic panel to the negative DC pole (-) of the inverter.

The inverter will then be connected to the corresponding protections, which may consist of electrical short circuit, fuse and connection terminals, both for the inverter and for the supply network.

1.6.4. SIGNALING

The entire electrical installation must be properly marked, and the necessary warnings and instructions shall be provided to prevent errors of interpretation, incorrect manoeuvres and accidental contacts with the voltage elements or any other type of accidents.

For this purpose, it will be taken into account that all major machines and appliances, panel panels and circuits, must be differentiated from each other with clearly established markings, marked by labels of appropriate dimensions and structure for easy reading and understanding. In particular, all the drive elements of the manoeuvre devices and the devices themselves, including the identification of the opening and closing positions, should be clearly marked, except in the case where their identification can be made with the naked eye.

1.7. FINISHES, CONTROL AND ACCEPTANCE, MEASUREMENT AND ABONO

For the provisional reception of the works after completion, the Optional Directorate shall, in the presence of the representatives of the Contractor or authorized installation company, carry out the precise recognitions and tests to verify that the works have been carried out subject to this project and comply with the technical conditions required.

1.7.1. FINISHES

After the electrical photovoltaic installation is complete, the boxes and distribution boxes will be protected to prevent them from being covered by the back linings of the walls. Once these works have been carried out, the electrical automations, bezels and lids will be discovered and placed.

1.7.2. CONTROL AND ACCEPTANCE

Controls during execution: observation points.

• Support structure Material and Anchorage fixing system

• Photovoltaic panels Orientation, tilt, shadow production State of the frames and the surface of the panel Interconnection between panels Connections to the inverter Space for thermal expansion

• Investor Situation with respect to the point indicated by the Distribution Company Anchor and position Connections and operation

• Protections Operational tests

• Measurement equipment

• Pipelines

• Wiring, terminals, splices, shunts and connections in general.

• Foundation, ditches and concrete (if applicable)

• Boxes

• Conservation until the reception of the works

All components of the electrical installation shall be preserved from coming into contact with aggressive materials and moisture.

1.7.3. MEASUREMENT AND FERTILIZER

Drivers shall be measured and valued per linear meter of equal characteristics length, all fully placed including tube, tray or insulation channel and proportional part of bypass boxes and masonry aids where they exist.

The rest of the elements of the installation, such as photovoltaic generator, inverter, general protection box, counter module, mechanisms, etc., per unit fully placed and tested including all the accessories and connections necessary for its proper operation.

1.8. RECOGNITIONS, TESTS AND TRIALS

1.8.1. RECOGNITION OF WORKS

Prior to the recognition of the works, the Contractor will have removed all leftover materials, debris, packaging, etc., until they are completely cleaned and cleared.

This recognition shall verify that all installed materials coincide with those admitted by the Optional Directorate in the prior control carried out prior to installation and that they correspond exactly to the samples in its possession, if any, and will finally verify that they do not suffer any deterioration in their appearance or operation.

Similarly, it will be verified that the realization of the electrical installation has been carried out and finished, finished correctly and completely.

In particular, the verification and verification of the following points is highlighted:

• Execution of terminals, splices, derivations and connections in general.

• Fixing the various devices, disconnectors, switches and others placed.

• Type, rated voltage, rated intensity, characteristics and operation of maniouvre and protection devices.

All low voltage cables as well as all light points and outlets will be tested for 24 hours, according to what the Optional Directorate deems appropriate.

If the heating produced in the bypass boxes, splices, terminals, were excessive, in the opinion of the Optional Directorate, the corresponding material, which will be replaced by a new material on without the Contractor, shall be rejected.

1.8.2. TESTS AND TRIALS

After the recognition is carried out, the following tests and tests shall be carried out by the Contractor irrespective of what is indicated above in this Technical Specifications:

• Operation and commissioning of all systems.

• Start and stop tests at different operating times.

• Testing of the elements and measures of protection, safety and alarm, as well as their action, with the exception of tests related to the automatic disconnect switch.

• Determination of installed power estimate installed power using catalogue and installation data and perform some simple measurements with a calibrated solar cell, thermometer, voltmeter and clamp. If this instrumentation is not available, the power meter itself can be used.

In this same order, the error of estimating the installed power will be increasing. After the testing and commissioning are completed, they will be moved to the provisional reception phase of the Facility. However, the Provisional Reception Act shall not be signed until it has verified that all systems and elements forming part of the supply have functioned properly for a minimum of 240 hours in a row, without interruption or downtime caused by failures or errors of the system supplied, and in addition to the following requirements have been met, in addition to those referred to in the first subparagraph of this paragraph :

Delivery of all required documentation in this Technical Condition Sheet.

During this period the supplier shall be solely responsible for the operation of the supplied systems, although it shall train the operating personnel.

All supplied elements, as well as the installation as a whole, shall be protected against defects in manufacture, installation or design by a two-year warranty.

However, the installer shall be obliged to repair any malfunctions that may occur if it is found that its origin comes from hidden design, construction, material or assembly defects, committing to redress them free of charge. In any case, it must comply with the provisions of the current legislation regarding hidden defects. It will also perform the following checks:

• Insulation measurement of the installation: the insulation test shall be carried out for each of the active conductors in relation to the grounded neutral, or between isolated active conductors. The insulation measure shall be carried out in accordance with Article 28 of the Electrotechnical Regulation for Low Voltage.

• Surge and short-circuit protections: The nominal intensity of the various automatic switches shall be checked to be equal to or less than the maximum service intensity value of the protected conductor.

Splices: it will be checked that the connections of the conductors are safe and that the contacts are not heated normally.

Measurement of the insulation levels of the grounding installation with a previously calibrated ohmeter, verifying, the Engineer Director, which are within the supported limits. Before final reception of the works, a recognition of the works will be carried out again, in order to verify compliance with the provisions on the conservation and repair of the works.

1.9. MAINTENANCE AND USE CONDITIONS

Maintenance actions on the electrical installations of photovoltaic installations connected to the Low Voltage Electrical Network are independent of the periodic inspections that must be carried out.

The owner or Property of the electrical installation are not authorized to perform modification, repair or maintenance operations. These actions must always be performed by an authorized installer.

During the life of the installation, the owners and users of the electrical installations of generation, transport, distribution, connection, link and receivers, must maintain permanently in good condition and operation their electrical installations, using them according to their functional characteristics.

The Property or owner of the installation must submit, together with the request for commissioning of the installation requiring maintenance, in accordance with the provisions of the "Instructions and Guide on the Legalization of Low Voltage Electrical Installations" (Annex VII to Decree 141/2009), a maintenance contract with authorized installer company registered in the corresponding administrative register, expressly contained by the technical maintenance officer.

Maintenance contracts shall be con formalized for annual periods, extendable by agreement of the parties, and where appropriate in a lawful manner. This document shall record the identification data of the installation concerned, in particular its owner, nominal electrical characteristics, location, description of the building and all those other special features worthy of mention.

However, where the operator proves that he has sufficient technical and human resources to carry out the proper maintenance of his facilities, he may acquire the status of maintainer of the facilities. In this case, compliance with the regulatory maintenance requirement will be justified by the presentation of a Certificate of Self-Maintenance that identifies the person responsible for the maintenance.

Outsourcing of maintenance through a third intermediary company will not be permitted.

For those new or renovated installations, the provision of the maintenance contract or the self-maintenance certificate will be mandatory along with the request for commissioning.

Distribution, carrier and generation undertakings on an ordinary regime are exempt from submitting self-maintenance contracts or certificates.

Authorized installers shall inform the competent Energy Management Centre of the acquisition and termination of maintenance contracts at their expense within one month of their subscription or termination.

The checks and checks to be carried out by the maintenance managers shall be carried out on an agreed basis, taking into account the type of installation, its level of risk and the environmental environment, all without prejudice to the other actions that must be carried out for correction of anomalies or by requirement of regulation. The details of the faults or defects detected, identification of the work carried out, list of repaired or replaced parts or devices and the result of the corresponding verifications shall be recorded on auditable support by the Administration.

Distribution companies, carriers and generation undertakings on an ordinary regime are required to communicate to the energy-competent body the relationship of installations subject to external maintenance, as well as the undertakings responsible for it.

Appropriate measures will be taken for such maintenance to ensure the safety of staff.

Maintenance actions on electrical installations are independent of periodic inspections that must be carried out.

In order to be entitled to public funding, through aid or incentives for energy or productive improvements in facilities or industries, the beneficiary natural or legal person shall justify that the corresponding periodic technical inspection of its facilities has been carried out, in accordance with the conditions that are regulatorily established.

1.9.1. Minimum general conditions to be followed for the proper maintenance and conservation of grid-connected solar photovoltaic power installations

Different steps of action are defined to encompass all the necessary operations during the life of the installation in order to ensure its proper operation, increase production and prolong the duration of the installation:

• Surveillance plan.

• Preventive maintenance.

• Corrective maintenance.

Surveillance plan: The monitoring plan basically refers to operations that ensure that the operational values of the facility are correct. It is a simple observation plan of the main functional parameters (energy, voltage etc.) to verify the proper functioning of the installation, including cleaning the modules if necessary.

Preventive maintenance plan: visual inspection operations, verification of actions and others, which applied to the installation should allow to maintain within acceptable limits the operating conditions, performance, protection and durability of the installation.

Corrective maintenance plan: All replacement operations needed to ensure that the system is working properly over its lifetime. Includes:

• Visit to the installation within a maximum period of 1 week and each time the user requires it for serious breakdown in it with resolution of the same within 15 days.

• Analysis and preparation of the budget of the work and replenishments necessary for the proper functioning of the installation.

• The economic costs of corrective maintenance, with the indicated scope, are part of the annual price of the maintenance contract. Neither the labour nor the necessary equipment replacements beyond the warranty period may be included.

Maintenance must be carried out by competent qualified technical personnel who are aware of solar photovoltaic technology and electrical installations in general and always under the responsibility of the installation company.

The installation will have a maintenance book reflecting all the operations performed, as well as corrective maintenance Preventive maintenance must include all maintenance and replacement operations of consumable or wearable elements, necessary to ensure that the system functions properly during its lifetime.

Preventive maintenance of the installation shall include at least one six-monthly review (annual for power installations less than 5 kWp) in which the following activities shall be carried out:

a) Checking electrical protections.

b) Checking the status of the modules: check the situation with respect to the original project and check the status of the connections.

c) Checking the status of the inverter:

operation, signal lamps, alarms, etc.

d) Checking the mechanical condition of cables and terminals (including ground outlet cables and terminal reopening), plates, transformers, fans/extractors, joints, reopening, cleaning.

A technical report will be made for each of the visits reflecting the status of the facilities and the incidents that have taken place.

Maintenance operations carried out in a maintenance book, which shall record the identification of maintenance personnel (name, qualification and authorization of the authorized company) shall be recorded.

Panels.

General inspection 1 or 2 times a year making sure that the connections between panels and the regulator are well adjusted and corrosion-free. In most cases, the action of rain eliminates the need to clean the panels; if necessary, simply use water.

1.9.2. Repair. Replacement

Whenever the installations are checked, the defects found will be repaired and, if necessary, the parts that require it will be replenished.

Faults in the facilities will be repaired at their location by the supplier. If the fault of any component cannot be repaired at the user's home, the component must be sent to the official workshop designated by the manufacturer on assistance and by the supplier.

The supplier shall make repairs or replacements of parts as soon as possible once the fault notice has been received but shall not be liable for any damage caused by the delay in such repairs provided that it is less than 15 calendar days.

1.10. PERIODIC INSPECTIONS

Periodic inspections of electrical installations are independent of maintenance actions required to be carried out.

They shall be carried out within the following time limits, depending on their date of start-up authorisation or their seniority, as the case may be:

1.1. Installations with start-up presented after 18 September 2003: 5 years.

1.2. Start-up installations submitted before 18 September 2003:

1.2.1. Since the last periodic review carried out in compliance with the Order of 30 January 1996: 5 years.

1.2.2. Rest of the un revisioned installations carried out, counted since its start-up: 5 years. Successive inspections shall have a periodicity of 5 years. In any case, these

inspections will be carried out by an Authorized Control Agency (O.C.A.), freely chosen by the owner of the installation.

1.10.1. Certificates of periodic inspections

Periodic inspection certificates shall be submitted in accordance with the official model provided for in Annex VIII to DECREE 141/2009 of 10 November, expressly mentioning the degree of compliance with regulatory conditions, the classification of the result of the inspection, the proposal for the necessary corrective measures and the maximum period for correction of anomalies, as appropriate.

Certificates must be signed by the authors of the inspection with visas by the corresponding Official College of professionals with competences in the field, in ONE (1) MONTH since its completion. In the case of a technician attached to an OCA, the OCA shall stamp its official seal. The certificates shall be kept in the possession of the owner of the facilities, who shall send a copy to the Ministry of Employment, Industry and Trade of the Government of the Canary Islands or Competent Energy Authority for the month following the fulfilment of the maximum deadlines set out in the preceding paragraph.

1.10.2. Generic periodic inspection protocol

The generic inspection protocol to be followed shall be that approved by the competent energy authority, although the undertaking holding the installations may request approval of its own specific review protocol.

1.10.3. Responsibility for regular inspections

Those responsible for the inspection may not be labourly linked to the owner or Owner of the installation, nor to companies subcontracted by that owner. They shall take out liability insurance in accordance with the responsibilities arising from the inspections carried out and have the necessary technical means to carry out the necessary checks.

In the case of other installations annexed of a non-electrical nature (e.g. hydrocarbons, pressure appliances, fire appliances, premises classified as explosive atmospheres, etc.) for which periodic review is also mandatory for the requirement of their specific regulations, convergence in the programming of review dates with those of the linked groups will be sought , although security and proper maintenance of the same shall prevail over other criteria of opportunity or organization.

1.10.4. Periodic inspections of power production facilities

Production facilities on an ordinary basis, as well as those for the transport and distribution of electricity, shall be periodically reviewed by an OCA or by a qualified technician with competence equivalent to that required for the commissioning of the installation, freely chosen by the operator of the installation. The review will take place at least every THREE (3) years, in terms of distribution and transport networks. In the case of generation installations, the manufacturer-defined for further review may be adopted as a review period, although the following time limits may not be exceeded, depending on the technology of the generator group:

a) Diesel groups: TWO (2) years

b) Gas turbines: ONE (1) year and SIX (6) months

c) Steam turbines: FOUR (4) years

d) Other generating systems: THREE (3) years

In the event of auxiliary installations linked to groups of different technologies, the most restrictive period of equipment shall be adopted.

1.10.5. Periodic inspections of all other electrical installations

The holder of the electrical installation shall be obliged to order an OCA, freely chosen by him, to carry out the mandatory periodic inspection, in the manner and time limits established by regulation. Low Voltage electrical installations which, in accordance with Instruction ITC-BT-05 of the Electrotechnical Regulation for Low Voltage, are subject to regular inspections, shall refer to the review periods taking as the start date the start date of commissioning or seniority, as set out in Annex VII to Decree 141/2009.

Medium and high voltage installations shall be subject to periodic inspection at least every three years.

The owners of the installation are obliged to facilitate the free access to them to the technical inspectors of these Agencies, when they are performing their duties, upon accreditation and without prejudice to compliance with the mandatory occupational safety requirements.

The installation company that has signed a maintenance contract shall be obliged to inform the operator of the installation, one (1) month in advance and by means of a reliable record, the date on which it is appropriate to request periodic inspection, attaching a list of all THEEs or referring it to the website of the competent energy body, where such list is located.

It shall also communicate to the competent body the list of electrical installations, in which it has contracted maintenance which have exceeded the mandatory periodic inspection period in three months.

The operator shall have the obligation to keep all technical and administrative documentation linked to the electrical installation in question, during its useful life.

1.10.6. Of the delivery times and validity of OCA inspection certificates

The OCA shall, within FIVE (5) days of inspection, send the original of the certificate to the operator of the installation and copy the professionals present at the inspection. In each inspection act, the OCA shall place on the main control and protection panel an identification label or adhesive plate of indelible material with the date of intervention.

The certificate of an OCA shall be valid for FIVE (5) years in the case of low voltage installations and THREE (3) years for medium and high voltage installations, provided that a substantial change in the characteristics of the installation to which it refers has not been executed.

If the inspection detects a modification to the facility that has not been previously legalized or authorized, as appropriate, it must be classified as negative by serious default. For new

installations, such a circumstance will imply the non-authorization of its commissioning, and for installations in service will be considered a serious breach, all without prejudice to the violations incurred by the responsible subjects, in accordance with the laws in force.

Qualified professionals attached to the OCA shall be obliged to complete and sign the certificates of inspections, whether periodic, initial or extraordinary, of the facilities in which they intervene, having to expressly record and certify the results of the review and guard the control templates used and the field notes of such recognitions. review results and guard the control templates used and fieldnotes of such recognitions.

1.10.7. The seriousness of the defects identified in the inspections of the facilities and the obligations of the owner and the installer

Where at least one defect classified as very serious is detected, the OCA shall classify the inspection as "negative", stating it in the Certificate of Inspection which shall forward, in addition to the operator of the installation and the professionals present at the inspection, to the competent energy authority.

For the commissioning of a facility with a "negative" Certificate of Inspection, it will be necessary to issue a new Certificate of Inspection without such qualification, by the same OCA once the defects that motivated the previous qualification have been corrected. As long as there is no change in the rating given by that Agency, the installation shall be kept out of service. Regardless of the obligations of the operator, the OCA shall forward to the competent energy authority the certificate stating the correction of anomalies.

If in an inspection the technical defects detected involve a serious risk, the OCA is obliged to require the operator of the installation and the installation company to leave out the part of the installation or appliances concerned, proceeding to the total or partial seal of the installation and communicating such a circumstance to the competent energy authority. The OCA inspection to get the installation back into operation shall be done within 24 hours of the operator's communication that the defect has been corrected.

If, despite the request made by the operator, the part of the installation or appliances concerned does not proceed to be left out of service, the OCA shall bring it to the knowledge of the competent energy authority, identifying the persons to which it communicated such a request, in order to take the necessary measures.

If the inspection detects the existence of at least one serious defect or slight defect from another previous inspection, the OCA shall classify the inspection as "conditional", stating it in the Certificate of Inspection which it shall deliver to the operator of the installation and to the professionals present at the inspection. If the installation is new, it will not be able to be put into service as long as the defects indicated have not been corrected and the OCA issues the certificate with the rating of "favorable". For installations already in operation, the OCA shall set a time limit for its correction, which may not exceed six months, depending on the importance and severity of the defects encountered. After the deadline has elapsed without the defects being re-corrected, the OCA shall issue the certificate with the rating of "negative", proceeding as described above.

If, as a result of the OCA inspection, no very serious or serious defects are determined in the installation, the rating may be "favourable". In the event that the OCA observes minor defects,

they must be recorded in the Certificate of Inspection for the constancy of the operator of the installation, indicating that it must put the means to reseat them in a short period of time and, in any case, before the next inspection visit.

1.11. OPTIONAL INDOLE CONDITIONS

1.11.1. FROM THE OWNER OF THE FACILITY AND ITS OBLIGATIONS

The communications of the holder to the Administration may be made using the telematics route (e-mail and internet), in order to speed up the administrative procedure, provided that the identity of the interested party is guaranteed, ensured the constancy of its receipt and the authenticity, integrity and preservation of the document.

Any application or communication made on paper, shall be addressed to the Director-General responsible for energy and shall be submitted in the register of the Energy Competent Counsellor, or in any of the places enabled by Article 38.4 of Law 30/1992 of 26 November on the Legal Regime of Public Administrations and the Common Administrative Procedure.

The inaccuracy or falsity in any data, manifestation or document, of an essential nature, that is accompanied or incorporated into a prior communication will imply the nullity of the act, preventing from the moment it is known, the exercise of the right or activity affected, without prejudice to the responsibilities, criminal, civil or administrative to which it exists.

Before initiating the relevant procedure, the holder of the proceedings must have the connection point to the distribution or transport network and the appropriate permits that enable him for the occupation of land or for the flight on it. If you do not have all the passing permits, you must initiate processing in combination with the public utility where appropriate.

The owner or Property of an electrical installation may act by representative, who must prove, for his action against the Administration, the representation with which he acts, in accordance with the provisions of Article 32.3 of Law 30/1992, of 26 November, on the Legal Regime of Public Administrations and the Common Administrative Procedure.

During the life of the installation, owners and users of electrical installations of generation, transport, distribution, connection, link and receivers must maintain their electrical installations permanently in good condition and operation, using them according to their functional characteristics.

The operator must submit, together with the request for the commissioning of private electrical installations, those of special generation and low voltage electrical installations requiring maintenance, in accordance with the provisions of the "Instructions and Guide on the Legalization of Low Voltage Electrical Installations" (Annex VII to Decree 141/2009), a maintenance contract with authorized installer company registered in the corresponding administrative register, expressly indicated by the technical maintenance officer.

However, where the operator proves that he has sufficient technical and human resources to carry out the proper maintenance of his facilities, he may acquire the status of maintainer of the facilities. In this case, compliance with the regulatory maintenance requirement will be justified by the presentation of a Certificate of Self-Maintenance that identifies the person responsible for the maintenance.

Outsourcing of maintenance through a third intermediary company will not be permitted.

1.11.2. FROM THE OPTIONAL DIRECTION

The Engineer-Director is the highest authority on the site or installation. Regardless of the responsibilities and obligations that legally assist you, you will be the only one with the legal capacity to adopt or introduce modifications to design, constructive or change materials that you consider justified and are necessary under the development of the work.

In the event that the construction management is shared by several competent technicians, it will be in accordance with the provisions of the current regulations.

The optional management shall ensure that the products, systems and equipment forming part of the installation have the documentation proving the characteristics of the products, systems and equipment, as well as the certificates in accordance with the UNE, EN, CIS or other standards that are required by regulations or by prescription of the designer, as well as the guarantees that it holds.

1.11.3. FROM THE INSTALLER OR CONTRACTOR

The installation company or Contractor is the natural or legal person legally established and registered in the corresponding Industrial Register of the competent energy body, which, using its means and organization and under the technical direction of a professional, carries out industrial activities related to the execution, assembly, reform, extension, review, repair, maintenance and dismantling of the electrical installations entrusted to it and is authorized to do so.

In addition to having the corresponding authorization of the competent energy body, it will have the proper solvency recognized by the Engineer-Director.

The contractor undertakes to maintain contact with the energy supplying company through the Director of Work, to apply the rules that affect him and avoid disparate criteria.

The Contractor shall be obliged to comply with the provisions of the Occupational Hygiene and Safety Regulations and any legal provisions of a social nature are in force and affect him.

The Contractor shall take maximum safety measures in the collection of materials and in the execution, conservation and repair of works, in order to protect workers, public, vehicles, animals and other property from damage.

The Contractor shall obtain all permits, licenses and opinions necessary for the execution of the works and commissioning, and must pay the charges, fees and taxes arising there from them.

The Contractor is obliged to comply with the provisions of the Labour Regulations and other provisions governing relations between employers and workers. Proof of TC-1 and TC-2 forms must be presented to the Engineer-Director of work when required, duly eded by the accredited Agency.

In addition, the Contractor shall include in the contract the use of the means and the construction of the auxiliary works that are necessary for the proper execution of the main works and ensure the safety of these The Contractor will take care of the perfect conservation

and repair of the works, redressing any damage or damage to the works, proceeding to the arrangement , repair or replacement of any element of the work.

1.11.4. FROM THE MAINTAINING COMPANY

The authorized installer who has entered into a maintenance contract with the owner or Owner of an electrical installation, or the maintenance manager in a company that has accredited having its own means of self-maintenance, shall have the following obligations, without prejudice to those established by other laws:

a) Permanently keep the facilities in good condition and operational.

b) In private facilities, discontinue service to the facility, in whole or in part, in cases where the imminent danger to people or things is observed, or there is a serious imminent environmental risk. Without prejudice to other actions concerning civil or criminal jurisdiction, in the event of an accident they must notify the competent Energy Management Centre, keeping the operation of the facility interrupted until the defects that have caused the accident are corrected. For the rest of the facilities, the provisions of Royal Decree 1.955/2000 of 1 December, or a rule to replace it, will be addressed.

c) To diligently address the requirements of the holder to prevent or correct faults that occur in the electrical installation.

(d) To inform the holder, in writing, of the deficiencies observed in the installation, affecting the safety of persons or things, so that they are re-implemented.

e) Have at least five (5) YEARS immediately after the completion of the maintenance contracts available to the General Directorate of Industry and Energy of the Government of the Canary Islands.

(f) Communicate to the operator of the installation, at least one (1) MONTH in advance, the date on which it is appropriate to carry out the periodic review to be carried out by an OCA Agency, where it is mandatory.

(g) Communicate to the competent Energy Management Centre the relationship of the electrical installations in which it has contracted the maintenance which have exceeded the official periodic inspection period required in three months.

(h) Assist inspections arising from compliance with current regulations and requested extraordinarily by the holder.

(i) Have subscribed a liability insurance that covers the risks that may arise from its actions, by means of a policy for a minimum amount of 600,000 euros, amount that will be updated annually according to the CPI certified by the Canary Institute of Statistics (ISTAC).

j) Sufficiently size both your technical and human resources and your organization according to the type, voltage, location and number of facilities under your responsibility.

1.11.5. FROM AUTHORIZED CONTROL BODIES

The actions carried out in the territorial field of this Autonomous Community by an OCA, in the terms defined in Article 41 of the Infrastructure Regulation for Industrial Quality and Safety,

approved by Royal Decree 2.200/1995 of 28 December and registered in the Register of Industrial Establishments of this Community and accredited in the field of electrical installations, shall comply with the rules set out below, unless other responsibilities imposed on it by the sectoral legislation.

The certificate of an OCA shall be valid for 5 years in the case of low voltage and 3 years installations for medium and high voltage installations, provided that a substantial change in the characteristics of the installation to which it refers has not been executed. If the inspection detects a modification to the installation that has not been previously authorised, it must be classified as a serious default refusal. For new installations such circumstance will imply the non-authorization of its commissioning, and for installations in service will be considered a serious breach, all without prejudice to the violations incurred by the responsible subjects in accordance with the laws in force.

The OCA shall have at the disposal of the competent energy authority all the registration and statistical data corresponding to each of its actions, classifying the interventions by holder, technician and installer.

Such information may be required at any time by the Administration.

Qualified professionals attached to the OCA shall be obliged to complete and sign the certificates of inspections, whether periodic, initial or extraordinary, of the facilities in which they intervene, having to expressly record and certify the results of the review and guard the control templates used and the field notes of such recognitions.

For the implementation of the revisions, checks and inspections entrusted to them, the OCA shall apply the models of inspection certificates provided for in Annex VIII to Decree 141/2009 and the manuals for reviewing and rating defects as set out in the corresponding guidance protocols, approved by the competent energy authority, or, where appropriate, those recognised by the OCA. THE OCA shall carry out the inspections requested by the competent energy authority, being present in the official inspections of those facilities in which they have intervened and are required.

The discrepancies of the owners of the installations in the event of the actions of the OCA will be revealed to the competent energy authority, which will resolve them within 1 month

1.12. ADMINISTRATIVE INDOLE CONDITIONS

1.12.1. BEFORE THE START OF THE WORKS

Before beginning the execution of this installation, the Property or owner must designate a competent qualified technician as responsible for the Optional Directorate of the work, who, after the completion of the same and carried out the mandatory tests and verifications, will issue the corresponding Certificate of Direction and Completion of Work (according to Annex VI to Decree 141/2009).

In addition, and before starting the works, the Owners or owners of the electrical installation in the construction project shall provide the distribution company or carrier, as appropriate, with all the information necessary to deduct the consumptions and loads to be produced, in order to be able to foresee in advance the growth and size of their networks.

The Owner of the future electrical installation will ask the distribution company for the point and technical conditions of connection that are necessary for the new supply. Such request shall be accompanied by the following information:

a) Name and address of the applicant, telephone, fax, email or other means of contact.

b) Name, address, telephone number and email address of the design technician and/or installer, if applicable.

c) Situation of the installation, building or construction site, indicating the urban classification of the land.

d) Use or destination of this.

e) Total power requested, regulatorily justified.

f) Point of the nearest network to make the connection, proposed by the corresponding installer or technician, unequivocally identifying it, preferably by graphic means.

g) Number of estimated customers.

In the event that it is necessary to submit any additional documentation, the distribution company will request it, within FIVE (5) DAYS of receipt of the application, justifying the origin of such request. Such communication may be made by telematics. The distribution company shall enable the necessary means to record reliable, whatever the route of receipt of the documentation or request, the requests for connection points made, for the purposes of the calculation of deadlines and other actions or responsibilities.

Applications for a connection point relating to installations under the special scheme are also subject to the procedure laid down in this Article.

The information provided must be considered confidential and therefore in its handling and use must comply with the guarantees established by the current legislation on data protection.

Neither the distribution company, nor any other undertaking linked therein, may make offers of services, apart from the technical and economic offer itself, involving restrictions on free competition in the Canary electricity market or favour unfair competition.

Likewise, the Technical Design Document required and described in the following section (project or technical design report), must be prepared and delivered to the Owner or owner before the start of the works and before proceeding with their administrative processing.

1.12.2. Before connecting the photovoltaic installation to the distribution company's network

Before connecting the photovoltaic installation to the low voltage electrical grid, and in accordance with section 9 of itC-BT-40, the distribution company may carry out the following checks, measurements and verifications:

• Review of the certificate of main characteristics of the installation and passing of tests issued by the Specialist Installer, modality 9, which performed the installation and carried out the tests.

• Verification that the characteristics of the elements installed in the boxes and modules correspond to those indicated in the project of the installation approved by the Distribution Company.

• Check that in the generation circuit up to the measurement equipment no generation element other than photovoltaic, accumulation or consumption has been interleaved.

• Checking the correct operation of the General Manual Switch and that it can be blocked by the distribution company in its open position.

• Checking the correct operation of the automatic switch of the interconnection and the voltage and frequency protections, which must be sealed by the distribution company.

• Measurement of the power factor of the photovoltaic installation.

• Review of the correct assembly of the measurement and sealing equipment of the circuits.

• Verification that the owner of the installation has a means of communication that can immediately put the distribution company with the person responsible for the operation of the photovoltaic installation. Whoever performs the verification must confirm with the Control Center of the Distribution Company their knowledge of it.

1.12.3. PROJECT DOCUMENTATION

This project consists of the documents and contents required to be established in the specific regulations that apply to it, and at least provides for the descriptive documentation, in texts and graphic representation, of the electrical installation, of the materials and other elements and activities considered necessary for the execution of an installation with the quality, functionality and security required.

In cases where a "Project Guide" specifically implements it, the Project shall conform in its essential content to that Guide.

This Guide will be indicative, so the projects must be complemented and adapted according to the peculiarities of the installation in question and can be expanded according to the experience and criteria of good practice of the designer. The development of the points that make up each guide presupposes to give content to said design document up to the level of detail that the designer considers, without prejudice to the omissions, failures or breaches that may exist in said document and that in any case are the responsibility of the author of the document.

The Project must be prepared and delivered to the Owner or owner before the start of the works and before their administrative processing.

The Project will consist of at least the following Documents

a) Descriptive memory (owner, location, type of industry or activity, use or destination of the premises and its classification, needs program, detailed description of the installation, total budget).

b) Memory of supporting calculations.

c) Environmental Impact Study in the relevant category, if any.

d) Safety and Health Study or Basic Safety and Health Study (as applicable in accordance with current occupational safety regulations).

(e) Plans at appropriate scales (situation, location, distribution, one-line scheme, etc.).

f) Specifications of Technical, Economic, Administrative and Legal Conditions.

(g) Statement of Measurements and Budget (measurements, partial budgets and general budget).

If during the processing or execution of the installation the change of authorized installer company is made, this fact must be expressly reflected in the documentation submitted by the interested party to the Administration. In the event that this entails changes in the original design technical memory, it must prove the conformity of the company author of the original design or, if not, provide a new Project.

1.12.3.1. NON-SIGNIFICANT MODIFICATIONS AND EXPANSIONS OF ELECTRICAL INSTALLATIONS

MODIFICATIONS AND EXPANSIONS OF IN-SERVICE FACILITIES AND PROJECT DOCUMENTATION

In the case of installations in service, modifications or extensions, which are not yet substantial, shall be reflected in the technical documentation attached to the relevant installation, provided that the technical information is kept permanently up-to-date, especially with regard to one-line schemes, layouts, instruction manuals and installation certificates. Such updates shall be the responsibility of the authorised installer, author of these, and where appropriate, of the competent technician who has directed them.

MODIFICATIONS AND EXPANSIONS OF THE INSTALLATIONS IN THE IMPLEMENTATION PHASE AND THE DOCUMENTATION OF THE PROJECT

In addition, in those electrical installations in execution and that do not represent substantial modifications or extensions (according to Article 45 of RD 141/2009), with respect to the original project, these will be considered as "annexes" to the Certificate of Direction and Completion of work or the Certificate of Installation respectively, without the need to present a reform of the original Project

1.12.3.2. SIGNIFICANT MODIFICATIONS AND EXPANSIONS OF ELECTRICAL INSTALLATIONS

In the case of electrical installations in which significant modifications or extensions are presented, these will involve, both low and high voltage, the presentation of a new Project, in addition to the other documents that are mandatory. The authorised technician or installer, as competent depending on the scope of the planned extension or modification, shall modify or reform the corresponding project or original, justifying the modifications made. In any case, it will be necessary to grant your authorization, depending on the appropriate procedure, in the terms established by Decree 141/2009 of 10 November and other regulations applicable to it.

Where substantial reforms not included in the relevant Technical Design Document have been implemented, the Administration or, where appropriate, the intervening OCA shall issue the Act or Certificate of Inspection, as appropriate, with the classification of "negative". This will imply that the commissioning of the installation will not be authorized or the installation will be

declared illegal if it was already in service, all without prejudice to the infringements incurred by the responsible subjects, in accordance with Law 21/1992, of July 16, industry, and other implementing laws.

1.12.4. FINAL DOCUMENTATION

After the necessary works of the electrical installation are completed, it must be perfectly documented and available to all its users, including its technical characteristics, the level of quality achieved, as well as the instructions for use and maintenance appropriate to it, which shall contain at least the following:

(a) Administrative and legal documentation: identification data of the professionals and companies involved in the work, minutes of receipt of work or equivalent document, administrative authorizations and all other documents determined in the legislation.

(b) Technical documentation: the relevant Technical Design Document (DTD), technical and installation certificates, as well as other technical information on the installation, equipment and materials installed.

c) Instructions for use and maintenance: information on the conditions of use of the installation as well as the instructions for proper maintenance, which shall be reflected in an "Instruction Manual or User Information Annex". This manual shall contain general and specific instructions for use (acting), instructions for use and maintenance: for private, receiving and generation installations on a special regime, information on the conditions of use of the installation, as well as instructions for proper maintenance, which shall be reflected in an "Instruction Manual or User Information Annex". This manual will contain the general and specific instructions for use (action), safety (preventive, prohibitions ...) and maintenance (which, periodicity, how, who ...) necessary and essential to operate and maintain, correctly and safely, the installation taking into account the expected level of qualification of the end user. Both the one-line scheme and the necessary graphic documentation must also be included.

(d) Energy efficiency certificates: (where applicable): documents and information on verified conditions regarding the energy efficiency of the building.

This documentation will be collected by the developer and owner of the installation, who will have the obligation to maintain and guard it during its useful life and in the case of buildings or installations containing various parts that are subject to alienation to different persons, the Promoter will deliver the documentation to the Community of Owners that is constituted.

1.12.5. CERTIFICATE OF DIRECTION AND COMPLETION OF WORK

It is the document issued by the Engineer-Director as a competent Optional Technician, in which it certifies that it has personally and effectively directed the work of the projected installation, assisting with the frequency that its duty to monitor the development of the work has considered necessary, finally checking that the work is completely completed and that it has been carried out in accordance with the specifications contained in the proposed implementation, with the minor modifications indicated, complying, in addition, with the current legislation on the Security Regulations that apply to it. That certificate shall conform to the corresponding model set out in Annex VI to Decree 141/2009.

If, during the processing or execution of the project, the engineer-designer or the Optional Director is changed, this fact must be expressly reflected in the documentation submitted by the petitioner to the Administration, designating the new corresponding optional technician. In the event that this entails changes to the original project, the agreement of the author of the project will be accredited or, if not, a new project will be provided.

The Certificate, once issued and dated by the optional technician, will lose its validity to the Administration if its presentation exceeds the period of THREE (3) MONTHS, counted from that date. In such a case, a new updated Certification, signed by the same author, must be issued.

1.12.6. CERTIFICATE OF INSTALLATION

It is the document issued by the installation company authorized and signed by the qualified professional attached to it that has executed the corresponding electrical installation, in which it is certified that it is completed and has been carried out in accordance with the current regulations and the corresponding technical design document, having been satisfactorily verified in the terms established by said specific regulations , and using materials and equipment that conform to the declared technical standards and specifications of mandatory compliance.

The authorised installation company shall, on a mandatory level, extend an Installation Certificate (according to official model) and an Instruction Manual for each installation it performs, whether it is a new or reform of an existing one. In the processing of facilities where several individual facilities are located, both Certificates and Manuals must be presented and individual facilities exist, in addition to those corresponding to the common areas.

Certificates of individual installations shall not be generally eded regardless of those corresponding to the common installation to which they are linked.

The Certificate of Installation once issued, dated and signed, must be presented to the Administration within the maximum period of THREE (3) MONTHS, counted from that date. Otherwise it will be necessary to issue a new updated Certificate by the same author.

1.12.7. CERTIFIED FOR INVERTERS OF THE PHOTOVOLTAIC INSTALLATION

In addition, and in accordance with the particular Standards of the Supplying Company, certification shall be issued without the investor of the photovoltaic installation complying with the regulations established in Royal Decree 1699/2011, of 18 November, regulating the network connection of small power production facilities, and in particular with the following technical conditions:

1. The protection functions of maximum and minimum frequency and maximum and minimum voltage referred to in Article 14 of the RD are integrated into the inverter equipment, and the disconnect-connect manoeuvres by action of these are performed by means of a contactor that will perform the automatic rearm of the equipment once the normal conditions of supply of the network are restored.

2. Protection for maximum and minimum frequency interconnection is within the values of 51 and 49 Hz, respectively and those of maximum and minimum voltage between 1.1 and 0.85 Um, respectively, there is an impossibility to modify the values of adjustment of protections by the user by means of software.

3. It is also certified that in the event that the distribution network to which the photovoltaic installation is connected is disconnected for any reason, the inverter shall not maintain the voltage on the distribution line.

4. The devices used for frequency and voltage detection have been calibrated by the equipment (description, make, model), having the inverter passed all the tests performed, being documented.

5. The inverter has galvanic separation between the BT distribution network and the photovoltaic installation.

1.12.8. BOOK OF ORDERS

In electrical installations for which an Optional Directorate is required, they shall have the obligation to have the existence of a Book of Orders reflecting all relevant incidents and actions in the work and its milestones, together with instructions, modifications, orders or other information addressed to the Contractor by the Optional Directorate.

Such book of orders will be in the office of the work and will be diligence and dated, before the beginning of these, by the corresponding Official College of professionals with competences in the matter and it may be required by the Administration at any time, during and after the execution of the installation, and will be considered as an essential document in those cases of discrepancy between the technical management and the operating companies involved.

The fulfillment of the orders expressed in this Book is mandatory for theontratist, as well as those contained in this Specification.

The authorized contractor or installer shall be obliged to transcribe in said Book any orders or instructions received in writing from the Optional Directorate, and to sign the appropriate acknowledgement of receipt, without prejudice to the authorization of such transcripts by the Directorate in the Book indicated.

The aforementioned Book of Orders and Assistances is governed by Decree 462/1971 and the Order of 9 June 1971.

1.12.9. INCOMPATIBILITIES

In the same installation or work, the Work Manager may not coincide with the installer or have a working connection with the installation company that is running the work.

1.12.10. INSTALLATIONS RUN BY MORE THAN ONE INSTALLER

In those facilities where more than one authorised installer intervenes in a coordinated manner, the performance of each one must be clearly defined and to what degree of subordination. Each

of the companies involved will issue its own Certificate of Installation, for the part of the installation that it has executed. The Optional Directorate shall have the obligation to collect such circumstance in the corresponding Certificate of Management and Completion of work, accurately indicating the distribution of tasks and responsibilities.

1.12.11. SUBCONTRACTING

The subcontracting may be carried out, but always and mandatory between authorized installation companies, requiring the prior authorization of the Promoter.

Subcontractors will respond directly to the main installer but will have to meet the same demands of professionalism, quality and safety on the site as the main installer.

ANNEX 2: BASIC HEALTH AND SAFETY STUDY

CONTENT

2.1. Object of the Study of safety and Health in the Works

This basic study of safety and health at work corresponds to the Project called "PROJECT OF PHOTOVOLTAIC INSTALLATION ON ROOFS OF THE PHYSICS AND MATHEMATICS SECTION OF THE ULL", and establishes the forecasts during the execution of the works, with respect to: risks of occupational accidents, occupational diseases and damage to third parties, as well as, indicate the guidelines to follow for the realization of the mandatory facilities of health and common services for workers, depending on the number of them that are going to use them. For it:

a) The procedures, technical equipment, machinery, auxiliary means, etc., to be used or to be used will be detailed.

b) The following will be identified: The occupational risks that can be avoided, establishing for this purpose the technical measures necessary for this; and Occupational risks that cannot be eliminated, in accordance with the aforementioned, specifying the preventive measures and technical protections aimed at controlling and reducing said risks, assessing their effectiveness, especially when alternative measures are proposed.

All this will serve to establish the basic guidelines for the construction company (and subcontractors), so that they can carry out their obligations in terms of prevention of professional risks, under the control of the Health and Safety Coordinator, in accordance with the provisions of the Real Decreto1627/1997, de 24 de octubre, which establishes the minimum safety and health provisions in construction works.

All personnel working on the construction site must be trained on the security measures contained in this study, as well as those contained in the subsequent Health and Safety Plan before its implementation.

2.1.1. Promoter of the work

This project is carried out at the request of Universidad de La Laguna.

2.1.2. Project designer of the work

Master's student in renewable energies Roberto Acosta López.

2.1.3. Safety and health coordinator

The Coordinator on Safety and Health, during the execution of the work, will be the competent technician integrated into the Optional Directorate and appointed by the promoter, in accordance with Real Dercreto1627/1997.

2.1.4. Contractors

Since the project is in the process of being processed by the Competent Official Bodies, for approval, the following works have not yet been awarded:

o Unload of material.

o Stakeout of the support structure.

o Placement of the support structure.

o Assembly of photovoltaic modules.

o Placement of the room in the area where the inverter is located and surround AC and DC protections

o Placement of the photovoltaic inverter and the AC and DC protection enclosure. Placement of pipes (tubes and trays) on the roof.

o Direct and alternating current wiring.

o Ground wiring.

o Carrying out functional tests. Construction Management (during the duration of the work).

2.2. FEATURES OF THE PHOTOVOLTAIC INSTALLATION

2.2.1. DESCRIPTION OF THE WORKS

To carry out this installation, the following works will be carried out:

a) Photovoltaic Solar Field:

- Assembly of the plastic structures to hold the photovoltaic modules.

- Installation of direct current and alternating current electrical cables, in conduits under tube, trays and buried.

- Assembly of terminals and connection pieces for conductors.

- Electrical assembly of photovoltaic modules.

- Assembly of the network of interconnection land structures.

b) Investor's room:

- Electrical assembly of the photovoltaic inverter.

- Electrical assembly of the protection panels.

- Electrical assembly of ground networks.

c) Connection to internal network:

- Assembly of the Measurement team.

- Assembly of the Ground Connection Network.

2.2.2. BUDGET

The budget for this project amounts to **TWO HUNDRED THIRTY-THREE THOUSAND THREE HUNDRED SEVENTY-SEVEN AND THIRTY-NINE (€ 233,377.39 IGIC not included)**

2.2.3. IMPLEMENTATION DEADLINE

It is considered possible to carry it out within a period of 32 days.

2.2.4. PLANNED STAFF

The average number of workers planned for the execution of the works is 6.

2.2.5. SITE OF THE SITE

The work is located at AVENIDA ASTROFÍSICO FRANCISCO SÁNCHEZ, S / N, 38206 in the Municipality of San Cristóbal de La Laguna.

2.2.6. CONSTRUCTIVE UNITS THAT MAKE UP THE WORK

The construction units that make up the work are the following:

a) Assembly of plastic structures:

- Transportation, storage and assembly of materials.

- Aluminum profiles.

- Special stainless steel screws.

- Health and Safety Material.

- Individual and collective protection equipment, etc.

b) Assembly of photovoltaic modules:

- Transportation and collection of materials.

- Screws for fastening the modules to the structure.

- Conductors for interconnection.

- Health and Safety Material.

- Individual and collective protection equipment, etc.

c) Assembly of frames, inverter and complementary equipment:

- Installation and connection: inverter and complementary equipment.

- Safety and Health Material.

- Individual protection equipment, collectives, etc.

d) Link to BT's internal network and complementary equipment:

- Conductors for interconnecting the inverter with the general frame.

- Installation and connection: measurement equipment, border switch and complementary equipment.

- Final testing and testing of the installation.

- Safety and Health Material.

- Individual protection equipment, collectives, etc.

2.3. Conditions Of The Environment In Which The Work Is Carried Out

It will be specified whether, once the works have started, there are risks for people outside the same.

2.3.1. Adjoining Buildings

The roof of the building where the photovoltaic system will be assembled has no adjoining buildings.

2.3.2. Existing Facilities

The existing facilities are those corresponding to the interior facilities of the building and the services of the building..

2.4. Available Resources

2.4.1. Materials

These are the ones described in the section MEASUREMENTS AND BUDGET.

2.4.2. Energy and Fluids

Electricity, Water, Human Effort, etc..

2.4.3. Labor

- Technical manager on site

- Electrical work officers

- Electrical work officers specialized in these facilities.

- Machinery operators.

- Specialist pawns.

- Gruists.

2.4.4. TOOLS

- Ferrallista tongs.

- Rules, squads, levels, plumbs.

- Baskets and buckets.

- Blade, scissors, peelers, cable shear, arc saw for metals.

- Complete set of manual tools for running splices and terminations.

- Use of load izing (strobes, flanges, hooks, etc.).

- Cables, slings and trácteles, etc..

2.4.5. AUXILIARY MEDIA

- Tips, easels, nets, ropes, hand ladders, baskets, etc.

- Safety signs, fences, warning beacons and risk indication and warning signs to third parties.

- Voltage absence checker.

- Various tooling (auxiliary maneuvering pulleys, anchor gun, mounting rods and pointers, rods, planks, corrugated, struts, granets, wooden studs, wooden or metal studs, plastic canvases, etc.)

- Etc.

2.4.6. MACHINERY, VEHICLES AND EQUIPMENT

- Truck-crane.

- Trucks and transport vehicles.

- Portable power tool machines, etc.Sistemas de transporte y/o manutención

- S l i n g s .

- Upholstery winch.

- Self-propelled mobile crane.

- etc.

2.5. IDENTIFICACTION, RISK ASSESSMENT AND PREVENTIVE PLANNING

Identify the risk factors, the risks of accident at work and / or occupational disease arising thereof, proceeding to its subsequent evaluation, in such a way as to serve as the basis for the subsequent planning of preventive action in which the measures and actions necessary for its correction will be determined (Law 31/1995, of 8 November, on the Prevention of Occupational Risks).

- After the analysis of the characteristics of the installation and the personnel exposed to the risks, the risks affecting the whole work, the workers of a section or area of the work and those of a particular workplace have been identified.

- After the analysis of the characteristics of the installation and the personnel exposed to the risks, the risks affecting the whole work, the workers of a section or area of the work and those of a particular workplace have been identified.

- The methodology used in this report is to identify the risk factor and associate the risks arising from its presence. The list of Occupational Accident and Disease Risks, based on the official classification of forms of accident and the table of occupational diseases of Social Security, has been used in the identification of risks.

- The concept Of Risk obtained from the joint assessment of the likelihood of injury and the severity of the consequences of the risk assessment is used for the risk assessment.

- Five levels of risk degree have been established for the different combinations of probability and severity, which are indicated in the following table:

GRADO DE RIESGO		SEVERIDAD		
		ALTA	MEDIA	BAJA
PROBABILIDAD	ALTA	MUY ALTO	ALTO	MODERADO
	MEDIA	ALTO	MODERADO	BAJO
	BAJA	MODERADO	BAJO	MUY BAJO

Probability is valued taking into account existing prevention measures and their suitability for legal requirements, technical standards and objects on correct practices.

- Severity is valued on the basis of the most likely consequences of accident or occupational illness.

High : When the estimated possible frequency of damage is high.

Mean : When the estimated possible frequency is occasional.

Low : When the occurrence is rare. It is estimated that the damage can happen, but it is difficult for it to occur.

N/P : Risk that does not proceed.

- High, medium and low severity levels can resemble hazard classification A, B and C, widely used in general inspections:

(A-High) Class A Hazard: Condition or practice capable of causing permanent disability, loss of life and/or very serious material loss.

(Middle) Class B Hazard: Condition or practice capable of causing transient disabilities and/or serious material loss.

(B-Low) Class C Hazard: Condition or practice capable of causing mild non-disabling lesions, and/or slight material loss.

- After the analysis of the characteristics of the work and the personnel exposed to the risks, the measures and actions necessary to be carried out by the installer company are established to treat each of the risks of accident at work and / or occupational disease detected..

2.5.1. Risk Assessment

Mounting the Support Structure

EVALUACIÓN DE RIESGOS									
Actividad	MONTAJE DE LA ESTRUCTURA SOPORTE								
Centro de trabajo								Evaluación nº: 1	
Sección	OBRA CIVIL							Fecha: Septiembre 2020	
Puesto de trabajo									
Evaluación		Periódica						Hoja nº: 1	
	X	Inicial							
Riesgos	**Probabilidad**				**Severidad**			**Evaluación**	
	A	M	B	N/P	A	M	B	G. RIESGO	
01. Caídas de personas a distinto nivel		X			X			ALTO	
02. Caídas de personas al mismo nivel		X				X		MODERADO	
03. Caídas de objetos por desplome o derrumbamiento			X				X	MUY BAJO	
04. Caídas de objetos en manipulación		X				X		MODERADO	
05. Caídas de objetos desprendidos		X					X	BAJO	
06. Pisadas sobre objetos			X				X	MUY BAJO	
07. Choques contra objetos inmóviles			X				X	MUY BAJO	
08. Choques contra objetos móviles			X				X	MUY BAJO	
09. Golpes por objetos y herramientas			X				X	MUY BAJO	
10. Proyección de fragmentos o partículas			X				X	MUY BAJO	
11. Atrapamiento por o entre objetos		X			X			ALTO	
12. Atrapamiento por vuelco de máquinas, tractores o vehículos				X				NO PROCEDE	
13. Sobreesfuerzos		X				X		MODERADO	
14. Exposición a temperaturas ambientales extremas		X				X		MODERADO	
15. Contactos térmicos			X				X	MUY BAJO	
16. Exposición a contactos eléctricos	X				X			MUY ALTO	
17. Exposición a sustancias nocivas			X				X	MUY BAJO	
18. Contactos con sustancias cáusticas y/o nocivas			X				X	MUY BAJO	
19. Exposición a radiaciones			X				X	MUY BAJO	
20. Explosiones			X				X	MUY BAJO	
21. Incendios			X			X		BAJO	
22. Accidentes causados por seres vivos				X				NO PROCEDE	
23. Atropello o golpes con vehículos				X				NO PROCEDE	
24. E.P. producida por agentes químicos			X				X	MUY BAJO	
25. E.P. infecciosa o parasitaria				X				NO PROCEDE	
26. E.P. producida por agentes físicos			X				X	MUY BAJO	
27. Enfermedad sistemática				X				NO PROCEDE	
28. Otros				X				NO PROCEDE	

ASSEMBLY OF PHOTOVOLTAIC MODULES, PIPELINES, AND WIRING

EVALUACIÓN DE RIESGOS									
Actividad	MONTAJE DE MÓDULOS FOTOVOLTAICOS, CANALIZACIONES Y CABLEADO								
Centro de trabajo								Evaluación nº: 2	
Sección	MONTAJE ELÉCTRICO							Fecha: Septiembre 2020	
Puesto de trabajo	ELÉCTRICO								
Evaluación		Periódica						Hoja nº: 2	
	X	Inicial							
Riesgos	**Probabilidad**				**Severidad**			**Evaluación**	
	A	M	B	N/P	A	M	B	G. RIESGO	
01. Caídas de personas a distinto nivel		X			X			ALTO	
02. Caídas de personas al mismo nivel		X				X		MODERADO	
03. Caídas de objetos por desplome o derrumbamiento		X				X		MODERADO	
04. Caídas de objetos en manipulación		X				X		MODERADO	
05. Caídas de objetos desprendidos		X				X		MODERADO	
06. Pisadas sobre objetos			X				X	BAJO	
07. Choques contra objetos inmóviles			X				X	BAJO	
08. Choques contra objetos móviles			X				X	BAJO	
09. Golpes por objetos y herramientas			X				X	BAJO	
10. Proyección de fragmentos o partículas		X				X		MODERADO	
11. Atrapamiento por o entre objetos		X			X			ALTO	
12. Atrapamiento por vuelco de máquinas, tractores o vehículos				X				NO PROCEDE	
13. Sobreesfuerzos		X				X		MODERADO	
14. Exposición a temperaturas ambientales extremas		X				X		MODERADO	
15. Contactos térmicos			X				X	BAJO	
16. Exposición a contactos eléctricos	X				X			MUY ALTO	
17. Exposición a sustancias nocivas			X				X	BAJO	
18. Contactos con sustancias cáusticas y/o nocivas			X				X	BAJO	
19. Exposición a radiaciones			X				X	BAJO	
20. Explosiones			X				X	BAJO	
21. Incendios			X				X	BAJO	
22. Accidentes causados por seres vivos				X				NO PROCEDE	
23. Atropello o golpes con vehículos				X				NO PROCEDE	
24. E.P. producida por agentes químicos			X				X	MUY BAJO	
25. E.P. infecciosa o parasitaria				X				NO PROCEDE	
26. E.P. producida por agentes físicos			X				X	MUY BAJO	
27. Enfermedad sistemática				X				NO PROCEDE	
28. Otros				X				NO PROCEDE	

MOUNTING INVERTER AND BOX PROTECTIONS CA

EVALUACIÓN DE RIESGOS									
Actividad	MONTAJE DE INVERSOR Y CAJA PROTECCIONES CA								
Centro de trabajo								Evaluación nº: 3	
Sección	MONTAJE ELÉCTRICO							Fecha: Septiembre 2020	
Puesto de trabajo	ELÉCTRICO								
Evaluación		Periódica						Hoja nº: 3	
	X	Inicial							

Riesgos	**Probabilidad**				**Severidad**			**Evaluación**
	A	M	B	N/P	A	M	B	G. RIESGO
01. Caídas de personas a distinto nivel		X				X		MODERADO
02. Caídas de personas al mismo nivel		X				X		MODERADO
03. Caídas de objetos por desplome o derrumbamiento		X				X		MODERADO
04. Caídas de objetos en manipulación		X				X		MODERADO
05. Caídas de objetos desprendidos		X				X		MODERADO
06. Pisadas sobre objetos			X				X	BAJO
07. Choques contra objetos inmóviles			X				X	BAJO
08. Choques contra objetos móviles			X				X	BAJO
09. Golpes por objetos y herramientas			X				X	BAJO
10. Proyección de fragmentos o partículas		X				X		MODERADO
11. Atrapamiento por o entre objetos		X			X			ALTO
12. Atrapamiento por vuelco de máquinas, tractores o vehículos				X				NO PROCEDE
13. Sobreesfuerzos		X				X		MODERADO
14. Exposición a temperaturas ambientales extremas			X				X	BAJO
15. Contactos térmicos			X				X	BAJO
16. Exposición a contactos eléctricos	X				X			MUY ALTO
17. Exposición a sustancias nocivas			X				X	BAJO
18. Contactos con sustancias cáusticas y/o nocivas			X				X	BAJO
19. Exposición a radiaciones			X				X	BAJO
20. Explosiones			X				X	BAJO
21. Incendios			X				X	BAJO
22. Accidentes causados por seres vivos				X				NO PROCEDE
23. Atropello o golpes con vehículos				X				NO PROCEDE
24. E.P. producida por agentes químicos			X				X	MUY BAJO
25. E.P. infecciosa o parasitaria				X				NO PROCEDE
26. E.P. producida por agentes físicos			X				X	MUY BAJO
27. Enfermedad sistemática				X				NO PROCEDE
28. Otros				X				NO PROCEDE

LINK TO LOW VOLTAGE INTERNAL GRID AND LAND GRID

EVALUACIÓN DE RIESGOS								
Actividad	ENLACE A RED INTERIOR DE BAJA TENSIÓN Y RED DE TIERRAS							
Centro de trabajo							Evaluación nº: 4	
Sección	MONTAJE ELÉCTRICO						Fecha: Septiembre 2020	
Puesto de trabajo	ELÉCTRICO							
Evaluación		Periódica					Hoja nº: 4	
	X	Inicial						
Riesgos	**Probabilidad**				**Severidad**			**Evaluación**
	A	M	B	N/P	A	M	B	G. RIESGO
01. Caídas de personas a distinto nivel			X				X	BAJO
02. Caídas de personas al mismo nivel			X				X	BAJO
03. Caídas de objetos por desplome o derrumbamiento			X				X	BAJO
04. Caídas de objetos en manipulación		X				X		MODERADO
05. Caídas de objetos desprendidos			X				X	BAJO
06. Pisadas sobre objetos			X				X	BAJO
07. Choques contra objetos inmóviles			X				X	BAJO
08. Choques contra objetos móviles			X				X	BAJO
09. Golpes por objetos y herramientas			X				X	BAJO
10. Proyección de fragmentos o partículas		X				X		MODERADO
11. Atrapamiento por o entre objetos		X				X		MODERADO
12. Atrapamiento por vuelco de máquinas, tractores o vehículos				X				NO PROCEDE
13. Sobreesfuerzos		X				X		MODERADO
14. Exposición a temperaturas ambientales extremas			X				X	BAJO
15. Contactos térmicos			X				X	BAJO
16. Exposición a contactos eléctricos	X				X			MUY ALTO
17. Exposición a sustancias nocivas			X				X	BAJO
18. Contactos con sustancias cáusticas y/o nocivas			X				X	BAJO
19. Exposición a radiaciones			X				X	BAJO
20. Explosiones			X				X	BAJO
21. Incendios			X				X	BAJO
22. Accidentes causados por seres vivos				X				NO PROCEDE
23. Atropello o golpes con vehículos				X				NO PROCEDE
24. E.P. producida por agentes químicos			X				X	MUY BAJO
25. E.P. infecciosa o parasitaria				X				NO PROCEDE
26. E.P. producida por agentes físicos			X				X	MUY BAJO
27. Enfermedad sistemática				X				NO PROCEDE
28. Otros				X				NO PROCEDE

2.6. GENERAL SAFETY AND HEALTH RULES. MINIMUM PROVISIONS

It refers to the minimum provisions contained in ANNEX IV to R.D. 1627/1997 and affecting the entire work..

2.6.1. GENERAL CONSIDERATIONS APPLICABLE DURING THE EXECUTION OF THE WORK

In accordance with the Law on the Prevention of Occupational Risks, the principles of preventive action set out in article 15 thereo shall apply during the execution of the work and, in particular, in the following tasks or activities:

a) The maintenance of the work in good condition of order and cleanliness.

b) The correct choice of the location of the posts and work areas, taking into account their conditions of access, and the determination of the routes or areas of displacement or circulation.

c) Proper handling of the various materials and use of auxiliary means.

(d) Maintenance, pre-commission control and periodic control of the facilities and devices necessary for the execution of the work, in order to correct defects that could affect the safety and health of workers.

(e) The delimitation and conditioning of storage and storage areas of the various materials, in particular in the case of hazardous materials or substances.

f) The collection of hazardous materials used.

(g) The storage and disposal or disposal of waste and debris.

(h) Adaptation, depending on the evolution of the work, of the effective period to be devoted to the various work or phases of work.

(i) Cooperation between contractors, subcontractors and self-employed workers.

j) Interactions and incompatibilities with any other type of work or activity performed on the site or near the site of the work.

2.6.2. Minimum Safety and Health Provisions to Be Applied in the Works

Stability and Solidity

(a) Mobile or fixed jobs above or below ground level shall be solid and stable taking into account:

1o) The number of workers occupying them.

(2) The maximum loads which, where appropriate, may have to be borne, as well as their distribution.

3o) External factors that may affect them.

(b) Where the supports and other elements of these workplaces do not have their own stability, their stability shall be ensured by appropriate and safe fasteners in order to avoid any unexpected or involuntary displacement of all or part of those jobs.

(c) Stability and robustness shall be appropriately checked, and especially after any change in the height or depth of the work station.

d) The stability of materials and equipment and, in general, any element that on any displacement could affect the safety and health of workers shall be ensured.

Object Drops

(a) Workers shall be protected against falling objects or materials: collective protection measures shall be used where technically possible.

(b) Where necessary, covered cases shall be established or access to hazardous areas shall be prevented.

c) Collection materials, equipment and work tools shall be placed or stored in such a way as to prevent their collapse, fall or overturn.

Exposure to Particular Risk

(a) Workers shall not be exposed to harmful sound levels or harmful external factors. (Gases, vapours, dust, etc.).

b) In the event that some workers have to enter an area whose atmosphere may contain toxic or harmful substances, or not have oxygen in sufficient quantity or be flammable, the confined atmosphere shall be controlled and appropriate measures taken to prevent any danger.

Temperature and Atmospheric Factors

(a) The temperature should be adequate for the human body during working time, where circumstances permit, taking into account the working methods applied and the physical burdens imposed on workers.

b) Workers should be protected from inclement weather that may compromise their safety and health.

Roads and Hazardous Areas

(a) Roads, access to work areas and loading docks and ramps shall be calculated, located, conditioned and prepared for use in such a way that they can be used easily, safely and in accordance with the use to which they are intended and so that workers employed in the vicinity of these driving routes are not at risk.

(b) The dimensions of the routes intended for the movement of persons or goods, including those in which loading and unloading operations are carried out, shall be calculated according to the number of persons who can use them and the type of activity.

c) Where means of transport are used on the roads, a sufficient safety distance or appropriate means of protection shall be provided for other persons who may be present in the working areas

HEALTH AND COMMON SERVICES

a) Medical service:

- It is planned to have such a service by the construction company, either own or pooled, and with sufficient means to provide first aid to workers.

- Measures to monitor and monitor the health of workers shall be carried out by health personnel with technical competence, training and accredited capacity.

- New staff entering the work will pass a pre-entry recognition to the workplace. Periodic medical examinations will be annual. Measures to monitor the health of workers shall always be carried out in compliance with the right to privacy and dignity of the worker and the confidentiality of all training related to his health status. The results of such recognitions shall be made known to the workers concerned and may never be used for discriminatory purposes or to the detriment of the worker.

In the event of an accident the injured person will be transferred as quickly as possible to the nearest hospital.

Portable kits will be available in construction vehicles, with all the necessary material indicated in the General Conditions Fold.

b) Hygienic services:

- For the impossibility of locating booths with portable services throughout the line, these will be located in the supply camps.

- They will have the following services: Water supply. Dressing rooms and toilets. Toilets. Showers

VEHICLES AND MACHINERYFOR EARTH MOVEMENT AND MATERIAL HANDLING

(a) Vehicles and machinery for earth movement and material handling shall comply with their specific regulations. In any event, and safe from specific provisions of the abovementioned legislation, vehicles and machinery for earth movement and material handling shall satisfy the conditions set out in the following points of this paragraph.

b) All vehicles and machinery for earth movement and material handling shall:

1o Be well designed and built, taking into account, as far as possible, the principles of ergonomics.

2o Keep in good working order.

3o Use correctly.

c) Drivers and personnel in charge of vehicles and machinery for earth movement and material handling shall receive special training.

(d) Preventive measures shall be taken to prevent them from falling into excavations or water, vehicles or machinery for earth movement and material handling.

(e) Where appropriate, machinery for earth movement and material handling shall be equipped with structures designed to protect the driver from crushing, in the event of overturning of the machine, and against falling objects.

FACILITIES, MACHINES AND EQUIPMENT

a) The installations, machinery and equipment used in the works shall comply with their specific regulations. In any event, and safe from specific provisions of the above-mentioned legislation, installations, machinery and equipment shall satisfy the conditions set out in the following points of this paragraph.

(b) Installations, machinery and equipment, including manual or non-motor tools, shall:

1o Be well designed and built, taking into account, as far as possible, the principles of ergonomics.

2o Keep in good working order.

3o Use exclusively for jobs that have been designed.

4o To be managed by workers who have received adequate training.

c) Pressure installations and appliances shall comply with their specific regulations.

d) The perimeter and accesses of the work shall be marked and highlighted in such a way as to be clearly visible and identifiable.

(e) On site, workers shall have drinking water and, where appropriate, other appropriate non-alcoholic beverages in sufficient quantity, both in the premises they occupy and near the jobs.

(f) Workers shall have facilities to be able to eat and, where appropriate, to prepare their meals in safety and health conditions.

2.7. SAFETY STANDARDS OF PREVENTIVE ACTION AT EVERY STAGE OF THE WORK

The objective of these safety standards of preventive action at each stage of the work, is to establish the actions and methodologies necessary to control accidents, occupational diseases or unsafe conditions that may presumably occur, as well as preventive measures and technical protections aimed at avoiding them.

2.7.1. In the work of Assembling Structures

Most Frequent Risks

- Improper collection of materials.

- Trapping by falling stacked material due to wind action.

- Hits and falling material during placement on the terrace.

- Collision of the load with obstacles.

- Etc.

Rules of Preventive Action

- Materials shall be collected in the pre-designed places, and the areas of evolution and passage of personnel must be free of obstacles. In case of stacking, the corresponding tracing devices or other fasteners shall be placed to avoid uncontrolled displacement or fall. Batteries shall be carried out taking into account the possible action of the wind.

- The materials shall be placed in the box of perfectly stacked vehicles and subjected so that they do not suffer unforeseen movements during transport. It is prohibited to carry personnel together with the cargo in the vehicle box, unless there is a rigid and consistent separation.

- The load shall not exceed the maximum authorised of the vehicle and shall not stand out from the sides of the case. The protruding loads at the rear of the vehicle shall not exceed 3 metres and shall be properly marked.

- The loading and unloading of materials with crane will be done taking into account that no person remains in the cab or the truck box, as well as within reach of the route to be carried out by the crane and the load.

- The crane will be handled by the truck driver and only one person will give the necessary instructions to carry out the movements with the load, in accordance with UNE 001.

- The driver is responsible for verifying that the weight to be borne does not exceed what is allowed in the crane's table of characteristics.

- The strobes and slings to be used will be suitable for the loads to be handled.

- The devices will never be left to be ingable with the loads suspended.

- The lifting of the load will always be done vertically and if it is carried out in an oblique or dragging direction, the Head of Labour will be responsible for taking all necessary security measures.

- In order to avoid accidents because of lack of visibility of the load path, the visionless angles of the load path for the driver (grower, etc.) shall be supplemented by operators who using pre-agreed signals supplant the vision of the said worker.

- The permanence (or work of operators) in areas under the path of suspended loads is prohibited.

- Work on the hosing, transport and descent of suspended loads shall be interrupted under winds above 60 km/h.

- In case of possibility of contact of machinery with power lines, gauges will be placed to protect the line.

- If there is a contact of an electrical line with a machine equipped with a pneumatic tread train, the driver shall remain stationary at his workplace and request assistance by means of horns. The tyre train shall be inspected in order to detect the possibility of an electric bridge with the ground; If possible jumping without risk of electrical contact, the driver will jump out of the machine without simultaneously touching the machine and the terrain.

- Machines in accidental contact with power lines shall be cordoned off at a distance of 5 metres, and the company that owns the line is notified to make the necessary supply and grounding cuts in order to safely change the position of the machine.

- Materials shall be collected at a distance from the edge of excavations greater than 2 metres, or at the depth of the excavation if the excavation is greater than 2 metres.

2.7.2. In the Asssembly of Photovoltaic Modules, Pipelines and Wiring

Most Frequent risks

- Fall of people and objects at different level.

- Falling people at the same level.

- Buried and/or aerial obstacles.

- Falling objects.

- Hits or projections.

- Injuries from breakage of the bars or pointers of the drill.

- Derivatives of performing work in powdery environments

- Hose breakage injuries.

- Injuries from work exposed to high noise.

- Internal injuries from continuous work exposed to strong vibrations.

- Entrapments and/or crushes.

- Over-strengthening.

- Others.

Rules of Preventive Action

- During the rethinking of the works, all obstacles, both air and buried, shall be marked with an indication of the situation and characteristics thereof, especially in the case of dangerous driving.

- The slashes at risk of falling from height will be executed fastened with the seat belt to a firm and solid point of the terrain (from the natural environment, or built exprofessive).

- Before starting the work, the slashes will be inspected by the Processor, who will give the starting order.

- It is recommended to prohibit work around a working pneumatic hammer at distances of less than 5 m.

- I know forbid placing workers working at lower levels under a pneumatic hammer in operation in prevention of detachments.

- A protective visor of those slashes, which must be executed at lower levels, shall be installed under a working pneumatic hammer.

- The splices and pressure hoses of pneumatic hammers shall be checked at the beginning of each break period, replacing those or sections there of them, defective or damaged.

- Drills shall be ensured to be carried out on the leeward, in the prevention of unnecessary exposures to powder environments.

- The personnel to use the hammers will know the perfect operation of the tool, the correct execution of the work and the risks of the machine.

- It is forbidden to leave the pointer swelled when interrupting work.

- It is forbidden to leave the hammer or drill keeping the pressure circuit connected.

- Personnel who handle pneumatic hammers in powdery environments shall be subject to special attention with regard to the airways in medical check-ups.

- Before starting work, it will be known whether there are buried water, gas or electricity conductions in the area where you use the pneumatic hammer in order to prevent possible interference accidents.

- In particular, in the presence of electrical conductions that emerge in un foreseen locations, work will be halting, notifying the Energy Supply Company, in order to cut off the power before the resumption of work.

2.7.3. In Mounting the Inverter and Enveloping CA Protections

Most Frequent Risks

- Hit or hit for mis manipulation.

- Falling people.

- Hits or projections.

- Derivatives of performing work in powdery environments

- Hose breakage injuries.

- Injuries from work exposed to high noise.

- Internal injuries from continuous work exposed to strong vibrations.

- Entrapments and/or crushes.

- Over-strengthening.

- Others.

Rules of Preventive Action

The following preventive measures shall be taken to neutralise the risks referred to in the previous paragraph:

- Before starting excavation work in a new area, existing service plans will be consulted to ensure that there are no buried facilities that may pose a risk.

- The edges of the excavations will be kept free of materials, debris, tools and any other loose material that may fall into it.

- All personnel will wear protective helmets, safety shoes and protective glasses.

2.7.4. In Low-Voltage, Land Grid Work

Most Frequent Risk

- Falling people.

- Falling people into ditches

- Hits with tools and laying machine.

- Hits with objects.

- Hand wounds.

- Member tightening.

- Over-strengthening.

- Etc.

Rules of Preventive Action

- The strobe of cable coils for loading and unloading, etc., will be carried out by means of a special tool adapted to the size and weight of the same.

- The coils may be placed on a vehicle or on fixed supports (cats-hydraulics) to unroll the cable. If they are on the vehicle, it will brake and fit; if placed on supports, they must be capable of the weight to be borne and stable enough not to yield to the axial shot that occurs when unrolling.

- Empty coils and their packaging will be removed from construction as soon as the cable is unrolled.

- When unrolling the cable is done by hand, a system shall be established to join forces and avoid over-efforts of operators isolated by coordination errors.

- The ends of each cable section shall be marked with rings or plates which allow unequivocal identification when making connections.

- All personnel involved in cable laying work will wear safety helmets, gloves, protective goggles and protective shoes.

- The communication elements (radio phones) must be tested before the start of any of the laying operations.

- A Safety Plan will be available for accident care and evacuation.

- The laying winch, driven by autonomous motor, must have a built-in mechanical voltage meter, dynamometer that must be maximum and of, with automatic stop device.

- The surface of the laying rollers shall be smooth and free of porosities and roughness. Rollers with canals or erosions that may damage the cable will not be permitted.

2.7.5. Execution of Terminals, Splices, Screen Lands, Downloaders, Etc.

Most Frequent Risks

- Falling people at the same level.

- Falls of people at different level.

- Manual tool handling cuts.

- Clicks on the hands by handling the cables.

- Manual tool hits.

- Over-strengthening by forced postures.

- Lighter burns during heating operations.

- Drops of objects.

- Burns from incandescent matches.

- Burns from contact with hot objects.

- Skin conditions.

- Injuries to the hands and feet.

- Shock or hits against objects.

- Strange bodies in the eyes.

- Others.

Rules of Preventive Action

a) Portable power tools:

- The supply voltage of manually operated portable power tools shall not exceed 250 Volts in relation to ground.

- The portable power tools to be used in the works of this, will be class II or double insulation.

- Portable power tools must have a switch under the pressure of a spring, which forces the operator to constantly press and hold the switch in the running position.

- Electric conductors shall be of the flexible type with a reinforced insulation of at least 440 V rated voltage.

- Portable power tools will not carry wire or grounding plug. b) Manual power tools:

- All Approved according to the EC Regulatory Technical Standard on Safety Isolation of manual tools used in electrical work in low voltage installations shall be.

- Manual Power Tools can be two types:

- Manual Tools: They will consist of insulating material, except in the working head, which can be of conductive material.

- Insulated tools: They are metallic, coated with insulating material.

- All electrical manual tools shall bear a badge with the inscription of the CE mark, date and maximum operating voltage 1,000 V. c) Portable electric lamps:

- The possible lighting of the work area, will be carried out by means of portable lamps, with watert seal lamp holder with insulating handle and light bulb protection grille, powered at 24 volts.

- They shall comply with UNE 20-417 and UNE 20- 419.

- Be equipped with a shock protection fence.

- Have a watertight tulip that guarantees protection against water projections.

- An insulating handle that avoids electrical risk.

- They must be built in such a way that they cannot be disassembled without the help of tools.

- They shall be of the appropriate IP degree of protection to the workplace.

- Insulation conductors shall be of the flexible type, reinforced insulation of at least 440 V rated voltage.

d) Other:

- The preventive measures described in the previous paragraphs will be met, mainly as regards the daily and prior to the start of work, the means of collective protection of the work and the equipment of individual protection will be reviewed.

2.7.6. Other Prevention Measures

In addition to the individual and collective protections listed in this section on general risk analysis and preventive measures, the following shall be adopted:

Training

- All staff will receive, upon entry into the work, training in the field of safety and health, with an account of working methods and the main risks, as well as the safety measures to be used to avoid them.

- As wide a number of qualified personnel as possible will be given a lifeguard and first aid course, so that at all times there is a lifeguard at all times.

Preventive Medicine and First Aid

- All personnel who start working on the site must pass medical examination in advance. Mobile machinery management personnel will also undergo psychotechnical recognition.

- Regular health inspections of the hygienic facilities of the work (dining rooms, changing rooms, toilets, etc.) will be carried out in check on its correct maintenance.

- If the water for consumption of personnel is not supplied from the municipal network, it must be analysed before distribution.

- Several kits will be available containing the material specified in the current legal regulations on the prevention of occupational hazards. Each slice will have a hand kit.

- All personnel will be informed of the site site of the different medical centres for the transfer of the accidents. A list of emergency departments and addresses will also be displayed in a clearly visible place.

2.8. Means of Protections

- Any protective clothing or equipment which has been treated as a limit, i.e. the maximum for which it was designed, shall be discarded and replaced at the time.

- Where, due to the circumstances of the work, there is a premature deterioration of personal protective equipment, they shall be replenished, regardless of the expected duration or date of delivery.

- The clothing or personal protective equipment will never pose a risk in itself.

- The personal protective clothing required shall bear the EC seal and shall be appropriate to the risk they seek to alleviate, in accordance with R.D. 773/97 of 30 May (BOE 12 June 1.997).

2.8.1. Individual Protections

- If there is EC-marked approval, the personal protective clothing to be used in this work shall be CE-marked and approved and are as follows:

- Class E dielectric safety helmets.

- Leather gloves.

- Rubber gloves.

- Safety boots.

- Impact and dust goggles.

- Seat belts.

- Safety harness.

- Tool holder belt.

- Dust masks.

- Foam ear protectors.

- Working jumpsuits.

- Anti-rain monkeys.

- Others.

2.8.2. Collective Protections

- Fences of limitation and protection.

- Traffic signals in on-site accesses.

- Safety signals in the slashes according to the risks.

- Beacon tapes.

- Stops for moving trucks in jobs next to unevenness, excavations, etc.

- Grounding in frames and electrical machines (except double insulation).

- Extinguishers.

- Vehicles equipped with acoustic and luminous motion indicators, as well as servo brakes and handbrake.

- Enclosures in machinery capable of cutting, rubbing, pricking or trapping.

- Damping and absorption systems in vibrating machinery.

- Rings or nameplates on cables to be connected.

- Others.

2.9. Safety and Health Coordinator During the Execution of the Works

This coordinator will be appointed by the Promoter, in accordance with Royal Decree 1627/1997, in order to develop the functions contained in the aforementioned regulations, among which is the custody of the Book of Incidents and the approval of the Safety and Health Plan to be developed by the construction company and the subcontractors.

2.10. Safety and Health Committee

- The Safety and Health Committee is the joint and collegiate body of participation aimed at regular and regular consultation of the company's actions on risk prevention.

- The Committee shall consist of the Prevention Delegates (as representatives of the workers), on the one hand, and the employer and/or his representatives in numbers equal to that of the Prevention Delegates, on the other.

- Trade Union Delegates and technical managers of prevention in the undertaking who are not included in the composition referred to in the preceding paragraph shall participate, with a voice but without a vote.

- The Safety and Health Committee will meet quarterly and whenever requested by any of the representations in the same.

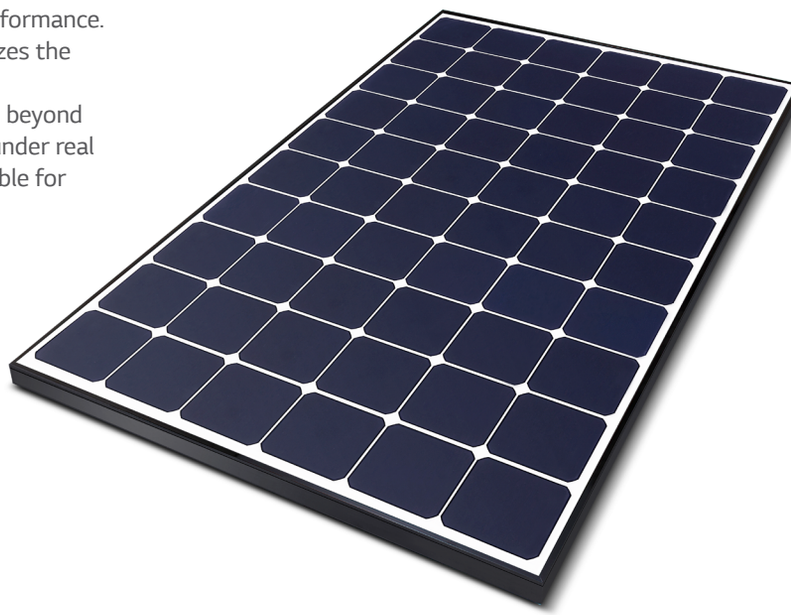
ANNEX 3: DATASHEETS

LG NeON®R

60

380W I 375W I 370W I 365W

LG NeON® R is powerful solar module that provides world-class performance. A new cell structure that eliminates electrodes on the front maximizes the utilization of light and enhances reliability.
LG NeON® R is a result of LG's efforts to increase customer's values beyond efficiency. LG NeON® R features enhanced durability, performance under real -world conditions, an enhanced warranty and aesthetic design suitable for roofs.



Feature

Aesthetic Roof

LG NeON® R has been designed with aesthetics in mind: the lack of any electrodes on the front creates an improved, modern aesthetic.

Extended Product Warranty

LG has extended the product warranty of the LG NeON® R to 25 years which is top level of the industry.

Enhanced Performance Warranty

LG NeON® R has an enhanced performance warranty. After 25 years, LG NeON® R is guaranteed to perform at minimum 90.8% of initial performance.

More generation per square meter

The LG NeON® R has been designed to significantly enhance its output, making it efficient even in limited space.

About LG Electronics

LG Electronics is a global big player, committed to expanding its operations with the solar market. The company first embarked on a solar energy source research program in 1985, supported by LG Group's vast experience in the semi-conductor, LCD, chemistry and materials industries. In 2010, LG Solar successfully released its first MonoX® series to the market, which is now available in 32 countries. The NeON® (previous. MonoX® NeON), NeON®2, NeON®2 BiFacial won the "Intersolar AWARD" in 2013, 2015 and 2016, which demonstrates LG Solar's lead, innovation and commitment to the industry.

LG NeON®R

LG380Q1C-V5 I LG375Q1C-V5 I LG370Q1C-V5 I LG365Q1C-V5

General Data

Cell Properties(Material / Type)	Monocrystalline / N-type
Cell Maker	LG
Cell Configuration	60 Cells (6 x 10)
Module Dimensions(L x W x H)	1,700mm x 1,016mm x 40mm
Weight	17.5 kg
Glass(Thickness / Material)	2.8mm / Tempered Glass with AR Coating
Backsheet(Color)	White
Frame(Material)	Anodized Aluminium
Junction Box(Protection Degree)	IP68 with 3 Bypass Diodes
Cables(Length)	1,000mm x 2EA
Connector(Type / Maker)	MC4 / MC

Certifications and Warranty

Certifications	IEC 61215-1/-1-1/2:2016, IEC 61730-1/2:2016
	UL 1703
	ISO 9001, ISO 14001, ISO 50001
	OHSAS 18001
Salt Mist Corrosion Test	IEC 61701:2012 Severity 6
Ammonia Corrosion Test	IEC 62716:2013
Module Fire Performance	Type 1 (UL 1703)
Fire Rating	Class C (UL 790, ULC/ORD C 1703)
Product Warranty	25 Years
Output Warranty of Pmax	Linear Warranty*

* 1) First year : 98%, 2)After 1st year : 0.3% annual degradation 3) 90.8% for 25years
** LG380Q1C-V5 model has UL 1703 certification only

Temperature Characteristics

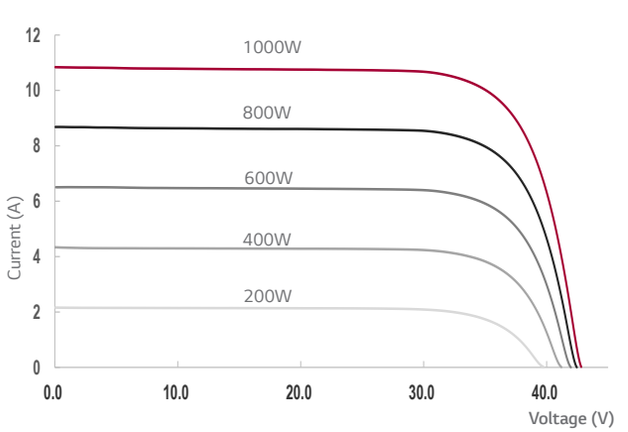
NMOT*	[°C]	44 ± 3
Pmax	[%/°C]	-0.30
Voc	[%/°C]	-0.24
Isc	[%/°C]	0.037

* NMOT(Nominal Module Operating Temperature) : Irradiance 800 W/m², Ambient temperature 20 °C, Wind speed 1 m/s, Spectrum AM 1.5

Electrical Properties (NMOT)

Model		LG380Q1C-V5	LG375Q1C-V5	LG370Q1C-V5	LG365Q1C-V5
Maximum Power (Pmax)	[W]	286	282	279	275
MPP Voltage (Vmpp)	[V]	37.3	37.1	36.9	36.6
MPP Current (Impp)	[A]	7.67	7.61	7.55	7.51
Open Circuit Voltage (Voc)	[V]	40.3	40.3	40.3	40.2
Short Circuit Current (Isc)	[A]	8.73	8.72	8.71	8.70

I-V Curves



Electrical Properties (STC*)

Model		LG380Q1C-V5	LG375Q1C-V5	LG370Q1C-V5	LG365Q1C-V5
Maximum Power (Pmax)	[W]	380	375	370	365
MPP Voltage (Vmpp)	[V]	37.4	37.2	37.0	36.7
MPP Current (Impp)	[A]	10.17	10.09	10.01	9.95
Open Circuit Voltage (Voc, ±5%)	[V]	42.9	42.8	42.8	42.8
Short Circuit Current (Isc, ±5%)	[A]	10.84	10.83	10.82	10.80
Module Efficiency	[%]	22.0	21.7	21.4	21.1
Power Tolerance	[%]	0 ~ +3			

* STC (Standard Test Condition): Irradiance 1000 W/m², Cell Temperature 25 °C, AM 1.5,
** Measure Tolerance : ± 3%

Operating Conditions

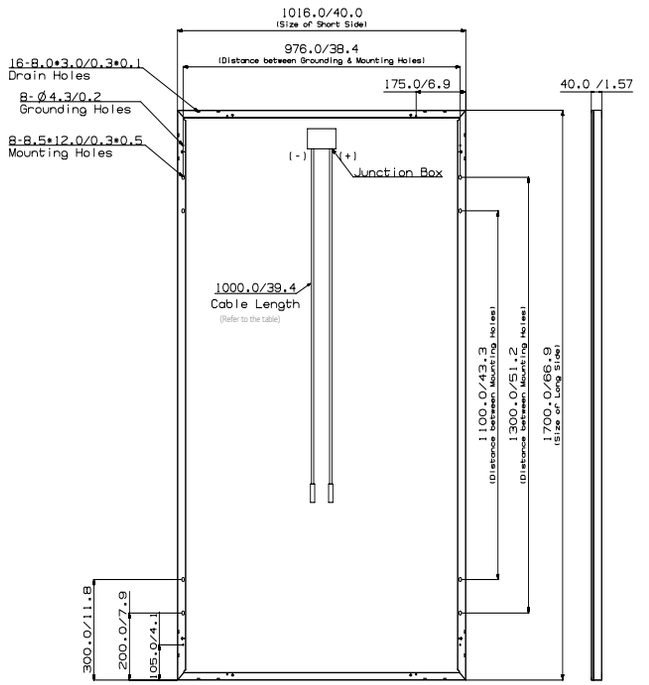
Operating Temperature	[°C]	-40 ~ +90
Maximum System Voltage	[V]	1,000
Maximum Series Fuse Rating	[A]	20
Mechanical Test Load(Front)	[Pa / psf]	5,400 / 113
Mechanical Test Load(Rear)	[Pa / psf]	4,000 / 83.5

※ Mechanical Test Load 5,400Pa / 4,000Pa based on IEC 61215-2 : 2016
(Test Load = Design Load x Safety Factor(1.5))

Packaging Configuration

Number of Modules Per Pallet	[EA]	25
Number of Modules Per 40ft HQ Container	[EA]	650
Packaging Box Dimensions (L x W x H)	[mm]	1,750 x 1,120 x 1,221
Packaging Box Gross Weight	[kg]	473

Dimensions (mm / inch)



LG Electronics Inc.
Solar Business Division
LG Twin Towers, 128 Yeoui-daero, Yeongdeungpo-gu, Seoul
07336, Korea

www.lg-solar.com

Product specifications are subject to change without notice.
DS-V5-60-C-G-F-EN-90812

Inversor Trifásico

SE12.5K - SE27.6K

INVERSORES

Especialmente diseñados para trabajar con los optimizadores de energía

- Rendimiento superior (98%)
- Pequeños, los más livianos de su categoría y fáciles de instalar
- Monitoreo integrado a nivel de módulo
- Conexión a Internet vía Ethernet o inalámbrica
- IP65 – Instalación en exteriores e interiores
- Inversor de tensión fija para cadenas más largas
- Control de la Gestión Inteligente de Energía
- Unidad de seguridad CC integrada opcional - elimina la necesidad de contar con aisladores CC externos (solo SE25K y SE27.6K)
- Protección contra sobretensiones CC y fusibles de CC opcionales (solo SE25K y SE27.6K)

solaredge

/ Inversor Trifásico

SE12.5K - SE27.6K

	SE12.5K	SE15K	SE16K	SE17K	SE25K	SE27.6K	
SALIDA							
Potencia nominal de salida CA	12500	15000	16000	17000	25000 [1]	27600	VA
Máxima potencia de salida CA	12500	15000	16000	17000	25000 [1]	27600	VA
Tensión de salida CA – Línea a línea / línea a neutro (nominal)	380 / 220; 400 / 230						Vac
Tensión de salida CA – Rango línea a neutro	184 - 264,5						Vac
Frecuencia CA	50/60 ± 5						Hz
Corriente de salida continua máxima (por fase)	20	23	25,5	26	38	40	A
Redes compatibles – Trifásicas	3 / N / PE (WYE con neutro)						V
Monitoreo de red, protección contra funcionamiento en isla, factor de potencia configurable, umbrales configurables por países	Sí						
ENTRADA							
Potencia máxima de CC (módulo STC)	16850	20250	21600	22950	33750	37250	W
Sin transformador, sin puesta a tierra	Sí						
Tensión máxima de entrada	900						Vdc
Tensión de entrada CC nominal	750						Vdc
Corriente máxima de entrada	21	22	23	23	37	40	Adc
Protección contra polaridad inversa	Sí						
Detección de aislamiento de falla de puesta a tierra	Sensibilidad de 700 kΩ				Sensibilidad de 350 kΩ[2]		
Rendimiento máximo del inversor	98				98,3		%
Rendimiento ponderado europeo	97,7	97,6	97,7	97,7	98	98	%
Consumo de energía durante la noche	< 2,5				< 4		W
CARACTERÍSTICAS ADICIONALES							
Interfaces de comunicación compatibles[3]	RS485, Ethernet, ZigBee (opcional), wifi (opcional), GSM integrado (opcional)						
Gestión inteligente de la energía	Limitación de la exportación, Smart Energy						
UNIDAD DE SEGURIDAD CC (OPCIONAL)							
Desconexión de 2 polos	N/D				1000 V / 40 A		
Protección contra sobretensiones CC	N/D				Tipo II, reemplazable in situ		
Fusibles de CC en positivo y negativo	N/D				Opcional, 20 A		
Cumplimiento	N/D				UTE-C15-712-1		
CUMPLIMIENTO DE NORMAS							
Seguridad	IEC-62103 (EN50178), IEC-62109, AS3100						
Normas sobre conexión a la red[4]	VDE-AR-N-4105, G59/3, AS-4777, EN 50438 , CEI-021, VDE 0126-1-1, CEI-016[5], BDEW						
Emisiones	IEC61000-6-2, IEC61000-6-3 , IEC61000-3-11, IEC61000-3-12						
RoHS	Sí						
ESPECIFICACIONES PARA LA INSTALACIÓN							
Diámetro del prensacables de salida CA / sección del cable	15-21 mm / Cable rígido 2,5-16 mm², cable flexible 2,5-10 mm²				18-25 mm / Cable rígido 2,5-16 mm², cable flexible 2,5-10 mm²		
Entrada CC	2 pares MC4				3 pares MC4		
Entrada de CC con unidad de seguridad	N/D				Prensaestopas diámetro 5-10		mm
					Sección del cable 0,5 - 13,5		mm²
Dimensiones (Al. x An. x Pr.)	540 x 315 x 260						mm
Dimensiones con unidad de seguridad (Al. x An. x Pr.)	N/D				775 x 315 x 260		mm
Peso	33,2				45		kg
Peso con unidad de seguridad	N/D				48		kg
Rango de temperatura de trabajo	-20 - +60[6] (versión M40 -40 - +60)						°C
Enfriamiento	Ventilador (reemplazable por el usuario)						
Ruido	< 50				< 55		dBA
Grado de protección	IP65 - Exteriores e interiores						
Montaje sobre soporte (suministrado)							

[1] 24,99 kVA en el Reino Unido
[2] Donde las regulaciones locales lo permitan
[3] Consultar Datasheets (Fichas técnicas) -> Communications (Comunicaciones) en la página Downloads (Descargas) para ver las especificaciones de las opciones de comunicación opcionales: http://www.solaredge.com/groups/support/downloads
[4] Consultar Certifications (Certificaciones) en la página Downloads (Descargas) para ver todas las normativas: http://www.solaredge.com/groups/support/downloads
[5] Solo modelos SE25K y SE27.6K
[6] Para más información sobre reducción de potencia, consultar: https://www.solaredge.com/sites/default/files/se-temperature-derating-note.pdf

CE RoHS

Inversor trifásico

SE30K / SE33.3K

INVERSORES

Diseñado para trabajar con optimizadores de potencia

- Inversor a tensión fija CC para una eficiencia superior (98,3%) y strings más largos
- Puesta en marcha rápida y sencilla del inversor directamente desde su smartphone con SolarEdge SetApp
- Pequeño, el más ligero de su categoría, y fácil de instalar
- Protección integrada frente a sobretensiones CC de tipo 2 de serie, para una mejor resistencia a las tormentas
- Protección opcional frente a sobretensiones para CA de tipo 2 y RS485
- Monitorización a nivel de módulo con comunicación por Ethernet, inalámbrica o telefonía móvil para una visibilidad completa del sistema
- Funciones de seguridad avanzadas: protección integrada contra fallos de arco y apagado de seguridad SafeDC
- IP65 - Instalación en interiores y exteriores
- Unidad de seguridad de CC integrada opcional: elimina la necesidad de interruptores externos de CC
- Solución de almacenamiento SolarEdge lista para el futuro

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/ Inversor trifásico

SE30K / SE33.3K

Aplicable a inversores con código de producto	SE30K	SE33.3K	
	SEXXK-XXX8IXXXX		
SALIDA			
Potencia nominal de salida CA	29990	33300	W
Potencia máxima de salida CA	29990	33300	VA
Tensión nominal de salida CA: fase-fase / fase-neutro	380/220 ; 400/230		Vca
Rango de tensión de salida CA: fase-fase / fase-neutro	304 - 437 / 176 - 253 ; 320 - 460 /184 - 264,5		Vca
Frecuencia CA	50/60 ± 5 %		Hz
Corriente máxima de salida constante (por fase)	43,5	48,25	Aac
Posibles conexiones de la línea de salida CA	3 W + PE, 4 W + PE		
Monitorización de red, protección contra funcionamiento en isla, factor de potencia configurable, umbrales configurables por país	Sí		
Distorsión armónica total	≤ 3		%
Rango de factor de potencia	+/-0.8 to 1		
ENTRADA			
Potencia máxima de CC admitida (módulo STC)	45000	50000	W
Sin transformador, sin puesta a tierra	Sí		
Tensión nominal de entrada CC+ a CC-	750		Vcc
Corriente máxima de entrada	43,5	48,25	Acc
Protección contra polaridad inversa	Sí		
Detección de fallo de aislamiento a tierra	Sensibilidad 150 kΩ[1]		
Rendimiento máximo del inversor	98,3		%
Rendimiento ponderado europeo	98		%
Consumo de energía nocturno	<4		W
CARACTERÍSTICAS ADICIONALES			
Interfaces de comunicación	2 x RS485, Ethernet, Wi-Fi (necesita antena), telefonía móvil (opcional)		
Gestión Smart Energy	Limitación de exportación		
Puesta en marcha del inversor	Con la aplicación móvil SetApp utilizando la conexión Wi-Fi integrada para la conexión local		
Protección contra fallos de arco	Integrado, configurable por el usuario (según UL1699B)		
Apagado rápido	Opcional[2] (Automático tras desconexión de la red de CA)		
Protección contra sobretensiones RS485	Opcional		
Protección contra sobretensiones de CC	Tipo II, reemplazable, integrada		
Protección contra sobretensiones de CA	Tipo II, reemplazable, opcional		
UNIDAD DE SEGURIDAD DE CC (OPCIONAL)			
Desconexión de 2 polos	1000 V/48,25 A		
Fusibles de CC	Opcionales, 25 A		
Cumplimiento	UTE-C15-712-1		
CUMPLIMIENTO DE NORMATIVAS			
Seguridad	IEC-62103 (EN50178), IEC-62109		
Normas de conexión a la red[3]	VDE 0126-1-1, VDE-AR-N-4105, RD1699, RD413, UNE 206007-1, UNE 206006		
Emisiones	IEC61000-6-2, IEC61000-6-3 Clase A, IEC61000-3-11, IEC61000-3-12		
RoHS	Sí		
ESPECIFICACIONES PARA LA INSTALACIÓN			
Diámetro prensaestopas de salida de CA/Sección transversal de línea/Sección transversal de PE	18-25 mm / 4 – 16 mm² / 4 – 16 mm²		
Entradas de CC[4][5]	4 pares MC4		
Entrada de CC con unidad de seguridad [4][5]	4 pares MC4		
	4 entradas por prensaestopas: Diámetro exterior del cable 5 - 10 mm / Sección trasversal del cable 2.5 - 16mm²		
	Entrada única por prensaestopa: Diámetro exterior del cable 9 - 16 mm / Sección trasversal del cable 6 - 35mm²		
Dimensiones (Al x An x P)	550 x 317 x 273		mm
Dimensiones con unidad de seguridad (Al x An x P)	836 x 317 x 300 (DC MC4); 819 x 317 x 300 (DC Gland)		mm
Peso	32		kg
Peso con unidad de seguridad	36,5		kg
Rango de temperatura de funcionamiento	De -40 a +85[6]		˚C
Refrigeración	Ventilador (reemplazable por el usuario)		
Ruido	<62		dBA
Grado de protección	IP65 — Exterior e interior		
Montaje	Sobre soporte (suministrado)		

(1) Donde permitido por la normativa local
(2) Código de inversor con desconexión rápida: SexxK-xxRxxxxx
(3) Para conocer todas las normativas, consulte la categoría Certificaciones en la página de Descargas: http://www.solaredge.com/groups/support/downloads
(4) Entrada de CC disponible con conectores MC4 o prensaestopas según el código de producto del inversor. Para más información, contactar con SolarEdge
(5) Solo los conectores MC4 fabricados por Stäubli están aprobados para la conexión de los modelos con entradas con conectores MC
(6) Para más información sobre derating por temperatura:: https://www.solaredge.com/sites/default/files/se-temperature-derating-note.pdf

CE RoHS

Optimizador de potencia

P650 / P701 / P730 / P800p / P801 / P850 / P950

OPTIMIZADOR DE POTENCIA

Optimización de potencia FV a nivel de módulo

La solución más económica para instalaciones industriales y a gran escala

- Especialmente diseñados para trabajar con inversores SolarEdge
- Hasta un 25 % más de energía
- Rendimiento superior (99,5%)
- Reducción de costes BoS; 50% menos en cables, fusibles y cajas de conexiones, posibilidad de crear strings dos veces más largos
- Instalación rápida con un solo tornillo
- Mantenimiento avanzado gracias a la monitorización a nivel de módulo
- Desconexión de la tensión a nivel de módulo para la seguridad de los instaladores y bomberos
- Diseñados para uso con dos módulos FV conectados en serie o en paralelo

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/ Optimizador de potencia

P650 / P701 / P730

Modelo de optimizador (compatibilidad típica de módulo)	P650 (para 2 módulos FV de 60 células)	P701 (para 2 módulos FV de 60/120 células)	P730 (para 2 módulos FV de 72 células)	
ENTRADA				
Potencia nominal CC de entrada[1]	650	700	730	W
Método de conexión	Entrada única para módulos conectados en serie			
Tensión máxima absoluta de entrada (Voc a la temperatura más baja)	96		125	Vdc
Rango de operación MPPT	12.5 - 80		12.5 - 105	Vdc
Corriente máxima de entrada (Isc)	11	11.75	11	Adc
Rendimiento máximo	99.5			%
Rendimiento ponderado	98.6			%
Categoría de sobretensión	II			
SALIDA DURANTE EL FUNCIONAMIENTO (OPTIMIZADOR DE POTENCIA CONECTADO AL INVERSOR SOLAREDGE EN FUNCIONAMIENTO)				
Corriente máxima de salida	15			Adc
Tensión máxima de salida	85			Vdc
SALIDA DURANTE STANDBY (OPTIMIZADOR DE POTENCIA DESCONECTADO DEL INVERSOR SOLAREDGE O INVERSOR SOLAREDGE APAGADO)				
Tensión de salida de seguridad por optimizador de potencia	1 ± 0.1			Vdc
CUMPLIMIENTO DE NORMATIVAS				
CEM	FCC Part15 Class A, IEC61000-6-2, IEC61000-6-3			
Seguridad	IEC62109-1 (class II safety)			
RoHS	Yes			
Seguridad contra incendios	VDE-AR-E 2100-712:2013-05			
ESPECIFICACIONES PARA LA INSTALACIÓN				
Inversores SolarEdge compatibles	Three phase inverters SE15K & larger	Three phase inverters SE16K & larger		
Tensión máxima permitida del sistema	1000			Vdc
Dimensiones (An. x La. x Al.)	129 x 153 x 42.5		129 x 153 x 49.5	mm
Peso (incluidos cables)	834		933	gr
Conector de entrada	MC4[2]			
Longitud de cable de entrada	0.16		0.16 , 0.9 [3]	m
Conector de salida	MC4			
Longitud de cable de salida	1,2 (conexión módulos en vertical)	-		m
	1,8 (conexión módulos en horizontal)		2,2 (conexión módulos en horizontal)	
Rango de temperatura de trabajo[4]	-40 - +85			˚C
Grado de protección	IP68 / NEMA6P			
Humedad relativa	0 - 100			%

(1) La Potencia STC nominal del módulo no puede exceder la "Potencia nominal de CC de entrada" del optimizador. Módulos con hasta un +5% de tolerancia de potencia permitida.
(2) Para otros tipos de conectores, contactar con SolarEdge.
(3) Disponibles otras longitudes de cables de entrada para módulos con caja de conexión separada. (Para 0.9m solicitar P730 xxxLxxx).
(4) Para temperaturas ambiente superiores a los +70°C , se aplica reducción de la potencia. Consultar la Nota de aplicación de reducción de potencia por temperatura de los optimizadores para más detalles

/ Optimizador de potencia

P800p / P801 / P850 / P950

Modelo de optimizador (compatibilidad típica de módulo)	P800p (para la conexión en paralelo de 2 módulos FV de 96 células 5")	P801 (para 2 módulos FV de 72 células)	P850[1] (para la conexión en serie de 2 módulos de alta potencia o bifaciales)	P950 (para 2 módulos de alta potencia o bifaciales)	
ENTRADA					
Potencia nominal CC de entrada[2]	800	800	850	950	W
Método de conexión	Entrada doble para conexión independiente	Entrada única para módulos conectados en serie			
Tensión máxima absoluta de entrada (Voc a la temperatura más baja)	83	125			Vdc
Rango de operación MPPT	12.5 - 83	12.5 - 105			Vdc
Corriente máxima de entrada (Isc)	7	11.75	12.5		Adc
Rendimiento máximo	99.5				%
Rendimiento ponderado	98.6				%
Categoría de sobretensión	II				
SALIDA DURANTE EL FUNCIONAMIENTO (OPTIMIZADOR DE POTENCIA CONECTADO AL INVERSOR SOLAREDGE EN FUNCIONAMIENTO)					
Corriente máxima de salida	18	15	18	17	Adc
Tensión máxima de salida	85				Vdc
SALIDA DURANTE STANDBY (OPTIMIZADOR DE POTENCIA DESCONECTADO DEL INVERSOR SOLAREDGE O INVERSOR SOLAREDGE APAGADO)					
Tensión de salida de seguridad por optimizador de potencia	1 ± 0.1				Vdc
CUMPLIMIENTO DE NORMATIVAS					
CEM	FCC, parte 15, clase B, IEC61000-6-2, IEC61000-6-3				
Seguridad	IEC62109-1 (seguridad de clase II)				
RoHS	Si				
Seguridad contra incendios	VDE-AR-E 2100-712:2013-05				
ESPECIFICACIONES PARA LA INSTALACIÓN					
Inversores SolarEdge compatibles	Inversores trifásicos SE16K y superiores				
Tensión máxima permitida del sistema	1000				Vdc
Dimensiones (An. x La. x Al.)	129 x 168 x 59	129 x 153 x 49.5	129 x 162 x 59		mm
Peso (incluidos cables)	1064	933	1064		gr
Conector de entrada	MC4[3]				
Longitud de cable de entrada	0.16	0.16 , 0.9	0.16 , 0.9 , 1.3 , 1.6[4]	0.16 , 1.3 , 1.6	m
Conector de salida	MC4				
Longitud de cable de salida	1,2 (conexión módulos en vertical)				m
	1,8 (conexión módulos en horizontal)	2,2 (conexión módulos en horizontal)			
Rango de temperatura de trabajo[5]	-40 - +85				˚C
Grado de protección	IP68 / NEMA6P				
Humedad relativa	0 - 100				%

(1) P850 sustituye el P800; ambos modelos se pueden usar indistintamente y se pueden conectar en el mismo string.
(2) La Potencia STC nominal del módulo no puede exceder la "Potencia nominal de CC de entrada" del optimizador. Módulos con hasta un +5% de tolerancia de potencia permitida.
(3) Para otros tipos de conectores, contactar con SolarEdge.
(4) Disponibles otras longitudes de cables de entrada para módulos con caja de conexión separada. (Para 0.9m solicitar P801/P850 xxxLxxx. Para 1.3m solicitar P850/P950 xxxXxxx. Para 1.6m solicitar P850/P950 xxxYxxx).
(5) Para temperaturas ambiente superiores a los +70°C , se aplica reducción de la potencia. Consultar la Nota de aplicación de reducción de potencia por temperatura de los optimizadores para más detalles.

/ Optimizador de potencia

P650 / P701 / P730 / P800p / P801 / P850 / P950

DISEÑO DE SISTEMA FV usando un inversor SolarEdge[6][7][8]		SE15K TRIFÁSICO Y SUPERIOR	SE16K TRIFÁSICO Y SUPERIOR						TRIFÁSICO PARA RED DE 277/480V						
Optimizadores de potencia compatibles		P650	P650	P701	P730	P801	P800p / P850	P950	P650	P701	P730	P801	P800p / P850	P950	
Longitud mínima de string	Optimizadores de potencia	14													
	Módulos FV[7]	27													
Longitud máxima de string	Optimizadores de potencia	30													
	Módulos FV[7]	60													
Potencia máxima por string		11250[9]					13500[9]	12750[9]	12750[10]				15300[10]	14450[10]	W
Strings paralelos de distintas longitudes o formatos		Si													

(6) P650/P701/P730/P801 se pueden mezclar en un string. No es posible mezclar P650/P701/P730/P801 con P850/P800p. No es posible mezclar P950 con algún otro modelo de optimizador ni mezclar P650-P950 con P300-P505 en el mismo string.

(7) En caso de strings con número de módulos impares es posible instalar un optimizador P650/P701/P730/P850/P800p/P801/P950 conectado con un sólo módulo. En caso de conectar un optimizador P800p con un módulo solamente sellar la entrada que no se utilice con el par de tapones suministrados.

(8) P850 sustituye el P800; cada par se puede usar indistintamente y se puede conectar en el mismo stringPara SE15k y superior, la potencia mínima de CC debe ser de 11KW.

(9) Para redes trifásicas 230/400V: con P650/P701/P730/P801 se pueden instalar hasta 13500W por string, con P850/P800p hasta 15750W y con P950 hasta 16250W por string cuando la máxima diferencia entre strings no sea superior a 2000W.

(10) Para redes trifásicas 277/480V: con P650/P701/P730/P801 se pueden instalar hasta 15000W por string, con P850/P800p hasta 17550W y con P950 hasta 17950W por string cuando la máxima diferencia entre strings no sea superior a 2000W.

CE RoHS

Application Note: SolarEdge Fixed String Voltage, Concept of Operation

Version History

- Version 1.1 (Feb. 2019) – Added note about M series power optimizers
- Version 1.0 (Sept. 2010) – Initial release

The SolarEdge system maintains a fixed string voltage regardless of string characteristics and environmental conditions. This application note details the concept of operation of the SolarEdge fixed string voltage and its benefits.

Concept of Operation

The SolarEdge power optimizer is a DC-DC power optimizer integrated into each module, replacing the junction box. The power optimizers, using an input control loop, perform per module MPPT and enable performance monitoring of each module. In an independent process, the power optimizers enable the inverter to automatically maintain a fixed string voltage, at the optimal point for DC-AC conversion by the inverter, regardless of string length and individual module performance.

The operating principles of the SolarEdge system are illustrated in the following example, which examines a system's behavior under varying conditions.

The example system consists of 10 200W modules. Each module has an integrated power optimizer, essentially a DC/DC buck-boost[1] converter with an MPPT controller. The power optimizers are serially-connected to form a string; multiple strings can be connected in parallel to the same input of the SolarEdge inverter. The SolarEdge inverter is a single stage current source – it continuously adapts the current it draws from the PV array in order to keep the input voltage constant.

The SolarEdge power optimizer is highly efficient, maintaining over 98% conversion efficiency over a wide range of conditions. However, for calculation simplicity, we assume 100% power optimizer efficiency in this example.

Scenario 1 – Ideal Conditions: Initially, we assume all the modules are exposed to full irradiance, each providing 200W of power. The power output of each solar module is maintained at the module's maximum power point by an input control loop within the corresponding power optimizer. This MPP loop dictates to the power optimizer an input current I_{in} and input voltage V_{in} that ensure the transfer of the entire 200W from the module to the DC bus. We assume an MPP voltage for each module (given perfectly matched modules for demonstration purposes) of V_{MPP} = 32V. This means the input voltage to the power optimizer is 32V, and the input current is 200W/32V = 6.25A. The input voltage to the inverter is controlled by a separate feedback loop. For simplicity, in this example the inverter requires a constant 400V. Since there are ten serially-connected modules, each providing 200W, the input current to the inverter is 2000W/400V = 5A. Thus, the DC bus current flowing through each of the power optimizers must be 5A. This means that each power optimizer in this example provides an output voltage of 200W/5A = 40V. In this case, the power optimizers are acting as up converters, converting the 32V input voltage to the target 40V output voltage. The various system currents and voltages in this case are illustrated in Figure 1.

[1] Applies to power optimizers from series PB, OP and P. M series power optimizers are buck only, however operate similarly.

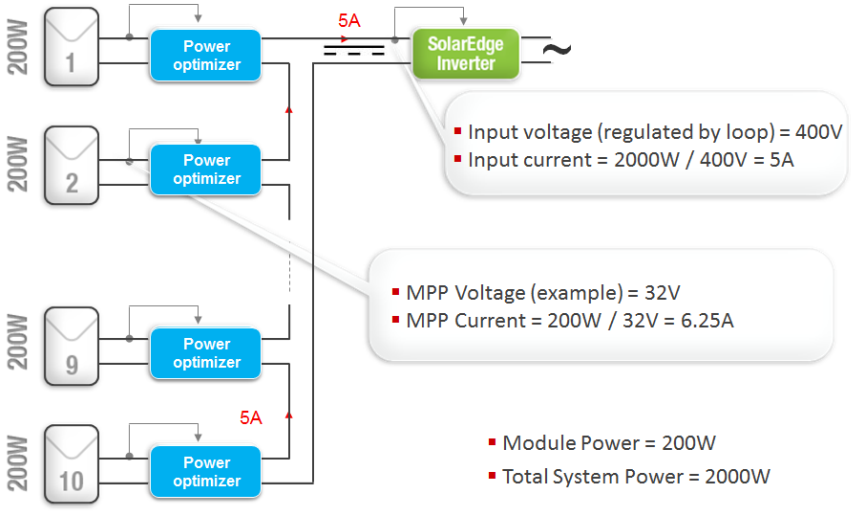

Figure 1: Operation under Ideal Conditions

Scenario 2 - Partial Shading: Next, we assume module #9 is shaded and consequently produces only 40W of power. The other 9 modules are not shaded and each still produces 200W of power. The power optimizer of the shaded module maintains that module at its maximum power point, which is now lowered due to the shading. Assuming V_{MPP} = 28V, the current is 40W/28V = 1.43A. The total power produced by the string is now 9x200W+40W = 1840W. Since the inverter still needs to maintain an input voltage of 400V, the input current to the inverter will now be 1840W/400V = 4.6A. This means that the DC bus current must be 4.6A. Therefore, the power optimizers of the 9 un-shaded modules will have an output of 200W/4.6A = 43.5V.

In contrast, the power optimizer attached to the shaded module will output 40W/4.6A = 8.7V. The input to the inverter can be obtained by summing 9 modules providing 43.5V and 1 module providing 8.7V, i.e. 9x43.5V+8.7V = 400V, as required by the inverter. In this case, the 9 power optimizers producing 200W each are essentially acting as up converters, converting the 32V input voltage to a 43.5V output voltage, whereas the power optimizer of module #9 is acting as a down converter, converting the 28V input voltage to an 8.7V output voltage.

The various system currents and voltages in this case are illustrated in Figure 2.

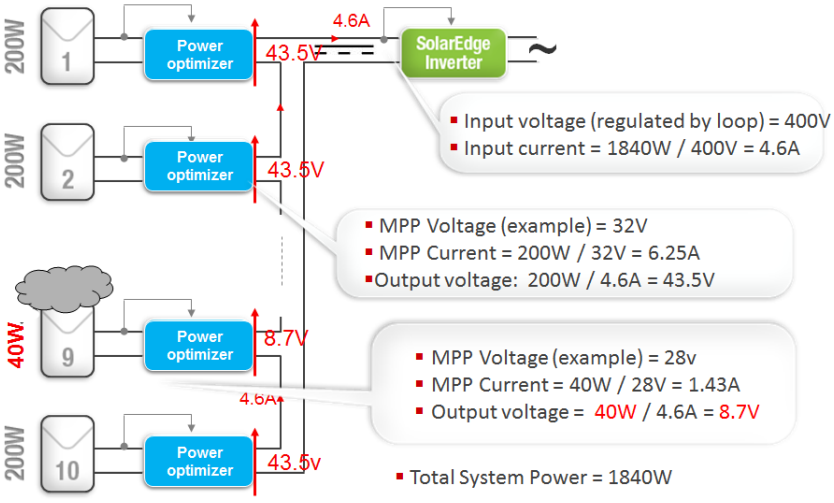

Figure 2: Operation with Partial Shading

As demonstrated by this example, each of the modules is operating at its maximum power point, regardless of operating conditions.

A comparison of the system operation in both cases can be seen in Figure 3. Note that both up and down DC/DC conversion are automatically used, depending on environmental conditions.

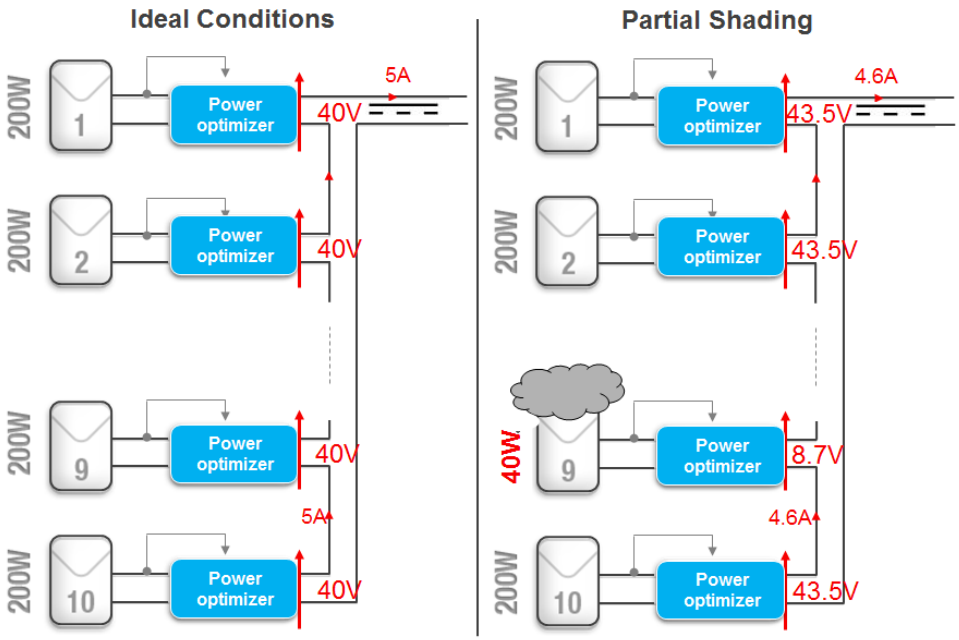

Figure 3: Case Comparison

Fixed String Voltage Benefits

The fixed string voltage maintained by the SolarEdge power optimizers provides multiple benefits:

- **Flexible Design** – mismatched modules can be serially-connected in a string. The number of modules in a single string is not dependant on module output voltage and therefore a wide string length range is permitted.
- **High Inverter Efficiency and Reliability** – the SolarEdge inverter components work at a fixed voltage, operating under less stress. The inverter always operates at a voltage that enables optimal DC-AC inversion efficiency, independent of string length or environmental conditions.
- **Reduced Installation Cost** - longer strings lower BoS element count and installation cost and labor.
- **Temperature Indifference** - the SolarEdge fixed string voltage completely removes the temperature constraints which strongly limit string length in traditional systems.
- **Improved Safety** - all power optimizers start up in "safety 1V output" mode until the power optimizers are connected to a functioning SolarEdge inverter. Additionally, in the event of a grid power shutdown, the modules immediately stop producing power and revert to this mode.

Fuse - FUSE 10,3X85 16A PV - 3062772

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Fuse, 10.3 mm x 85 mm, up to 1500 V DC, gPV characteristic

Your advantages

- Designed in accordance with the photovoltaic standard IEC 60269-6
- 10 x 85 midget fuses for reliable protection of PV modules and their control system
- Use in PV lines with a nominal voltage of up to 1500 V DC

RoHS

Key Commercial Data

Packing unit	1 pc
Minimum order quantity	10 pc
GTIN	4 046356 657259
GTIN	4046356657259
Weight per Piece (excluding packing)	14.000 g
Custom tariff number	85351000
Country of origin	Slovenia

Technical data

General

Color	white
Flammability rating according to UL 94	V0

Dimensions

Length	85 mm
Diameter	10.3 mm

Fuse - FUSE 10,3X85 16A PV - 3062772

Technical data

General

Fuse	Midget/10.3 x 85
Connection in acc. with standard	IEC 60269-6
Nominal current I_N	16 A
Nominal voltage U_N	1500 V DC

Ambient conditions

Ambient temperature (operation)	-60 °C ... 85 °C
Ambient temperature (storage/transport)	-25 °C ... 55 °C (For a short time, not exceeding 24 h, -60 to +70 °C)
Permissible humidity (storage/transport)	30 % ... 70 %
Ambient temperature (assembly)	-5 °C ... 70 °C
Ambient temperature (actuation)	-5 °C ... 70 °C

Standards and Regulations

Connection in acc. with standard	IEC 60269-6
Flammability rating according to UL 94	V0

Environmental Product Compliance

China RoHS	Environmentally friendly use period: unlimited = EFUP-e
	No hazardous substances above threshold values

Classifications

eCl@ss

eCl@ss 10.0.1	27142002
eCl@ss 4.0	27142000
eCl@ss 4.1	27142000
eCl@ss 5.0	27142000
eCl@ss 5.1	27142000
eCl@ss 6.0	27142000
eCl@ss 7.0	27142002
eCl@ss 8.0	27142002
eCl@ss 9.0	27142002

ETIM

ETIM 3.0	EC000035
ETIM 4.0	EC002704
ETIM 5.0	EC002704
ETIM 6.0	EC002704
ETIM 7.0	EC002704

Fuse - FUSE 10,3X85 16A PV - 3062772

Classifications

UNSPSC

UNSPSC 6.01	30211915
UNSPSC 7.0901	39121514
UNSPSC 11	39121514
UNSPSC 12.01	39121514
UNSPSC 13.2	39121627
UNSPSC 18.0	39121627
UNSPSC 19.0	39121627
UNSPSC 20.0	39121627
UNSPSC 21.0	39121627

Approvals

Approvals

Approvals

EAC

Ex Approvals

Approval details

EAC	EAC	RU C-DE.BL08.B.00724

Descargadores de corrientes de rayo/de sobretensiones tipo 1/2 - VAL-MB-T1/T2 1500DC-PV/2+V - 2905641

Tenga en cuenta que los datos indicados aquí proceden del catálogo en línea. Los datos completos se encuentran en la documentación del usuario. Son válidas las condiciones generales de uso de las descargas por Internet.
(http://phoenixcontact.es/download)

Descargador de corrientes de rayo/sobretensiones para sistemas de tensión continua de 1500 V DC aislados de 2 polos, para montaje sobre carril, elementos de protección con control de temperatura, mensaje de estado en el módulo.

Sus ventajas

- Borne doble para una conexión equipotencial segura y sencilla
- Fosos para tornillos con esferas elevadas para trabajar con seguridad
- Conexiones principales con tolvas de entrada prolongadas para una elevada resistencia a las corrientes de fuga
- Indicación óptica para control de estado directamente en el equipo
- Construcción compacta para una instalación con ahorro de espacio

RoHS

Datos mercantiles

Unidad de embalaje	1 pcs
EAN	4 046356 984393
EAN	4046356984393
Peso por unidad (sin incluir el embalaje)	488,610 g
Número de tarifa arancelaria	85354000
País de origen	Alemania
Clave de venta	CL1231

Datos técnicos

Medidas

Altura	120 mm
Anchura	71,2 mm
Profundidad	65,5 mm (Con carril de 7,5 mm)
Unidad	4 UD

Condiciones ambientales

Índice de protección	IP20 (Solo si se emplean todos los puntos de embornaje)

Descargadores de corrientes de rayo/de sobretensiones tipo 1/2 - VAL-MB-T1/T2 1500DC-PV/2+V - 2905641

Datos técnicos

Condiciones ambientales

Temperatura ambiente (servicio)	-40 °C ... 80 °C
Temperatura ambiente (almacenamiento / transporte)	-40 °C ... 80 °C
Altitud	≤ 6000 m (amsl (del inglés, above mean sea level, es decir, sobre el nivel del mar))
Humedad de aire admisible (servicio)	5 % ... 95 %
Choques (en servicio)	50g (Semisinusoide / 11ms / 3x ±X, ±Y, ±Z)
Vibración (en servicio)	5g (5-500 Hz/2,5 h/X, Y, Z)

Generalidades

Clase de ensayo IEC	PV I / II
	PV T1 / T2
Tipo EN	T1 / T2
Sistema de alimentación de corriente IEC	DC
Comportamiento frente a averías SPD	OCM (Comportamiento con error de desconexión)
Configuración de conexión	Configuración Y
Lugar de montaje	Interior
Accesibilidad	Accesible
Lugar de montaje del dispositivo de desconexión	Interno
Pistas de protección	(L+) - (L-)
	(L+) - PE
	(L-) - PE
Tipo de montaje	Carril simétrico: 35 mm
Color	gris tráfico A RAL 7042
Material carcasa	PA 6.6
Grado de polución	2
Clase de combustibilidad según UL 94	V-0
Construcción	Módulo para montaje sobre carril, de una pieza
Mensaje Protección contra sobretensiones defectuosa	óptico

Otras descripciones

Observación	El producto también puede utilizarse en instalaciones fotovoltaicas con una corriente de cortocircuito máx. I_{SCPV} = 15 kA (según EN 50539-11: 2013).

Circuito de protección lado de tensión continua (DC)

Tensión constante máxima U_{CPV}	1500 V DC
Resistencia al cortocircuito I_{SCPV}	2000 A
Corriente de servicio constante I_{CPV}	< 100 µA
Corriente de carga nominal I_L	50 A
Corriente de conductor de protección I_{PE}	≤ 100 µA DC
	≤ 540 µA AC
Absorción de potencia standby P_C	≤ 150 mVA

Descargadores de corrientes de rayo/de sobretensiones tipo 1/2 - VAL-MB-T1/T2 1500DC-PV/2+V - 2905641

Datos técnicos

Circuito de protección lado de tensión continua (DC)

Corriente transitoria nominal (8/20) µs	20 kA
Corriente transitoria máxima $I_{máx}$ (8/20) µs	40 kA
Corriente de rayo de prueba (10/350) µs, carga	3,125 As
Corriente de rayo de prueba (10/350) µs, energía específica	9,77 kJ/Ω
Corriente de rayo de prueba (10/350) µs, corriente de pico I_{imp}	6,25 kA
Corriente transitoria total I_{total} (8/20) µs	40 kA
Corriente transitoria total I_{total} (10/350) µs	12,5 kA
Nivel de protección U_p	≤ 4,5 kV
Tensión residual U_{res}	≤ 4,5 kV (en I_n)
	≤ 3,3 kV (con 3 kA)
	≤ 3,6 kV (con 6,25 kA)
	≤ 3,8 kV (con 10 kA)
	≤ 4,2 kV (Con 15 kA)
	≤ 5,4 kV (con 40 kA)
Tiempo de reacción t_A	≤ 25 ns
Resistencia de aislamiento R_{iso}	> 5 GΩ (a 500 V DC)

Datos de conexión

Tipo de conexión	Conexión por tornillo
Rosca de tornillo	M5
Par de apriete	3 Nm
Longitud a desaislar	16 mm
Sección de conductor flexible	2,5 mm² ... 35 mm²
2 conductores con la misma sección flexibles con puntera sin manguito de plástico mín.	2,5 mm²
2 conductores con la misma sección flexibles con puntera sin manguito de plástico máx.	10 mm²
Sección de conductor AWG	14 ... 2

Normas y especificaciones

Normas/especificaciones	EN 50539-11 2013

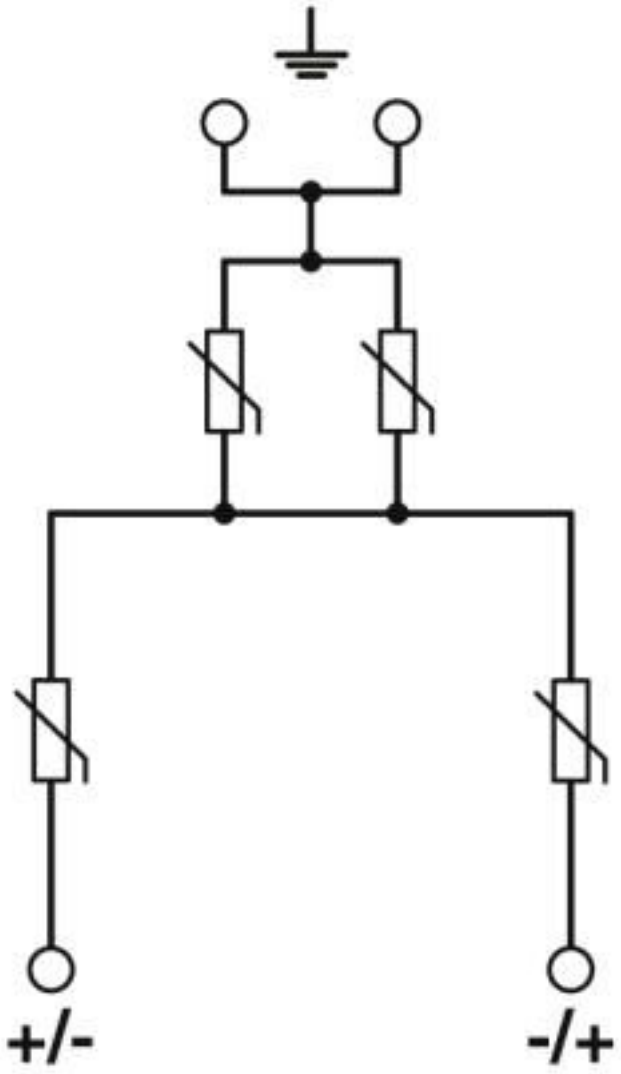
Environmental Product Compliance

China RoHS	Espacio de tiempo para el uso previsto (EFUP): 50 años
	Encontrará información sobre las sustancias peligrosas en la declaración del fabricante en la pestaña "Descargas"

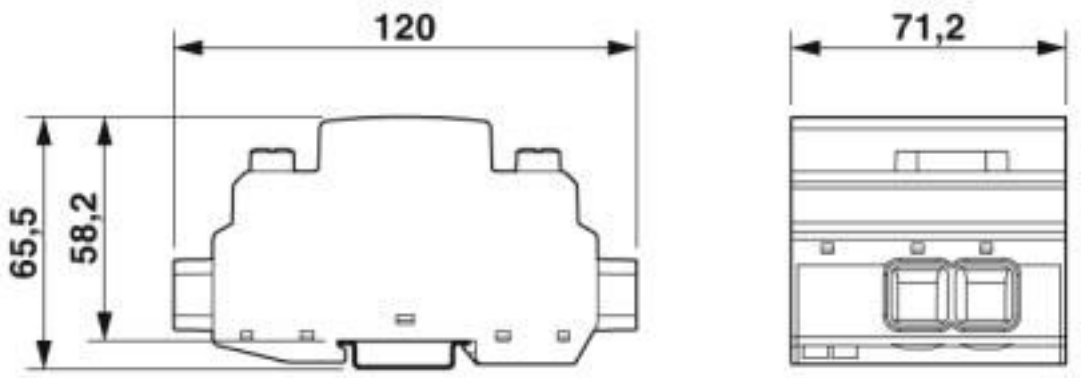
Dibujos

Descargadores de corrientes de rayo/de sobretensiones tipo 1/2 - VAL-MB-T1/T2 1500DC-PV/2+V - 2905641

Diagrama eléctrico



Esquema de dimensiones



Descargadores de corrientes de rayo/de sobretensiones tipo 1/2 - VAL-MB-T1/T2 1500DC-PV/2+V - 2905641

Homologaciones

Homologaciones

Homologaciones

CCA / KEMA-KEUR

Homologaciones Ex

Detalles de homologaciones

CCA			NTR-NL 7422
KEMA-KEUR	KEMA KEUR	http://www.dekra-certification.com	2181728.01

Accesorios

Accesorios

Rotulador marcador

Rotulador especial - X-PEN 0,35 - 0811228

Rotulador especial sin cartucho de tinta, para la rotulación manual de índices de rotulación, rotulación de gran resistencia al lavado, grosor de rotulado 0,35 mm

Hoja de características del producto

Características

A9N18374

C120N 4P 100A C 10000A 415V MINIATURE CI

Principal

Gama de producto	Dardo Plus
Gama	Acti 9
Nombre del producto	C120
Tipo de producto o componente	Interruptor automático en miniatura
Nombre corto del dispositivo	C120N
Aplicación del dispositivo	Distribución
Número de polos	4P
Número de polos protegidos	4
[In] Corriente nominal	100 A en 30 °C
Tipo de red	CA
Tecnología de unidad de disparo	Térmico-magnético
Código de curva	C
Capacidad de corte	10000 A Icn en 230...400 V CA 50/60 Hz acorde a EN/IEC 60898-1 6 kA Icu en 440 V CA 50/60 Hz acorde a EN/IEC 60947-2 20 kA Icu en 220...240 V CA 50/60 Hz acorde a EN/IEC 60947-2 10 kA Icu en 380...415 V CA 50/60 Hz acorde a EN/IEC 60947-2 10 kA Icu en <= 500 V CC acorde a EN/IEC 60947-2
Poder de seccionamiento	Sí acorde a IEC 60947-2

Complementario

Frecuencia de red	50/60 Hz
[Ue] Tensión nominal de empleo	380...415 V CA 50/60 Hz <= 500 V CC 220...240 V CA 50/60 Hz 440 V CA 50/60 Hz 230...400 V CA 50/60 Hz
Límite de enlace magnético	5...10 x In
[Ics] poder de corte en servicio	7500 A 75 % acorde a EN/IEC 60898-1 - 230...400 V CA 50/60 Hz 4,5 kA 75 % acorde a EN/IEC 60947-2 - 440 V CA 50/60 Hz 7,5 kA 75 % acorde a EN/IEC 60947-2 - 380...415 V CA 50/60 Hz 15 kA 75 % acorde a EN/IEC 60947-2 - 220...240 V CA 50/60 Hz

	10 kA 100 % acorde a EN/IEC 60947-2 - <= 500 V CC
Clase de limitación	3 acorde a EN/IEC 60947-2
[Ui] Tensión nominal de aislamiento	500 V CA 50/60 Hz acorde a EN/IEC 60947-2
[Uimp] Resistencia a picos de tensión	6 kV acorde a EN/IEC 60947-2
Indicador de posición del contacto	Sí
Tipo de control	Maneta
Señalizaciones en local	Indicación de encendido/apagado
Tipo de montaje	Ajustable en clip
Soporte de montaje	Carril DIN simétrico de 35 mm
Compatibilidad de bloque de distribución y embarrado tipo peine	NO
Pasos de 9 mm	12
Altura	81 mm
Anchura	108 mm
Profundidad	73 mm
Peso del producto	0,82 kg
Color	Blanco
Durabilidad mecánica	20000 ciclos
Durabilidad eléctrica	5000 ciclos acorde a IEC 60947-2
Conexiones - terminales	Terminales de tipo túnel1…50 mm² rígido Terminales de tipo túnel1,5…35 mm² Flexible
Longitud de cable pelado para conectar bornas	15 mm
Par de apriete	3,5 N.m
Protección contra fugas a tierra	Bloque independiente

Entorno

Normas	EN/IEC 60947-2 EN/IEC 60898-1
Certificaciones de producto	EAC
Grado de protección IP	IP20 acorde a IEC 60529
Grado de contaminación	3 acorde a IEC 60947-2
Categoría de sobretensión	IV
Tropicalización	2 acorde a IEC 60068-1
Humedad relativa	95 % en 55 °C
Altitud máxima de funcionamiento	2000 m
Temperatura ambiente de funcionamiento	-25…70 °C
Temperatura ambiente de almacenamiento	-40…85 °C

Unidades de embalaje

Tipo de unidad del paquete 1	PCE
Número de unidades en el paquete 1	1
Peso del paquete 1	0,772 kg
Paquete 1 Altura	0,750 dm
Paquete 1 ancho	0,880 dm
Paquete 1 Longitud	1,080 dm
Tipo de unidad del paquete 2	BB1
Número de unidades en el paquete 2	3
Peso del paquete 2	2,378 kg
Paquete 2 Altura	10 cm
Ancho del paquete 2	9 cm
Longitud del paquete 2	33 cm

Tipo de unidad del paquete 3	S03
Número de unidades en el paquete 3	18
Paquete 3 Peso	14,735 kg
Paquete 3 Altura	30 cm
Ancho del paquete 3	30 cm
Paquete 3 Longitud	40 cm

Sostenibilidad de la oferta

Estado de oferta sostenible	Producto Green Premium
Conforme con REACh sin SVHC	Sí
Directiva RoHS UE	Conforme Declaración RoHS UE
Sin metales pesados tóxicos	Sí
Sin mercurio	Sí
Información sobre exenciones de RoHS	Sí
Normativa de RoHS China	Declaración RoHS China Declaración proactiva de RoHS China (fuera del alcance legal de RoHS China)
Comunicación ambiental	Perfil ambiental del producto
RAEE	En el mercado de la Unión Europea, el producto debe desecharse de acuerdo con un sistema de recolección de residuos específico y nunca terminar en un contenedor de basura.

Información Logística

País de Origen	ES

Garantía contractual

Periodo de garantía	18 months

Hoja de características del producto
Características

A9N18579
VIGI C120 125A 4P 300 MA A ADAPTABLE RES

Principal

Tipo de producto o componente	Bloque Vigi
Nombre corto del dispositivo	Vigi C120
Número de polos	4P
[In] Corriente nominal	125 A
Tipo de red	CA
Sensibilidad de fuga a tierra	300 mA
Retardo de la protección contra fugas a tierra	Instantáneo
Clase de protección contra fugas a tierra	Tipo A

Complementario

Ubicación del dispositivo en el sistema	Salida
Frecuencia de red	50/60 Hz
[Ue] Tensión nominal de empleo	230...415 V CA 50/60 Hz
Tecnologia de disparo corriente residual	Independiente de la tensión
[Ui] Tensión nominal de aislamiento	500 V CA 50/60 Hz acorde a IEC 60947-1
[Uimp] Resistencia a picos de tensión	6 kV acorde a IEC 60947-2
Tipo de montaje	Ajustable en clip
Soporte de montaje	Carril DIN simétrico de 35 mm
Conexión eléctrica a MCB	Mediante tornillos
Pasos de 9 mm	10
Altura	95 mm
Anchura	198 mm
Profundidad	73 mm
Peso del producto	0,58 kg
Color	Blanco

Durabilidad mecánica	20000 ciclos
Conexiones - terminales	Terminales de tipo túnel1…35 mm² Flexible Terminales de tipo túnel1…50 mm² rígido
Longitud de cable pelado para conectar bornas	15 mm
Par de apriete	3,5 N.m

Entorno

Normas	EN 61009
Grado de protección IP	IP20
Grado de contaminación	3 acorde a IEC 60947-2
Temperatura ambiente de funcionamiento	-25…60 °C
Temperatura ambiente de almacenamiento	-40…60 °C

Unidades de embalaje

Tipo de unidad del paquete 1	PCE
Número de unidades en el paquete 1	1
Peso del paquete 1	0,677 kg
Paquete 1 Altura	0,900 dm
Paquete 1 ancho	1,350 dm
Paquete 1 Longitud	2,500 dm
Tipo de unidad del paquete 2	S03
Número de unidades en el paquete 2	8
Peso del paquete 2	5,739 kg
Paquete 2 Altura	30 cm
Ancho del paquete 2	30 cm
Longitud del paquete 2	40 cm

Sostenibilidad de la oferta

Estado de oferta sostenible	Producto Green Premium
Directiva RoHS UE	Conforme Declaración RoHS UE
Sin mercurio	Sí
Información sobre exenciones de RoHS	Sí
Normativa de RoHS China	Declaración RoHS China Producto fuera del ámbito de RoHS China. Declaración informativa de sustancias
Comunicación ambiental	Perfil ambiental del producto
RAEE	En el mercado de la Unión Europea, el producto debe desecharse de acuerdo con un sistema de recolección de residuos específico y nunca terminar en un contenedor de basura.

Información Logística

País de Origen	ES

Garantía contractual

Periodo de garantía	18 months

Hoja de características del producto
Características

LV432894
disjuntor - NSX630N Micrologic 2.3 630A 4P4D

Principal

Gama	Compact
Nombre del producto	Compact NSX
Gama de producto	NSX400...630
Nombre corto del dispositivo	Compact NSX630N
Tipo de producto o componente	Interruptor automático
Aplicación del dispositivo	Distribución
Número de polos	4P
Descripción de polos protegidos	4t 3t 3t + N/2
Posición de neutro	Izquierda
[In] Corriente nominal	630 A en 40 °C
[Ue] Tensión nominal de empleo	690 V CA 50/60 Hz
Tipo de red	CA
Frecuencia de red	50/60 Hz
Poder de seccionamiento	Sí acorde a EN 60947-2 Sí acorde a IEC 60947-2
Categoría de empleo	Categoría A
[Icu] rated ultimate short-circuit breaking capacity	85 kA en 240 V CA 50/60 Hz acorde a UL 508 22 kA Icu en 525 V CA 50/60 Hz acorde a IEC 60947-2 85 kA Icu en 220/240 V CA 50/60 Hz acorde a IEC 60947-2 10 kA Icu en 660/690 V CA 50/60 Hz acorde a IEC 60947-2 30 kA Icu en 500 V CA 50/60 Hz acorde a IEC 60947-2 20 kA en 600 V CA 50/60 Hz acorde a UL 508 50 kA en 480 V CA 50/60 Hz acorde a UL 508 50 kA Icu en 380/415 V CA 50/60 Hz acorde a IEC 60947-2 42 kA Icu en 440 V CA 50/60 Hz acorde a IEC 60947-2
Performance level	N 50 kA 415 V CA
Unidad de control	Micrologic 2.3
Tecnología de unidad de disparo	Electrónico

Funciones de protección de unidad de control	LSoI
Tipo de control	Maneta
Circuit breaker mounting mode	Fijo

Complementario

[Ui] Tensión nominal de aislamiento	800 V CA 50/60 Hz
[Uimp] Resistencia a picos de tensión	8 kV
[Ics] rated service short-circuit breaking capacity	11 kA en 525 V CA 50/60 Hz acorde a IEC 60947-2 85 kA en 220/240 V CA 50/60 Hz acorde a IEC 60947-2 10 kA en 660/690 V CA 50/60 Hz acorde a IEC 60947-2 50 kA en 380/415 V CA 50/60 Hz acorde a IEC 60947-2 30 kA en 500 V CA 50/60 Hz acorde a IEC 60947-2 42 kA en 440 V CA 50/60 Hz acorde a IEC 60947-2
Durabilidad mecánica	15000 ciclos
Soporte de montaje	Placa posterior
Conexión superior	Frontal
Conexión hacia abajo	Parte frontal
Tipo de protección	Prot.cont. sobrec. (per.largo) Short time short-circuit protection with fixed delay Prot.contra cortocirc.(inst.)
Calibre de la unidad de disparo	630 A en 40 °C
Long-time pick-up adjustment type Ir (thermal protection)	9 regulaciones
[Ir] long-time protection pick-up adjustment range	0,9...1 x Io
Long-time protection delay adjustment type tr	Fijo
[Tr] long-time protection delay adjustment range	16 s en 6 x Ir
Memoria térmica	20 minutos antes y después de desconexión
Short-time protection pick-up adjustment type Isd	9 regulaciones
[Isd] Short-time protection pick-up adjustment range	1.5...10 x Ir
Short-time protection delay adjustment type tsd	Fijo
Instantaneous protection pick-up adjustment type Ii	Fijo
[Ii] instantaneous protection pick-up adjustment range	6900 A
Neutral protection settings	0,5 x Ir - tipo de cable: 3t + N/2) 1 x Ir - tipo de cable: 4t) Sin protección - tipo de cable: 3t)
Composición de los contactos auxiliares	Sin
Width (W)	185 mm
Height (H)	255 mm
Depth (D)	110 mm
Peso del producto	8,13 kg

Entorno

Normas	EN/IEC 60947 UL 508
Certificaciones de producto	EAC CCC Marine
Categoría de sobretensión	Clase II

Clase de potección contra descargas eléctricas	Clase II
Grado de contaminación	3 acorde a IEC 60664-1
Grado de protección IP	IP40 acorde a IEC 60529
Grado de protección IK	IK07 acorde a IEC 62262
Temperatura ambiente de funcionamiento	-35…70 °C
Temperatura ambiente de almacenamiento	-55…85 °C

Unidades de embalaje

Tipo de unidad del paquete 1	PCE
Número de unidades en el paquete 1	1
Peso del paquete 1	7,464 kg
Paquete 1 Altura	15,000 cm
Paquete 1 ancho	20,800 cm
Paquete 1 Longitud	29,200 cm

Sostenibilidad de la oferta

Estado de oferta sostenible	Producto Green Premium
Directiva RoHS UE	Conforme Declaración RoHS UE
Sin mercurio	Sí
Información sobre exenciones de RoHS	Sí
Normativa de RoHS China	Declaración RoHS China Producto fuera del ámbito de RoHS China. Declaración informativa de sustancias
Comunicación ambiental	Perfil ambiental del producto
Perfil de circularidad	Información de fin de vida útil
RAEE	En el mercado de la Unión Europea, el producto debe desecharse de acuerdo con un sistema de recolección de residuos específico y nunca terminar en un contenedor de basura.

Información Logística

País de Origen	ES

Garantía contractual

Periodo de garantía	18 months

PROTECH® EVOLUCIÓN C_{ca} (AS)
RZ1-K (AS)

Tensión asignada: 0,6/1 kV
Norma diseño: UNE 21123-4
Designación genérica: RZ1-K (AS)

ECOLÓGICO

CARACTERÍSTICAS Y ENSAYOS

NO PROPAGACIÓN DE LA LLAMA
EN 60332-1-2
IEC 60332-1-2

NO PROPAGACIÓN DEL INCENDIO
EN 50399
EN 60332-3-24
IEC 60332-3-24

LIBRE DE HALÓGENOS
EN 60754-2
EN 60754-1
IEC 60754-2
IEC 60754-1

REDUCIDA EMISIÓN DE GASES TÓXICOS
EN 60754-2
NFC 20454
DEF-STAN 02-713

BAJA EMISIÓN DE HUMOS
EN 50399

BAJA OPACIDAD DE HUMOS
EN 61034-2
IEC 61034-2

NULA EMISIÓN DE GASES CORROSIVOS
EN 60754-2
IEC 60754-2
NFC 20453

BAJA EMISIÓN DE CALOR
EN 50399

REDUCIDO DESPRENDIMIENTO DE GOTAS / PARTÍCULAS INFLAMADAS
EN 50399

CE CPR COMPLIANT
UNE-EN 50575: 2014+A1: 2016

C_{ca} CPR
C_{ca}-s1b,d1,a1

DESCÁRGATE la DoP (Declaración de Prestaciones) en este código QR.
www.prysmianclub.es/cprblog/DoP

Nº DoP 1003876

RESISTENCIA A LA ABSORCIÓN DEL AGUA

RESISTENCIA AL FRÍO

CABLE FLEXIBLE

RESISTENCIA A LOS RAYOS ULTRAVIOLETAS

AFUMEX AS
ALTA SEGURIDAD

MÁXIMA PELABILIDAD
Gracias a la capa especial antiadherente se puede retirar la cubierta fácil y rápidamente. Un importante ahorro de tiempo de instalación.

LIMPIO Y ECOLÓGICO
La ausencia de talco y aceites de silicona permite un ambiente de trabajo más limpio y con menos partículas contaminantes.

- Temperatura de servicio: -40 °C, +90 °C (Cable termoestable).
- Ensayo de tensión alterna durante 5 min: 3500 V

Prestaciones frente al fuego en la Unión Europea:
- Clase de reacción al fuego: C_{ca}-s1b,d1,a1.
- Norma armonizada: EN 50575:2014/A1:2016.
- Clasificación respecto al fuego: EN 13501-6.
- Aplicación de los resultados: CLC/TS 50576.
- Métodos de ensayo: EN 60332-1-2; EN 50399; EN 60754-2; EN 61034-2.

Normativa de fuego también aplicable a países que no pertenecen a la Unión Europea:
- No propagación de la llama: EN 60332-1-2; IEC 60332-1-2
- No propagación del incendio: EN 50399; EN 60332-3-24; IEC 60332-3-24.
- Libre de halógenos: EN 60754-2; EN 60754-1; IEC 60754-2; IEC 60754-1.
- Reducida emisión de gases tóxicos: EN 60754-2; NFC 20454; DEF STAN 02-713.
- Baja emisión de humos: EN 50399.
- Baja opacidad de humos: EN 61034-2; IEC 61034-2.
- Nula emisión de gases corrosivos: EN 60754-2; IEC 60754-2; NFC 20453.
- Baja emisión de calor: EN 50399.
- Reducido desprendimiento de gotas/partículas inflamadas: EN 50399.

Draka

A brand of the Prysmian Group

V-20.06.2017

PROTECH® EVOLUCIÓN C_{ca} (AS)
RZ1-K (AS)

Tensión asignada: 0,6/1 kV
Norma diseño: UNE 21123-4
Designación genérica: RZ1-K (AS)

ECOLÓGICO

CONSTUCIÓN

CONDUCTOR
Metal: cobre electrolítico recocido.
Flexibilidad: flexible, clase 5, según UNE EN 60228.
Temperatura máxima en el conductor: 90 °C en servicio permanente, 250 °C en cortocircuito.

AISLAMIENTO
Material: mezcla de polietileno reticulado (XLPE), tipo DIX3 según UNE HD 603-1.
Colores: marrón, negro, gris, azul, amarillo/verde según UNE 21089-1.

ELEMENTO SEPARADOR
Capa especial antiadherente.

RELLENO
Material: mezcla LSOH libre de halógenos.

CUBIERTA
Material: mezcla especial libre de halógenos tipo AFUMEX UNE 21123-4.
Color: verde.

APLICACIONES

- Cable de fácil pelado especialmente adecuado para instalaciones en locales de pública concurrencia: salas de espectáculos, centros comerciales, escuelas, hospitales, edificios de oficinas, pabellones deportivos, etc.
- En centros informáticos, aeropuertos, naves industriales, parkings, túneles ferroviarios y de carreteras, locales de difícil ventilación y/o evacuación, etc.
- En toda instalación donde el riesgo de incendio no sea despreciable: instalaciones en montaje superficial, canalizaciones verticales en edificios o sobre bandejas, etc., o donde se requieran las mejores propiedades frente al fuego y/o la ecología de los productos en edificios o sobre bandejas, etc., o donde se requieran las mejores propiedades frente al fuego y/o la ecología de los productos de construcción.
- Líneas generales de alimentación (ITC-BT 14).
- Derivaciones individuales ITC-BT 15).
- Instalaciones interiores o receptoras (ITC-BT 20).
- Locales de pública concurrencia (ITC-BT 28).
- Locales con riesgo de incendio o explosión **(adecuadamente canalizado)** (ITC-BT 29).
- Industrias (Reglamento de Seguridad contra Incendios en los Establecimientos Industriales R.D. 2267/2004.
- Edificios en general (Código técnico de la Edificación, R.D. 314/2006, art. 11).

PROTECH® EVOLUCIÓN C_{ca} (AS)

RZ1-K (AS)

Tensión asignada: 0,6/1 kV
Norma diseño: UNE 21123-4
Designación genérica: RZ1-K (AS)

ECOLÓGICO

DATOS TÉCNICOS

NÚMERO DE CONDUCTORES x SECCIÓN mm²	ESPESOR DE AISLAMIENTO mm (1)	DIÁMETRO EXTERIOR mm (1)	PESO TOTAL kg/km (1)	RESISTENCIA DEL CONDUCTOR a 20 °C Ω /km	INTENSIDAD ADMISIBLE (2) A	INTENSIDAD ADMISIBLE ENTERRADO (3) A	CAÍDA DE TENSIÓN V/A km (2)	
							cos Φ = 1	cos Φ = 0,8
1 x 1.5	0,7	7	67	13,3	21	21	26,5	21,36
1 x 2,5	0,7	7,5	79	7,98	29	27,5	15,92	12,88
1 x 4	0,7	8	97	4,95	38	35	9,96	8,1
1 x 6	0,7	8,5	120	3,3	49	44	6,74	5,51
1 x 10	0,7	9,6	167	1,91	68	58	4	3,31
1 x 16	0,7	10,6	226	1,21	91	75	2,51	2,12
1 x 25	0,9	12,3	321	0,78	116	96	1,59	1,37
1 x 35	0,9	13,8	421	0,55	144	117	1,15	1,01
1 x 50	1	15,4	579	0,38	175	138	0,85	0,77
1 x 70	1,1	17,3	780	0,27	224	170	0,59	0,56
1 x 95	1,1	19,2	995	0,20	271	202	0,42	0,43
1 x 120	1,2	21,3	1240	0,16	314	230	0,34	0,36
1 x 150	1,4	23,4	1529	0,12	363	260	0,27	0,31
1 x 185	1,6	25,6	1826	0,10	415	291	0,22	0,26
1 x 240	1,7	28,6	2383	0,08	490	336	0,17	0,22
1 x 300	1,8	31,3	2942	0,06	630	380	0,14	0,19
1 x 400	2	36	3921	0,05	749	446		
2 x 1.5	0,7	10	134	13,3	24	24	30,98	24,92
2 x 2,5	0,7	10,9	169	7,98	33	32	18,66	15,07
2 x 4	0,7	11,8	213	4,95	45	42	11,68	9,46
2 x 6	0,7	12,9	271	3,3	57	53	7,90	6,42
2 x 10	0,7	15,2	399	1,91	76	70	4,67	3,84
2 x 16	0,7	17,7	566	1,21	105	91	2,94	2,45
2 x 25	0,9			0,78	135	116	1,86	1,59
2 x 35	0,9			0,55	168	140	1,34	1,16
2 x 50	1			0,38	204	166	0,99	0,88
3 G 1.5	0,7	10,4	150	13,3	24	24	30,98	24,92
3 G 2,5	0,7	11,4	193	7,98	33	32	18,66	15,07
3 G 4	0,7	12,4	250	4,95	45	42	11,68	9,46
3 G 6	0,7	13,6	324	3,3	57	53	7,90	6,42
3 G 10	0,7	16	486	1,91	76	70	4,67	3,84
3 G 16	0,7	18,7	696	1,21	106	91	2,94	2,45
3 x 25	0,9			0,78	115	96	1,62	1,38
3 x 35	0,9			0,55	143	117	1,17	1,01
3 x 50	1			0,38	174	138	0,86	0,77
3 x 70	1,1			0,27	223	170	0,6	0,56
3 x 95	1,1			0,20	271	202	0,43	0,42
3 x 120	1,2			0,16	314	230	0,34	0,35
3 x 150	1,4			0,12	359	260	0,28	0,3
3 x 185	1,6			0,10	409	291	0,22	0,26
3 x 240	1,7			0,08	489	336	0,17	0,21
3 x 300	1,8			0,06	549	380	0,14	0,18

.../...

(1) Valores aproximados.

(2) Instalación en bandeja al aire (40 °C).
→ XLPE3 con instalación tipo F → columna 11 (1x trifásica).
→ XLPE2 con instalación tipo E → columna 12 (2x, 3G monofásica).
→ XLPE3 con instalación tipo E → columna 10b (3x, 4G, 4x, 5G trifásica).

(3) Instalación enterrada, directamente o bajo tubo con resistividad térmica del terreno estándar de 2,5 K.m/W.
→ XLPE3 con instalación tipo Método D1/D2 (Cu) → 1x, 3x, 4G, 4x, 5G trifásica.
→ XLPE2 con instalación tipo D1/D2 (Cu) → 2x, 3G monofásica.

Según UNE-HD 60364-5-52 e IEC 60364-5-52.

PROTECH® EVOLUCIÓN C_{ca} (AS)

RZ1-K (AS)

Tensión asignada: 0,6/1 kV
Norma diseño: UNE 21123-4
Designación genérica: RZ1-K (AS)

ECOLÓGICO

DATOS TÉCNICOS

NÚMERO DE CONDUCTORES x SECCIÓN mm²	ESPESOR DE AISLAMIENTO mm	DIÁMETRO EXTERIOR mm	PESO TOTAL kg/km	RESISTENCIA DEL CONDUCTOR a 20 °C Ω /km	INTENSIDAD ADMISIBLE (1) A	INTENSIDAD ADMISIBLE ENTERRADO (2) A	CAÍDA DE TENSIÓN V/A km (2)	
							cos Φ = 1	cos Φ = 0,8
.../... 3 x 25/16	0,9/0,7			0,780/1,21	115	96	1,62	1,38
3 x 35/16	0,9/0,7			0,554/1,21	143	117	1,17	1,01
3 x 50/25	1,0/0,9			0,386/0,780	174	138	0,86	0,77
3 x 70/35	1,1/0,9			0,272/0,554	223	170	0,6	0,56
3 x 95/50	1,1/1,0			0,206/0,386	271	202	0,43	0,42
3 x 120/70	1,2/1,1			0,161/0,272	314	230	0,34	0,35
3 x 150/70	1,4/1,1			0,129/0,272	359	260	0,28	0,3
3 x 185/95	1,6/1,1			0,106/0,206	409	291	0,22	0,26
3 x 240/120	1,7/1,2			0,0801/0,161	489	336	0,17	0,21
3 x 300/150	1,8/1,4			0,0641/0,129	549	380	0,14	0,18
4 G 1,5	0,7	11,2	173	13,3	20	21	26,94	21,67
4 G 2,5	0,7	12,3	227	7,98	26,5	27,5	16,23	13,1
4 G 4	0,7	13,4	298	4,95	36	35	10,16	8,23
4 G 6	0,7	14,7	391	3,3	46	44	6,87	5,59
4 G 10	0,7	17,5	593	1,91	65	58	4,06	3,34
4 G 16	0,7	20,4	855	1,21	87	75	2,56	2,13
4 x 25	0,9	24,3	1267	0,78	110	96	1,62	1,38
4 x 35	0,9	28,4	1792	0,55	137	117	1,17	1,01
4 x 50	1	32,5	2439	0,38	167	138	0,86	0,77
4 x 70	1,1	37,1	3359	0,27	214	170	0,6	0,56
4 x 95	1,1	41,2	4276	0,20	259	202	0,43	0,42
4 x 120	1,2	46,7	5500	0,16	314	230	0,34	0,35
4 x 150	1,4	51,8	6750	0,12	343	260	0,28	0,3
4 x 185	1,6	57,6	8172	0,10	391	291	0,22	0,26
4 x 240	1,7	64,4	10642	0,08	468	336	0,17	0,21
5 G 1.5	0,7	12	202	13,3	20	21	26,94	21,67
5 G 2,5	0,7	13,3	266	7,98	26,5	27,5	16,23	13,1
5 G 4	0,7	14,5	351	4,95	36	35	10,16	8,23
5 G 6	0,7	16	467	3,3	46	44	6,87	5,59
5 G 10	0,7	19	711	1,91	65	58	4,06	3,34
5 G 16	0,7	22,2	1028	1,21	87	75	2,56	2,13
5 G 25	0,9	26,6	1529	0,78	110	96	1,62	1,38
5 G 35	0,9	31,4	2169	0,55	137	117	1,17	1,01
5 G 50	1	35,2	2969	0,38	167	138		

(1) Valores aproximados.

(2) Instalación en bandeja al aire (40 °C).
→ XLPE3 con instalación tipo F → columna 11 (1x trifásica).
→ XLPE2 con instalación tipo E → columna 12 (2x, 3G monofásica).
→ XLPE3 con instalación tipo E → columna 10b (3x, 4G, 4x, 5G trifásica).

(3) Instalación enterrada, directamente o bajo tubo con resistividad térmica del terreno estándar de 2,5 K.m/W.
→ XLPE3 con instalación tipo Método D1/D2 (Cu) → 1x, 3x, 4G, 4x, 5G trifásica.
→ XLPE2 con instalación tipo D1/D2 (Cu) → 2x, 3G monofásica.

Según UNE-HD 60364-5-52 e IEC 60364-5-52.

RETENAX CPRO Flex
RV-K

Tensión asignada: 0,6/1 kV
Norma diseño: UNE 21123-2
Designación genérica: RV-K

CARACTERÍSTICAS Y ENSAYOS

NO PROPAGACIÓN DE LA LLAMA
EN 60332-1-2
IEC 60332-1-2

REDUCIDA EMISIÓN DE HALÓGENOS
EN 60754-1
IEC 60754-1
(emisión HCl < 14 %)

CPR COMPLIANT

Eca CPR

DESCÁRGATE la DoP (Declaración de Prestaciones) en este código QR. www.prysmianclub.es/cprblog/DoP

Nº DoP 1003873

RESISTENCIA A LA ABSORCIÓN DEL AGUA

RESISTENCIA AL FRÍO

CABLE FLEXIBLE

RESISTENCIA A LOS RAYOS ULTRAVIOLETA

RESISTENCIA A LOS AGENTES QUÍMICOS

RESISTENCIA A LAS GRASAS Y ACEITES

- Temperatura de servicio: -25 °C, +90 °C (Cable termoestable).
- Ensayo de tensión alterna durante 5 min: 3500 V.

Prestaciones frente al fuego en la Unión Europea:
- Clase de reacción al fuego (CPR): E_{ca}.
- Requerimientos de fuego: EN 50575:2014 + A1:2016.
- Clasificación respecto al fuego: EN 13501-6.
- Aplicación de los resultados: CLC/TS 50576.
- Métodos de ensayo: EN 60332-1-2.

Normativa de fuego también aplicable a países que no pertenecen a la Unión Europea:
- No propagación de la llama: EN 60332-1-2; IEC 60332-1-2
- Reducida emisión de halógenos: EN 60754-1; IEC 60754-1 (emisión HCl < 14 %).

CONSTRUCCIÓN

CONDUCTOR
Metal: cobre electrolítico recocido
Flexibilidad: Flexible, clase 5 según UNE EN 60228.
Temperatura máxima en el conductor: 90 °C en servicio permanente, 250 °C en cortocircuito.

AISLAMIENTO
Material: mezcla de polietileno reticulado (XLPE) Tipo DIX 3, según HD 603-1.
Colores: marrón, negro, gris, azul, amarillo/verde según UNE 21089-1.

ELEMENTO SEPARADOR
Cinta de papel longitudinal (opcional).

RELLENO
Material: Si es necesario, mezcla termoplástica apropiada.

CUBIERTA
Material: policloruro de vinilo (PVC) tipo DMV-18 según HD 603-1.
Colores: negro o crema.

APLICACIONES

Cable de fácil pelado y alta flexibilidad para instalaciones subterráneas en general e instalaciones al aire en las que se requiere una gran facilidad de manipulación y no es obligatorio Afumex (AS).

- Redes subterráneas de distribución e instalaciones subterráneas (ITC-BT 07).
- Redes subterráneas de alumbrado exterior (ITC-BT 09).
- Instalaciones interiores o receptoras (ITC-BT 20); salvo obligación de Afumex (AS) (ver ITC-BT 28 y R.D. 2267 / 2004).

Los cables RV-K no están permitidos en servicios provisionales en general (obras, ferias, stands... ITC-BT 33, 34 ...) ni para servicios móviles, ni prolongados (ver Flextreme), ni para servicios sumergidos (ver Bupreno Bombas Sumergidas).

RETENAX CPRO Flex
RV-K

Tensión asignada: **0,6/1 kV**
Norma diseño: **UNE 21123-2**
Designación genérica: **RV-K**

DATOS TÉCNICOS

NÚMERO DE CONDUCTORES x SECCIÓN mm²	ESPESOR DE AISLAMIENTO mm (1)	DIÁMETRO EXTERIOR mm (1)	PESO kg/km (1)	RESISTENCIA DEL CONDUCTOR a 20 °C Ω /km	INTENSIDAD ADMISIBLE AL AIRE (2) A	INTENSIDAD ADMISIBLE ENTERRADO (3) A	CAÍDA DE TENSIÓN V/A km (2) Y (3)	
							cos Φ = 1	cos Φ = 0,8
1 x 1,5	0,7	5,7	42	13,3	21	21	26,50	21,36
1 x 2,5	0,7	6,2	54	7,98	30	27,5	15,92	12,88
1 x 4	0,7	6,6	70	4,95	40	35	9,96	8,1
1 x 6	0,7	7,2	91	3,3	52	44	6,74	5,51
1 x 10	0,7	8,3	135	1,91	72	58	4	3,31
1 x 16	0,7	9,4	191	1,21	97	75	2,51	2,12
1 x 25	0,9	11	280	0,78	122	96	1,59	1,37
1 x 35	0,9	12,5	389	0,554	153	117	1,15	1,01
1 x 50	1	14,2	537	0,386	188	138	0,85	0,77
1 x 70	1,1	15,8	726	0,272	243	170	0,59	0,56
1 x 95	1,1	17,9	958	0,206	298	202	0,42	0,43
1 x 120	1,2	18,9	1170	0,161	350	230	0,34	0,36
1 x 150	1,4	21,2	1460	0,129	401	260	0,27	0,31
1 x 185	1,6	23,8	1830	0,106	460	291	0,22	0,26
1 x 240	1,7	26,7	2310	0,0801	545	336	0,17	0,22
1 x 300	1,8	29,3	3100	0,0641	630	380	0,14	0,19
2 x 1,5	0,7	8,7	95	13,3	23	24	30,98	24,92
2 x 2,5	0,7	9,6	125	7,98	32	32	18,66	15,07
2 x 4	0,7	10,5	165	4,95	44	42	11,68	9,46
2 x 6	0,7	11,7	215	3,3	57	53	7,90	6,42
2 x 10	0,7	13,9	330	1,91	78	70	4,67	3,84
2 x 16	0,7	16,9	503	1,21	104	91	2,94	2,45
2 x 25	0,9	20,6	775	0,78	135	116	1,86	1,59
2 x 35	0,9	23,6	1060	0,554	168	140	1,31	1,16
2 x 50	1	27	1470	0,386	204	166	0,99	0,88
3 G 1,5	0,7	9,2	110	13,3	23	24	30,98	24,92
3 G 2,5	0,7	10,1	150	7,98	32	32	18,66	15,07
3 G 4	0,7	11,1	200	4,95	44	42	11,68	9,46
3 G 6	0,7	12,3	270	3,3	57	53	7,90	6,42
3 G 10	0,7	14,7	415	1,91	78	70	4,67	3,84
3 G 16	0,7	18	639	1,21	104	91	2,94	2,45
3 x 25	0,9	21,4	946	0,78	115	96	1,62	1,38
3 x 35	0,9	25,1	1355	0,554	143	117	1,17	1,01
3 x 50	1	28,8	1900	0,386	174	138	0,86	0,77
3 x 70	1,1	32,3	2550	0,272	223	170	0,6	0,56
3 x 95	1,1	35,9	3290	0,206	271	202	0,43	0,42
3 x 120	1,2	39,2	4060	0,161	314	230	0,34	0,35
3 x 150	1,4	44,2	5070	0,129	359	260	0,28	0,3
3 x 185	1,6	50,3	6400	0,106	409	291	0,22	0,26
3 x 240	1,7	56,7	8200	0,0801	489	336	0,17	0,21
3 x 300	1,8	62,2	10450	0,0641	549	380	0,14	0,18

.../...

(1) Valores aproximados.

(2) Instalación en bandeja al aire (40 °C).
→ XLPE3 con instalación tipo F → columna 11 (1x trifásica).
→ XLPE2 con instalación tipo E → columna 12 (2x, 3G monofásica).
→ XLPE3 con instalación tipo E → columna 10b (3x trifásica).

(3) Instalación enterrada, directamente o bajo tubo con resistividad térmica del terreno estándar de 2,5 K.m/W.
→ XLPE3 con instalación tipo D1/D2 (Cu) → 1x, 3x trifásica.
→ XLPE2 con instalación tipo D1/D2 (Cu) → 2x, 3G monofásica.

Según UNE-HD 60364-5-52 e IEC 60364-5-52.

RETENAX CPRO Flex
RV-K

Tensión asignada: **0,6/1 kV**
Norma diseño: **UNE 21123-2**
Designación genérica: **RV-K**

DATOS TÉCNICOS

NÚMERO DE CONDUCTORES x SECCIÓN mm²	ESPESOR DE AISLAMIENTO mm (1)	DIÁMETRO EXTERIOR mm (1)	PESO kg/km (1)	RESISTENCIA DEL CONDUCTOR a 20 °C Ω /km	INTENSIDAD ADMISIBLE AL AIRE (2) A	INTENSIDAD ADMISIBLE ENTERRADO (3) A	CAÍDA DE TENSIÓN V/A km (2) Y (3)	
							cos Φ = 1	cos Φ = 0,8
.../... 4 G 1,5	0,7	9,9	135	13,3	20	21	26,94	21,67
4 G 2,5	0,7	11	180	7,98	28	27,5	16,23	13,1
4 G 4	0,7	12,1	245	4,95	38	35	10,16	8,23
4 G 6	0,7	13,5	330	3,3	49	44	6,87	5,59
4 G 10	0,7	16,2	520	1,91	68	58	4,06	3,34
4 x 16	0,7	19,9	796	1,21	91	75	2,56	2,13
4 x 25	0,9	24	1240	0,78	115	96	1,62	1,38
4 x 35	0,9	27,7	1700	0,554	143	117	1,17	1,01
4 x 50	1	32,2	2430	0,386	174	138	0,86	0,77
4 x 70	1,1	35,8	3260	0,272	223	170	0,6	0,56
4 x 95	1,1	39,8	4210	0,206	271	202	0,43	0,42
4 x 120	1,2	43,7	5178	0,161	314	230	0,34	0,35
4 x 150	1,4	49,5	6476	0,129	359	260	0,28	0,3
4 x 185	1,6	56,1	8778	0,106	409	291	0,22	0,26
4 x 240	1,7	63,2	10526	0,0801	489	336	0,17	0,21
5 G 1.5	0,7	10,8	160	13,3	20	21	26,94	21,67
5 G 2,5	0,7	12	215	7,98	28	27,5	16,23	13,1
5 G 4	0,7	13,2	300	4,95	38	35	10,16	8,23
5 G 6	0,7	14,8	400	3,3	49	44	6,87	5,59
5 G 10	0,7	17,7	630	1,91	68	58	4,06	3,34
5 G 16	0,7	21,8	976	1,21	91	75	2,56	2,13
5 G 25	0,9	26,2	1460	0,78	115	96	1,62	1,38
5 G 35	0,9	30,6	2070	0,54	143	117	1,17	1,01

(1) Valores aproximados.

(2) Instalación en bandeja al aire (40 °C).
→ XLPE3 con instalación tipo E → columna 10b (4G, 4x, 5G trifásica).

(3) Instalación enterrada, directamente o bajo tubo con resistividad térmica del terreno estándar de 2,5 K.m/W.
→ XLPE3 con instalación tipo D1/D2 (Cu) → 4G, 4x, 5G trifásica.

Según UNE-HD 60364-5-52 e IEC 60364-5-52.

BRONMETAL

PLETINAS de COBRE

para APLICACIONES ELÉCTRICAS SEGÚN EN 13601

INTENSIDAD ADMISIBLE. DIN 43671

Temperatura ambiente 35ºC • Temperatura final barras 65ºC • Conductividad 56 M/Ωmm2(ρ- 0,0178Ωmm2/m)

Ancho x Espesor	Corriente alterna hasta 60 Hz								Corriente continua y alterna 16 2/3 Hz								CARACTERISTICAS ESTATICAS					
	Pintado				Brillante				Pintado				Brillante				x - F - x			y - F - y		
	Número de Barras 1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4						
	I	II	III	50* II II	I	II	III	50* II II	I	II	III	IIII	I	II	III	IIII	Jx cm4	Wx cm3	Ix cm	Jy cm4	Wy cm3	Iy cm
12 x 2	123	202	228		108	182	216		123	202	233		108	182	220		0,0288	0,0480	0,346	0,000800	0,00800	0,0577
15 x 2	148	240	261		128	212	247		148	240	267		128	212	252		0,0563	0,0750	0,433	0,00100	0,0100	0,0577
15 x 3	187	316	381		162	282	361		187	316	387		162	282	365		0,0844	0,113		0,00338	0,0225	0,0866
20 x 2	189	302	313		162	264	298		189	302	321		162	266	303		0,133	0,133	0,577	0,00133	0,0133	0,0577
20 x 3	237	394	454		204	348	431		237	394	463		204	348	437		0,200	0,200		0,00450	0,0300	0,0866
20 x 5	319	560	728		274	500	690		320	562	729		274	502	687		0,333	0,333		0,02080	0,0833	0,1440
20 x 10	497	924	1320		427	825	1180		499	932	1300		428	832	1210		0,667	0,667		0,16700	0,3330	0,2890
25 x 3	287	470	525		245	412	498		287	470	536		245	414	506		0,391	0,313	0,722	0,00563	0,0375	0,0866
25 x 5	384	662	869		327	586	795		384	664	841		327	590	794		0,651	0,521		0,02600	0,1040	0,1440
30 x 3	337	544	593		285	476	564		337	546	608		286	478	575		0,675	0,450		0,00675	0,0450	0,0866
30 x 5	447	760	944		379	672	896		448	766	950		380	676	897		1,130	0,750	0,866	0,03130	0,1250	0,1440
30 x 10	676	1200	1670		573	1060	1480		683	1230	1630		579	1080	1520		2,250	1,500		0,25000	0,5000	0,2890
40 x 3	435	692	725		366	600	690		436	696	748		367	604	708		1,60	0,800		0,00900	0,0600	0,0866
40 x 5	573	952	1140		482	836	1090		576	966	1160		484	848	1100		2,67	1,330	1,15	0,04170	0,1670	0,1440
40 x 10	850	1470	2000	2580	715	1290	1770	2280	865	1530	2000		728	1350	1880		5,33	2,670		0,33300	0,6670	0,2890
50 x 5	697	1140	1330	2010	583	994	1260	1920	703	1170	1370		588	1020	1300		5,21	2,08	1,44	0,0521	0,208	0,144
50 x 10	1020	1720	2320	2950	852	1510	2040	2600	1050	1830	2360		875	1610	2220		10,40	4,17		0,4170	0,833	0,289
60 x 5	826	1330	1510	2310	688	1150	1440	2210	836	1370	1580	2060	696	1190	1500	1970	9,00	3,00	1,73	0,0625	0,250	0,144
60 x 10	1180	1960	2610	3290	985	1720	2300	2900	1230	2130	2720	3580	1020	1870	2570	3390	18,00	6,00		0,5000	1,000	0,289
80 x 5	1070	1680	1830	2830	885	1450	1750	2720	1090	1770	1990	2570	902	1530	1890	2460	21,30	5,33	2,31	0,0833	0,333	0,144
80 x 10	1500	2410	3170	3930	1240	2110	2790	3450	1590	2730	3420	4490	1310	2380	3240	4280	42,70	10,70		0,6670	1,330	0,289
100 x 5	1300	2010	2150	3300	1080	1730	2050	3190	1340	2160	2380	3080	1110	1810	2270	2960	41,70	8,33	2,89	0,1040	0,417	0,144
100 x 10	1810	2850	3720	4530	1490	2480	3260	3980	1940	3310	4100	5310	1600	2890	3900	5150	83,30	16,70		0,8330	1,670	0,289
120 x 10	2110	3280	4270	5130	1740	2860	3740	4500	2300	3900	4780	6260	1890	3390	4560	6010	144,00	24,00	3,46	1,0000	2,000	
160 x 10	2700	4130	5360	6320	2220	3590	4680	5530	3010	5060	6130	8010	2470	4400	5860	7110	341,00	42,70	4,62	1,3300	2,670	0,2890
200 x 10	3290	4970	6430	7490	2690	4310	5610	6540	3720	6220	7460	9730	3040	5390	7150	9390	667,00	66,70	5,77	1,6700	3,330	

En el caso de varias barras en paralelo, la distancia entre las barras se toma igual al espesor. Para corriente alterna la distancia neta entre las fases se toma > 0,8 la distancia entre ejes de fases.

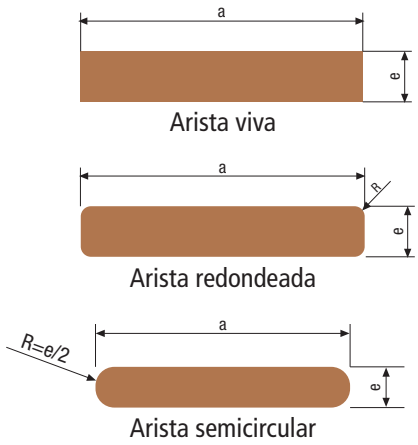
* Distancia mínima.

BRONMETAL

PLETINAS de COBRE

para APLICACIONES ELÉCTRICAS SEGÚN EN 13601

DETALLE DE LA ARISTA:



FORMATOS:

Plano, en Rollo y Encarretado.

TABLA DE PESOS TEÓRICOS

FORMATO PLETINA

FORMULA: (Ancho x espesor x 8'96) / 1000 = Kg / Metro

ESPESOR \ ANCHO	10	12	15	20	25	30	35	40	45	50	60	70	80	100	120	125	150	200	250
2	0,18	0,22	0,27	0,36	0,45	0,54	0,63	0,72	0,81	0,90	1,08	1,25	-	-	-	-	-	-	-
3	0,27	0,32	0,40	0,54	0,67	0,81	0,94	1,08	1,21	1,34	1,61	1,88	2,15	2,69	-	-	-	-	-
4	0,36	0,43	0,54	0,72	0,90	1,08	1,25	1,43	1,61	1,79	2,15	2,51	2,87	3,58	4,30	-	-	-	-
5	0,45	0,54	0,67	0,90	1,12	1,34	1,57	1,79	2,02	2,24	2,69	3,14	3,58	4,48	5,38	5,60	6,72	8,96	-
6	-	0,65	0,81	1,08	1,34	1,61	1,88	2,15	2,42	2,69	3,23	3,76	4,30	5,38	6,45	6,72	8,06	10,75	-
7	-	-	0,94	1,25	1,57	1,88	2,20	2,51	2,82	3,14	3,76	4,39	5,02	6,27	7,53	7,84	9,41	12,54	-
8	-	-	1,08	1,43	1,79	2,15	2,51	2,87	3,23	3,58	4,30	5,02	5,73	7,17	8,60	8,96	10,75	14,34	-
10	-	-	1,34	1,79	2,24	2,69	3,14	3,58	4,03	4,48	5,38	6,27	7,17	8,96	10,75	11,20	13,44	17,92	22,40
12	-	-	-	-	2,69	3,23	3,76	4,30	4,84	5,38	6,45	7,53	8,60	10,75	12,90	13,40	16,13	21,50	26,90
15	-	-	-	-	3,37	4,03	4,70	5,38	6,05	6,72	8,06	9,41	10,75	13,44	16,13	-	20,16	26,88	33,60
20	-	-	-	-	4,48	5,38	6,27	7,17	8,06	8,96	10,75	12,54	14,34	17,92	21,50	-	26,88	35,87	44,80
25	-	-	-	-	-	6,72	7,84	8,96	10,08	11,20	13,44	15,68	17,92	22,40	26,88	-	33,60	44,80	-
30	-	-	-	-	-	-	9,41	10,75	12,09	13,44	16,13	18,82	21,50	26,88	32,26	-	40,32	53,76	-
35	-	-	-	-	-	-	-	-	-	-	18,82	21,95	25,09	31,36	37,63	-	47,04	62,72	-
40	-	-	-	-	-	-	-	-	-	-	21,50	25,09	28,67	35,84	43,01	-	53,76	71,68	-
50	-		-	-	-	-	-	-	-	-	-	-	35,84	44,80	53,76	-	67,20	89,60	-
60	-	-	-	-	-	-	-	-	-	-	-	-	-	53,76	64,51	-	80,64	107,52	-
70	-	-	-	-	-	-	-	-	-	-	-	-	-	62,72	75,26	-	94,08	125,40	-

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