1 OBJECTIVE

These specifications describe the minimum requirements for low-voltage strips, referred to below as LV strips.

2 FRAMEWORK

The LV strips must meet the minimum and additional/explanatory requirements/wishes stated in this specification.

3 TERMS AND DEFINITIONS

Term	Definition
Low voltage (LV)	A voltage level less than or equal to 1 kV.
EPG	Emergency power generator.
LV strip	Module of a low-voltage distribution rack to connect one or two 3-phase cables with switchable NH fuse bases. The switchable NH fuse bases are load separators.
EPG synchronisation strip	LV strip used to connect the reference/bypass cable of an emergency power generator.
EPG supply strip	LV strip used to connect the supply cables of an emergency power generator.
IL strip	Strip used for internal lighting.
PL strip	Strip used to supply public lighting.
PL	Public lighting.
LOC	Logistics Operations Centre.

4 TECHNICAL REQUIREMENTS

4.1 Standards

The most recently valid version of each standard, guideline, regulation or provision listed below will apply in all cases.

	Document	Description
1	EN-IEC 60269-1	Low-voltage fuses - Part 1: General requirements.
2	EN-IEC 60269-2-1	Low-voltage fuses - Part 2-1: Additional requirements for fuses for use by authorised parties (fuses for primarily industrial applications) - Sections I to V - Examples of standardised fuses.
3	EN-IEC 60529	Degrees of protection of electrical equipment enclosures (IP coding).
4	EN-IEC 60947-1	Low-voltage switchgear - Part 1: Switches, disconnectors, combined units of switches/disconnectors and fuses.
5	EN-IEC 60947-3	Low-voltage switchgear - Part 3: Switches, disconnectors, combined units of switches/disconnectors and fuses.
6	NEN-EN-IEC 61243-3	Live working voltage detectors - Part 3
7	IPXXB	Protection against access to live parts with a finger in accordance with EN-IEC 60529.

4.2 Exceptions

Any deviations from the stipulations of Chapter 4 – Technical Requirements – must represent the same quality level and the same sustainability and safety levels, and must be agreed with Enexis in advance. In the event of any undated references, the most recent edition of the referenced publication will apply.

4.3 Component characteristics for LV strips

4.3.1 Normative requirements for LV strips

Unless indicated otherwise, LV strips in the distribution network must meet the requirements of the standards:

- IEC 60947-1 [3],
- IEC 60947-3 [4].

The supplier must demonstrate, by means of testing, the load capacity (in consultation with the energy network operator) and short-circuit resistance in accordance with the aforementioned standards. All tests must be carried out by an institute recognised for this purpose in Europe and by Enexis. In addition, the strips must meet the requirements of this specification.

4.3.2 Electrical requirements of LV strips

The strips must meet, at least, the following electrical requirements:

1. Rated voltage (U_e): 500 V
2. Insulation voltage (U_i): 690 V
3. Rated current (I_e): in accordance with section 4.3.3
4. Test voltage (AC) 1 minute: 2.5kV
5. Test voltage (DC) 1 minute: 3.5kV
6. Maximum impulse voltage (1.2/50 µs, U_{imp}): 8kV
7. Short-circuit current strips (I_{cw}): in accordance with section 4.3.3
8. Dynamic short-circuit current strips (I_{pk}): in accordance with section 4.3.3
9. Mains frequency: 50 Hz
10. Rated voltage of fuses used both 400 and 500 V
11. Characteristic of fuses used gG and gFF

Rated current I_e related to usage class of at least AC22B in accordance with IEC 60947-3 [5]. In this case, the dynamic short-circuit current must be equal to the conditional short-circuit current in accordance with IEC 60947-1 [4], based on a protected power supply unit for the strips.

4.3.3 Types of LV strips

The following types of LV strips, for different values of rated current, will be used. The LV strips need to be suitable for type NH fuses in accordance with IEC 60269 [2], [3].

Type LV strip	NH Fuse Link	Minimum rated current	Minimum short-circuit current I_{cw}/I_{pk}	Use
1	NH00	80 A	15/30 kA	IL strip, EPG synchronisation strip, PL main power supply, outgoing feeder
2	NH2	400 A	15/30 kA	Outgoing feeder excluding PL
3	NH2	400A	15/30 kA	Outgoing feeder including PL
4	NH3	630 A	15/30 kA	Supply transformer feeder of up to 400 kVA
5	NH3	1000 A	25/52.5 kA	Supply transformer feeder of up to 630 kVA
6*	NH3/NH4**	1600 A	25/52.5 kA	Supply transformer feeder of up to 1000 kVA

* Optional
** Dependent of the chosen solution from supplier

4.3.4 PL connection

As described in 4.3.3, the outgoing strips (type 3) must be supplied both with and without a connection for public lighting (PL). PL connection means the following:

Low-voltage strip with PL

1. A low-voltage strip with PL is equipped with surge protection (circuit breakers) above the strip that are fitted/clicked onto a DIN rail.
2. The wiring from these circuit breakers is routed down towards the connection area under the strip.
3. The part under PL means the connection area under the strip where the cable and the PL wires from the cable are assembled.
4. This applies to combination cables, where power cables and PL wires are included in a single cable.Mounting the PL wires at the bottom of the strip keeps the wiring neat and tidy and avoids having to route wiring along or in front of the cover caps.

Low-voltage strip without PL

1. A low-voltage strip without PL is used for cables without PL wires.
2. The cable is assembled at the bottom of the strip, with only the power cables being connected.
3. The lack of PL wires means no PL assembly is required and cabling remains limited to power connections under the strip.

4.3.5 Accessories

Besides the different types of LV strips, a number of individual products are included in the tender. These products and application are outlined in the table below.

Accessory	Use
Adapter NH00 strip	Adapter for placing two NH00 strips in the space of one NH2 strip
Strip connection cover	Isolated protection for touch safety cable lug
Rail cover	Isolated protection for touch safety rail
Busbar clamp SL00 5-10mm	Busbar clamp for drill-free mounting of NH2 strip on old LV rack
Connection terminal for single outgoing cable - NH2 Strip type	Assembly of distribution cable on outgoing feeder
Connection terminal for double outgoing cable - NH2 Strip type	Assembly of distribution cable on outgoing feeder

4.3.6 Emergency power generator (EPG) connection unit

In addition to this LV strip, we are therefore also requesting the supply of an NH00 LV strip fitted ex-works with Snap-Lock connectors. These Snap-Lock connectors are for the secondary connection of the EPG for reference purposes.

A connection option for the generator reference/bypass cable is required to enable synchronous start-up and shutdown. This connection must meet the following requirements:

1. A type 1 LV strip (EPG synchronisation strip) is to be used to synchronise the generator. This strip must be insulated when fitted to the rails. An equivalent alternative to using a Type 1 LV strip is also permitted.
2. The EPG synchronisation strip is to be connected in front of the supply strip to the power supply from the power transformer. Wiring to the EPG synchronisation strip must be protected by means of a fuse in the NH00 LV strip.
3. Snap-Lock connectors are therefore to be fitted to the outgoing side of the EPG synchronisation strip to which the reference/bypass cable can be connected.
4. The synchronisation connection is to be accompanied by a text description.

4.3.7 Functional requirements for LV strips

1. This tender does not cover the fuses for the LV strips. These will be installed in the LV strips by Enexis itself.
2. LV strips must be available on demand to manufacturers of LV racks and LV cabinets. Delivery to Enexis LOCs will also have to be arranged. See paragraph 8.8 for the delivery model.
3. The strips must be suitable for a standard rail spacing of 185 mm. A solution must also be available (for example adapters) for a rail spacing of 170 mm (as is occasionally required at Enexis).
4. The supply strip which is used to connect the LV transformer cables must have a centre rear connection as standard, with optional left, right and top connections also being available.
5. The 630 A (type 4) supply strips must be suitable for connecting type BMvK 0.6/1 kV 1x240 Cu rss power cables.
6. The 1000 A (type 5) supply strip must be suitable for connecting 2 type BMvK 0.6/1 kV 2x240 Cu rss power cables.
7. The 1600 A (type 6) supply strip must be suitable for connecting 3 type BMvK 0.6/1 kV 3x240 Cu rss power cables.
8. The outgoing feeder (types 2 and 3 strips) must at least be suitable for the standard cable types used by Enexis:
    - V-VMvKhsas 0.6/1kV 4x50 Alsvm+4x2½ rm +sas 25
    - V-VMvKhsas 0.6/1kV 4x95 Alsvm+4x6 rm +sas 35
    - V-VMvKhsas 0.6/1kV 4x150 Alsvm+4x6 rm +sas 50
    - V-VMvKhsas 0.6/1kV 4x240 Alsvm+4x6 rm +sas 70
    - V-VMvKsas 0.6/1kV 4x50 Alsvm +sas 25
    - V-VMvKsas 0.6/1kV 4x50 Alsvm +sas 35
    - V-VMvKsas 0.6/1kV 4x50 Alsvm +sas 50
    - V-VMvKsas 0.6/1kV 4x50 Alsvm +sas 70
    - Z1G-Ymz1Kas B2ca 0.6/1 kV 4x95 Cusvss +shaft 50

9. The outgoing feeder (types 2 and 3 strips) must be suitable/adaptable for connecting 2 equal conductor cross-sectional areas of the above cable types, up to a maximum of 2x150 Al. The clamp must be suitable for the cross-sectional area referred to and for connecting one or two cables with the stated conductor materials.

10. The outgoing feeder (types 2 and 3 strips) must be supplied with clamps. These clamps must be suitable for the above cable types used by Enexis.
11. The IL, PL and outgoing feeder strips (type 1) must be suitable for connecting a cable diameter of between 6 mm^2 and 25 mm^2.
12. The clamp must be of the cage clamp type. The clamp meets at least the following test requirements as described in EN-IEC 60947-1:
    - 9.2.5 Mechanical and electrical properties of terminals
    - 9.2.5.2 Tests of mechanical strength of terminals
    - 9.2.5.3 Testing for damage to and accidental loosening of conductors (flexion test)
    - 9.2.5.4 Pull-out test
13. The outgoing LV strips must be suitable for single-pole switching.
14. The supply LV strip and EPG synchronisation strip are always 3-pole switched.
15. The material must comply with Chapter 6 of this document which relates to environmental requirements.
16. The LV strips must have a minimum working life of 30 years, based on normal use.
17. The strips must be intended for use inside electrical commercial premises.
18. Conductors must be made of corrosion-resistant material.
19. The phase sequence for the connection must be accurately encoded with L1, L2 and L3. Encodings must be such that they do not become illegible due to usage or ageing for 30 years.
20. Each strip must be suitable for a unit number to be attached.
21. Each strip must have a free space to attach a name or direction tag.
22. The switching capacity of the LV strips must comply with EN-IEC 60947-3 [5] cat. AC-22B.
23. Maximum degree of contamination 3 (occurrence of conductive contamination or non-conductive contamination that becomes conductive due to condensation in accordance with EN-IEC 60947-1 [4] is permitted).
24. Each strip must be fitted with a cover cap for the cable connection for the sake of shock protection.
25. Minimum degree of protection of the strip:
    - IP2XB protection rating on front when closed.
    - IP10 on front when open (in accordance with EN-IEC 60529 [3]).
    - Cable connection IPXXB protection rating.
    - The above protection ratings will apply under normal operating conditions. This includes transformer unit connection strips (cover cap over transformer cables connection).
26. LV strips must be suitable for tools used within Enexis, see annex 9.1.
27. All mechanical and electrical connections to be tightened with a torque (spanner) must be marked.
28. Each strip is to be fitted with mounting bolts.
29. It must always be possible to assemble cables on the LV strip and PEN rail via phase/neutral terminal using the same tightening principle/tool.
30. Desirable (not a must have, but optional): The LV strips can be fitted with integrated Rogowski coils. See annex 0
31. The LV strips include an opening to test for de-energisation (in-line principle). The opening is sufficiently large to accommodate measuring equipment in accordance with NEN-EN-IEC 61243-3 [10]. See also *Figure* 1 and *Figure* 2.
32. The voltage level can be demonstrated using a multimeter in accordance with EN-IEC 61010-031.

4.3.8 Emergency power generator (EPG) synchronisation connection unit

A connection option for an emergency power generator as backup for the power transformer must be provided on the LV rack. In order to transfer to synchronisation, an EPG synchronisation strip is required which fulfils the following specifications:

- The connectors must have the following colour markings: L1: red, L2: yellow, L3: blue, Neutral: black, Earth: green, using Snap-Lock connectors.
- The EPG synchronisation connection must be covered so it is safe to touch (NEN-EN-IEC 61140 and at least IPXXB).

5 DESIGN VERIFICATION AND TESTING

The LV strip testing must comply with EN-IEC 60947-1 and EN-IEC 60947-3 [4, 5]. The testing must be carried out and documented as specified in these standards. This documentation must be available. Any additional tests must be defined by mutual agreement. The supplier must demonstrate, by means of a type test, compliance with the load capacity (in consultation with the energy network operator) and resistance to short circuit. The type test must not be older than 5 years on the contract commencement date. Tests (type tests, AC22, combustibility and thermal stability tests) must be carried out by an institute recognised for this purpose in Europe and by Enexis. This institute must be an ISO 17025 certified or accredited laboratory. The scope of the certification must include references to EN-IEC 60947-1 and 60947-3.

6 ENVIRONMENTAL REQUIREMENTS

1. The low-voltage strips and assemblies must be made of materials which are recyclable as much as possible.
2. The material must not cause any environmental damage during use.
3. The supplier and/or material must demonstrably comply with the European Restriction of Hazardous Substances (RoHS) and Waste Electrical and Electronic Equipment (WEEE) directives.
4. In the event of a fire, no toxic substances must be released due to combustion of the materials used.
5. The synthetic materials used must have a Limiting Oxygen Index (LOI) equal to or higher than 21.
6. No materials containing asbestos must be incorporated into the LV strips.
7. No materials, components or products must be processed that contain carcinogenic and mutagenic (C&M) substances, with the preference also being for reprotoxic-free substances to be used.

7 QUALITY ASSURANCE

7.1 General

1. All electrical connections must be assembled ex-works with the correct torques as determined by the manufacturer. All connections must be visibly marked after tightening.
2. If any innovations or adjustments are made to the low-voltage strips, multiple specimens of the adjusted low-voltage strips must be made available to Enexis for approval.
3. For any initial delivery, compliance with the requirements of this component specification, in addition to previous quality control requirements, must be demonstrated by means of a type test conducted by an institution recognised for this purpose in Europe and by Enexis. The result of this type test must be made available, for inspection, in the Dutch language. This institute must be an ISO 17025 certified or accredited laboratory. The scope of the certification must include references to EN-IEC 60947-1 and 60947-3.

7.2 Quality Assurance Protocol

Tenderer must substance to Enexis' ambition in the framework of quality, by fulfilling the requirements and submitting the requested documents at the time of submitting the tender according to Appendix 19 – Quality Assurance Protocol. During the verification audit of the production facilities after the preliminary awarding of the Framework Agreement, these documents and processes will be audited. Findings and points for improvement by Enexis will become part of the audit report and be included as an appendix to the framework agreement. This will serve as the starting point. The implementation of these points for improvement must be solved within the first year and will be monitored during the utilization phase of the framework agreement.

8 SUPPLY CHAIN REQUIREMENTS

8.1 Supply Chain conditions

The supplier must comply and deliver in accordance with the Enexis Supply Chain Order, Delivery & Packaging Requirements, as set out in Appendix 12.

8.2 Delivery time

The tenderer commits to a contractual delivery time of 7 calendar days after the order has been placed by Enexis or a third party within the Enexis chain on the basis of the LV Strips framework agreement.

8.3 Delivery performance

The minimum delivery performance against the contractually agreed delivery time must be at least 95% at order line level.

$$\text{Delivery performance} = \left(\frac{\text{Date of receipt} < \text{Orderdate} + \text{Contractual delivery time}}{\textit{Total number of order lines received}} \right) * 100\%$$

8.4 Management reporting

In the event of 3 months or more of supplier performance of <95%, the contracting authority will require the tenderer to communicate this proactively to the contracting authority through an improvement plan to restore the situation to the minimum supplier performance of 95%. The improvement plan must be submitted within one month of identifying a supplier performance <95%.

8.5 Delivery reliability

The minimum delivery reliability against the delivery time requested by the tenderer supplier must be at least 98% at order line level.

$$\text{Delivery reliability} = \left(\frac{\text{Receipt date} = \text{Requested delivery date}}{\textit{Total number of order lines received}} \right) * 100\%$$

8.6 Packing

Before the start of the contract, the tenderer will send a trial delivery to the contracting authority for approval of the packaging (including requirements in accordance with KE 208) and in accordance with the Enexis Supply Chain Ordering, Delivery, Packaging requirements.

8.7 Article list

After the contract has been awarded, the tenderer will provide an article list including all requested master data, in accordance with Enexis parameters as added under the format article master data tab. See Appendix 18 - Article master data sheet.

8.8 Contractual position and Delivery model

The contracts that will be awarded after successfully completing this tender procedure with the supplier of LV strips shall function as a Framework Agreement with **Enexis Netbeheer B.V**. itself and, subordinately, for supply to third parties that operate within the Enexis supply chain. These third parties include, but are not limited to:

- Suppliers of LV racks
- Suppliers of (compact)substations
- Suppliers of LV cabinets

Enexis shall act as **contracting and paying entity**. With the winning suppliers, a Framework Agreement shall be signed with Enexis, from which call-offs for the aforementioned third parties will be made. The supplier will deliver the products in accordance with the contractual conditions for the benefit of Enexis, whereby the assembly and integration of these products will take place at the third parties within the Enexis supply chain.

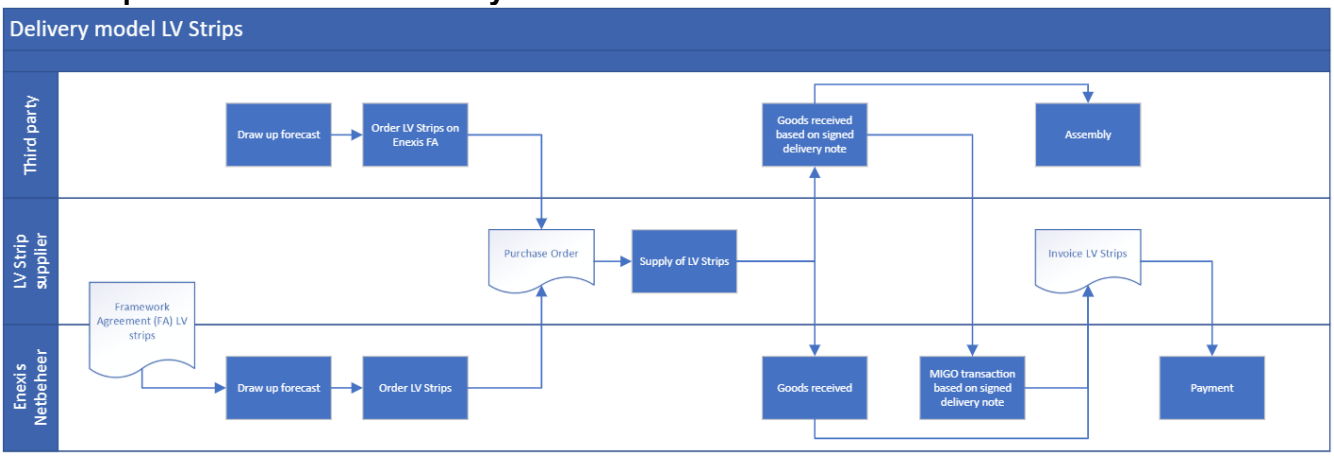
Invoicing will take place exclusively via Enexis. This means that de supplier will submit its invoices to Enexis, according to the contractual agreements and Enexis' invoicing requirements. Physical delivery of the product will be to the aforementioned third parties, or at the by Enexis designated locations, such as warehouses or other relevant supply chain partners.

This delivery model ensures:

- Uniform contractual terms and pricing
- Central coordination and administrative handling by Enexis
- Efficient and timely delivery within the supply chain
- Consistent application of LV strips within the Enexis infrastructure

The supplier must be capable of adequately supporting this delivery model during the term of the contract and must explicitly take this into account in its organization, logistical processes and administrative setup.

Visual representation of the delivery model



9 ANNEXES

9.1 Equipment and tools used within Enexis

9.1.1 Voltage de-energisation detection equipment

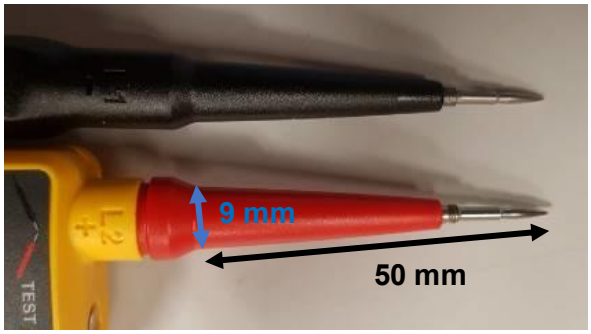


Figure 1: Two-pole Voltage Tester - Fluke

Figure 2: Two-pole voltage tester - Duspol

9.1.2 Equipment for cable fault localisation in the low-voltage grid

Figure 3: Baur NSG 1200 (install per phase)

Figure 4: Baur NSG 7000 G/T (install per phase)

9.1.3 Earthing set for outgoing earthing cables

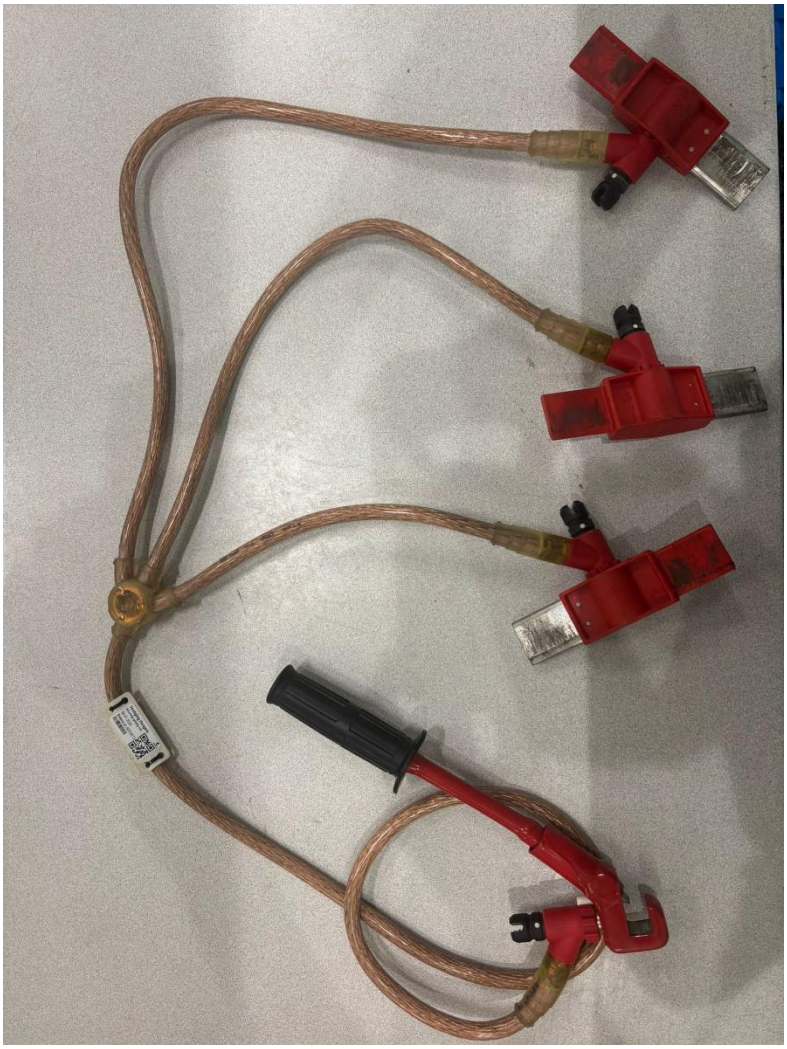


Figure 5: Arcus-Schiffmann earthing set

9.1.4 Phase rotation indicator

Figure 6: Phase rotation indicator - Gossen Metrawatt

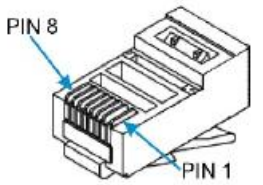
9.1.5 Rogowski measuring coils

GENERAL SPECIFICATIONS

REQUIREMENT ID	PARAMETER	VALUE
1	Environment temperature (degrees Celsius)	-20 to +55
2	Environment humidity	10-95% non-condensing
3	Accuracy class according to IEC 61869-10	0.5
4	Coil size	Fitting the LV feeder
5	Phase current (max)	250A
6	mV(rms) at 1000A(rms) @ 50Hz	100mV
7	Position Error vs theoretical ideal	Less than +/- 1%
8	Frequency bandwidth	1Hz-100kHz
9	Zero drift voltage	Less than 0.1mV
10	Rated insulation level	3kV
11	Connector type	RJ45
12	Technical lifetime	10+ years
13	Technical lifetime conditions	Temp: -10 (1% of the time), 20 (98% of the time), +55 (1% of the time) Humidity: 40% (5% of the time), 65% (85% of the time), 85% (10% of the time)

PIN LAYOUT RJ45

PIN	SIGNAL	DESCRIPTION
1	I-L1-	ROGOWSKI COIL PHASE 1 CURRENT NEGATIVE
2	I-L1+	ROGOWSKI COIL PHASE 1 CURRENT POSITIVE
3	GND	SHIELD
4	I-L2-	ROGOWSKI COIL PHASE 2 CURRENT NEGATIVE
5	I-L2+	ROGOWSKI COIL PHASE 2 CURRENT NEGATIVE
6	GND	SHIELD
7	I-L3-	ROGOWSKI COIL PHASE 3 CURRENT NEGATIVE
8	I-L3+	ROGOWSKI COIL PHASE 3 CURRENT NEGATIVE
9	GND	SHIELD



RJ45 pin numbers