TEST REPORT

Applicant	:	Shenzhen Lvyou Energy Technology Co., Ltd.
Address	:	103-104, Building 12, Dawangshan 2nd Industrial Zone, Shajing, Baoan District,Shenzhen,Guangdong,Chain
Manufacturer	:	Shenzhen Lvyou Energy Technology Co., Ltd.
Address	:	103-104, Building 12, Dawangshan 2nd Industrial Zone, Shajing, Baoan District,Shenzhen,Guangdong,Chain
Product Name	:	PV Microinverter
Trade Mark	:	EFFiSolax
Model No.	:	ES-800
Ratings	:	See Copy of marking plate for details IP67
Standard	:	IEC 60529:1989+A1:1999+A2:2013 Degrees of protection provided by enclosures(IP code)
Date of Receive	:	December 29, 2023
Date of Test	:	October 17, 2023 to October 18, 2023
Date of Issue	:	January 02, 2024
Test Report Form No	:	NTCS-IEC60529-A1-IP
Test Result	:	Pass *

This Test Report is Issued Under the Authority of:

Compiled by	Approved by / Authorized Signer
Van Fu/ Engineer	Ryan Li / Authorized Signatory

*Remarks:

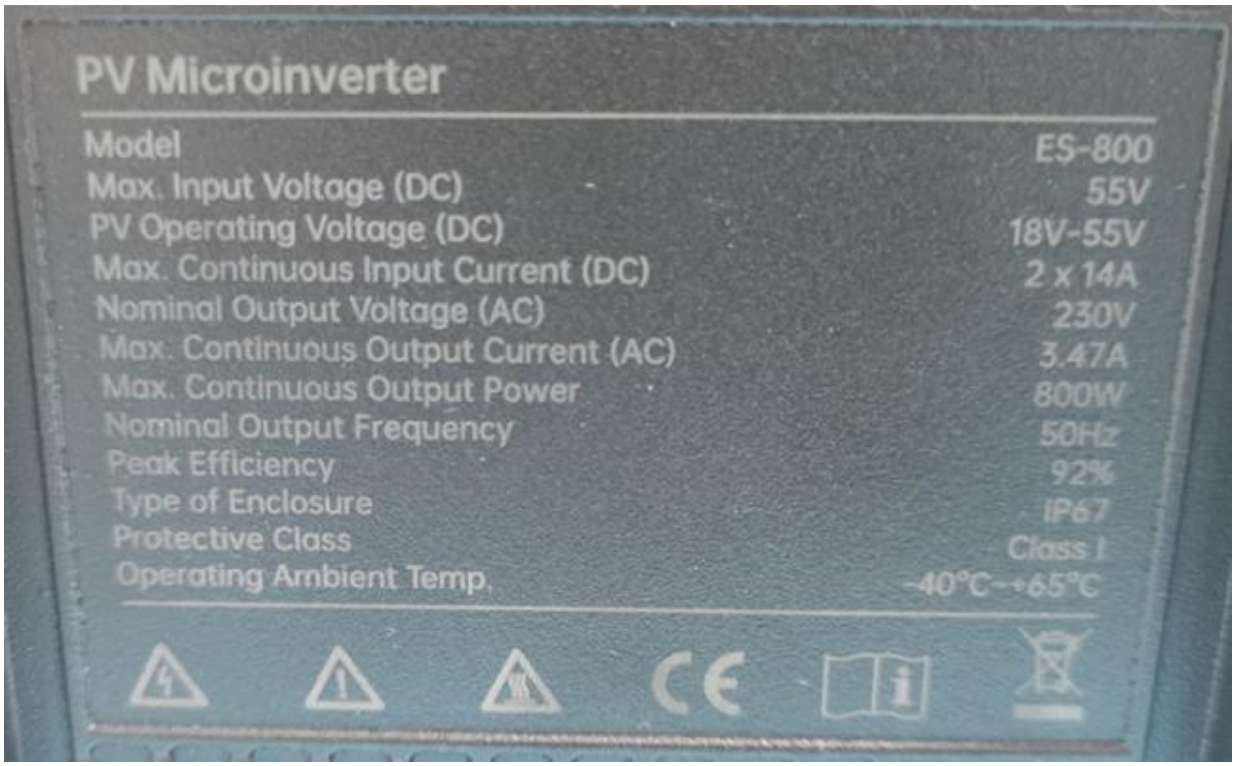
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of Dongguan Nore Testing Center Co., Ltd. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

TEL: +86-769-22022444 FAX: +86-769-22022799 Web: www.ntc-c.com
Address: Building D, Gaosheng Science & Technology Park, Zhouxi Longxi Road, Nancheng District, Dongguan City, Guangdong, China

Revision History of This Test Report

Report Number	Description	Issued Date
NTC2310039SV00	Initial Issue	2023-12-26
NTC2310039SV01	See page 4 for details	2024-01-02
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--
--	--	--

Copy of marking plate:



Summary of testing:

From the result of our tests on the submitted sample, we conclude it comply with the requirements of the IP67 testing.

Test item particulars	
Classification of installation and use ..... :	Fixed equipment
Supply Connection ..... :	DC supply via DC terminal block

Possible test case verdicts:	
- test case does not apply to the test object ..... :	N (N/A)
- test object does meet the requirement ..... :	P (Pass)
- test object does not meet the requirement ..... :	F (Fail)

General remarks:

"(see remark #)" refers to a remark appended to the report.
"(see appended table)" refers to a table appended to the report.
Throughout this report a dot is used as the decimal separator.
The test results presented in this report relate only to the object tested.
This report shall not be reproduced except in full without the written approval of the testing laboratory.

General product information:

The product covered in this report is PV Microinverter, Classified IP67.

History of amendments and modifications:

Ref. No. NTC2310039SV00 dated December 26, 2023. (Original test report)
Ref. No. NTC2310039SV01 dated January 02, 2023. (1st modification)

Description of change(s): (**NTC2310039SV01**)

1. Change the Trademark, see below table for details:

Original	New
	EFFiSolax

2. Change the Applicant and Manufacturer name and address, see below table foe details:

Original	New
Factory: Shenzhen Longsheng Energy Technology Co.,Ltd. **Address:** 1410, Huiyi Building, No. 9 Zhongxin Road, Taoyuan Community, Dalang.Street, Longhua District, Shenzhen,	**Factory**: Shenzhen Lvyou Energy Technology Co., Ltd. **Address**: 103-104, Building 12, Dawangshan 2nd Industrial Zone, Shajing, Baoan District,Shenzhen,Guangdong,Chain

3. Change the Model No, see below table for details:

Original	New
LS-800	ES-800

The model in this report is the same as original report's model, except for model name only.

For the above-described change(s) not test to be necessary.

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
5	**DEGREES OF PROTECTION AGAINST ACCESS TO HAZARDOUS PARTS AND AGAINST SOLID FOREIGN OBJECTS INDICATED BY THE FIRST CHARACTERISTIC NUMERAL**		P
5	The designation with a first characteristic numeral implies that conditions stated in both 5.1and 5.2 are met.		P
	The first characteristic numeral indicates that:		P
	the enclosure provides protection of persons against access to hazardous parts by preventing or limiting the ingress of a part of the human body or an object held by a person;		P
	and simultaneously the enclosure provides protection of equipment against the ingress of solid foreign objects.		P
	An enclosure shall only be designated with a stated degree of protection indicated by the first characteristic numeral if it also complies with all lower degrees of protection.		P
	However, the tests establishing compliance with any one of the lower degrees of protection need not necessarily be carried out provided that these tests would obviously be met if applied		P
5.1	Protection against access to hazardous parts		P
	Table 1 gives brief descriptions and definitions for the degrees of protection against access to hazardous parts.	IP6X	P
	Degrees of protection listed in table 1 shall be specified only by the first characteristic numeral and not by reference to the brief description or definition.		P
	To comply with the conditions of the first characteristic numeral, adequate clearance shall be kept between the access probe and hazardous parts.		P
	The tests are specified in clause 12.		P

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict

Table 1 – Degrees of protection against access to hazardous parts indicated by the first characteristic numeral

First characteristic numeral	Degree of protection		Test conditions, see
	Brief description	Definition	
0	Non-protected	–	–
1	Protected against access to hazardous parts with the back of a hand	The access probe, sphere of 50 mm ⌀, shall have adequate clearance from hazardous parts	12.2
2	Protected against access to hazardous parts with a finger	The jointed test finger of 12 mm ⌀, 80 mm length, shall have adequate clearance form hazardous parts	12.2
3	Protected against access to hazardous parts with a tool	The access probe of 2,5 mm ⌀ shall not penetrate	12.2
4	Protected against access to hazardous parts with a wire	The access probe of 1,0 mm ⌀ shall not penetrate	12.2
5	Protected against access to hazardous parts with a wire	The access probe of 1,0 mm ⌀ shall not penetrate	12.2
6	Protected against access to hazardous parts with a wire	The access probe of 1,0 mm ⌀ shall not penetrate	12.2

NOTE In the case of the first characteristic numerals 3, 4, 5 and 6, protection against access to hazardous parts is satisfied if adequate clearance is kept. The adequate clearance should be specified by the relevant product committee in accordance with 12.3.

Due to the simultaneous requirement specified in table 2, the definition "shall not penetrate" is given in table 1.

--

5.2	Protection against solid foreign objects		P
	Table 2 gives brief descriptions and the definitions for the degrees of protection against the penetration of solid foreign objects including dust.	IP6X	P
	Degrees of protection listed in table 2 shall only be specified by the first characteristic numeral and not by reference to the brief description or definition.		P
	The protection against the ingress of solid foreign objects implies that the object probes up to numeral 2 in table 2 shall not fully penetrate the enclosure. This means that the full diameter of the sphere shall not pass through an opening in the enclosure.		N/A
	Object probes for numerals 3 and 4 shall not penetrate the enclosure at all.		N/A
	Dust-protected enclosures to numeral 5 allow a limited quantity of dust to penetrate under certain conditions.		N/A
	Dust-tight enclosures to numeral 6 do not allow any dust to penetrate.		P
	Note Enclosures assigned a first characteristic numeral of 1 to 4 generally exclude both regularly and irregularly shaped solid foreign objects provided that three mutually perpendicular dimensions of the object exceed the appropriate figure in column 3 of table 2.		N/A
	The tests are specified in Clause 13.		P

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict

	Table 2 – Degrees of protection against solid foreign objects indicated by the first characteristic numeral	--

First characteristic numeral	Degree of protection		Test conditions, see
	Brief description	Definition	
0	Non-protected	–	–
1	Protected against solid foreign objects of 50 mm ⌀ and greater	The object probe, sphere of 50 mm ⌀, shall not fully penetrate 1)	13.2
2	Protected against solid foreign objects of 12,5 mm ⌀ and greater	The object probe, sphere of 12,5 mm ⌀, shall not fully penetrate 1)	13.2
3	Protected against solid foreign objects of 2,5 mm ⌀ and greater	The object probe, sphere of 2,5 mm ⌀, shall not penetrate at all 1)	13.2
4	Protected against solid foreign objects of 1,0 mm ⌀ and greater	The object probe of 1,0 mm ⌀, shall not penetrate at all 1)	13.2
5	Dust-protected	Ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the apparatus or to impair safety	13.4 13.5
6	Dust-tight	No ingress of dust	13.4 13.6

1) The full diameter of the object probe shall not pass through an opening of the enclosure.

6	**DEGREES OF PROTECTION AGAINST INGRESS OF WATER INDICATED BY THE SECOND CHARACTERISTIC NUMERAL**		P
	The second characteristic numeral indicates the degree of protection provided by enclosures with respect to harmful effects on the equipment due to the ingress of water.		P
	The tests for the second characteristic numeral are carried out with fresh water. The actual protection may not be satisfactory if cleaning operations with high pressure and temperature water jet outside the requirements of second characteristic numeral 9 and/or solvents are used.		P
	Table 3 gives brief descriptions and definitions of the protection for the degrees represented by the second characteristic numeral.	IPX7	P
	Degrees of protection listed in table 3 shall be specified only by the second characteristic numeral and not by reference to the brief description or definition.		P
	The tests are specified in Clause 14.		P
	Up to and including second characteristic numeral 6, the designation implies compliance also with the requirements for all lower characteristic numerals.		N/A
	However, the tests establishing compliance with any one of the lower degrees of protection need not necessarily be carried out provided that these tests obviously would be met if applied.		P

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	An enclosure designated with second characteristic numeral 9 only is considered unsuitable for exposure to water jets (designated by second characteristic numeral 5 or 6) and immersion in water (designated by second characteristic numeral 7 or 8) and need not comply with requirements for numeral 5,6,7 or 8 unless it is multiple coded as follows:		N/A
	Enclosures for “versatile” application shall meet requirements for exposure to both water jets and temporary or continuous immersion.		N/A
	Enclosures for “restricted” application are considered suitable only for temporary or continuous immersion and unsuitable for exposure to water jets		N/A
	Table 3 – Degrees of protection against water indicated by the second characteristic numeral		--

Second characteristic numeral	Degree of protection		Test conditions, see
	Brief description	Definition	
0	Non-protected	–	–
1	Protected against vertically falling water drops	Vertically falling drops shall have no harmful effects	14.2.1
2	Protected against vertically falling water drops when enclosure tilted up to 15°	Vertically falling drops shall have no harmful effects when the enclosure is tilted at any angle up to 15° on either side of the vertical	14.2.2
3	Protected against spraying water	Water sprayed at an angle up to 60° on either side of the vertical shall have no harmful effects	14.2.3
4	Protected against splashing water	Water splashed against the enclosure from any direction shall have no harmful effects	14.2.4
5	Protected against water jets	Water projected in jets against the enclosure from any direction shall have no harmful effects	14.2.5
6	Protected against powerful water jets	Water projected in powerful jets against the enclosure from any direction shall have no harmful effects	14.2.6
7	Protected against the effects of temporary immersion in water	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water under standardized conditions of pressure and time	14.2.7
8	Protected against the effects of continuous immersion in water	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is continuously immersed in water under conditions which shall be agreed between manufacturer and user but which are more severe than for numeral 7	14.2.8
9	Protected against high pressure and temperature water jets	Water projected at high pressure and high temperature against the enclosure from any direction shall not have harmful effects	14.2.9

7	**DEGREES OF PROTECTION AGAINST ACCESS TO HAZARDOUS PARTS INDICATED BY THE ADDITIONAL LETTER**	N/A
8	**SUPPLEMENTARY LETTERS**	N/A
9	**EXAMPLES OF DESIGNATIONS WITH THE IP CODE**	N/A

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict

10	**MARKING**		N/A
	The requirements for marking shall be specified in the relevant product standard.		N/A
	Where appropriate, such a standard should also specify the method of marking which is to be used when：		N/A
	- one part of an enclosure has a different degree of protection to that of another part of the same enclosure;		N/A
	- the mounting position has an influence on the degree of protection;		N/A
	- the maximum immersion depth and time are indicated.		N/A

11	**GENERAL REQUIREMENTS FOR TESTS**		P
11.1	Atmospheric conditions for water or dust tests		P
	Unless otherwise specified in the relevant product standard, the tests should be carried out under the standard atmospheric conditions described in IEC 60068-1.		P
	The recommended atmospheric conditions during the tests are as follows:		P
	Temperature range: 15 to 35 °C Relative humidity: 25 to 75% Air pressure: 86 to 106 kPa (860 to 1060 mbar)	24.5 ºC 51%R.H. 101.3kPa	P
11.2	Test samples		P
	The tests specified in this standard are type tests.		P
	Unless otherwise specified in a relevant product standard, the test samples for each test shall be in a clean and new condition, with all parts in place and mounted in the manner stated by the manufacturer.		P
	If it is impracticable to test the complete equipment, representative parts or smaller equipment having the same full-scale design details shall be tested.		P
	The relevant product standard shall specify details such as:		P
	- the number of samples to be tested;		P
	- the conditions for mounting, assembling and positioning of the samples, for example by the use of an artificial surface (ceiling, floor or wall);		P
	- the pre-conditioning, if any, which is to be used;		N/A
	- whether to be tested energized or not;		N/A
	- whether to be tested with its parts in motion or not.		N/A
	In the absence of such specification, the manufacturer's instructions shall apply.		P
11.3	Application of test requirements and interpretation of test results		P

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	The application of the general requirements for tests and the acceptance conditions for equipment containing drain-holes or ventilation openings is the responsibility of the relevant Technical Committee.		P
	In the absence of such specification the requirement of this standard shall apply.		P
	The interpretation of test results is the responsibility of the relevant Technical Committee. In the absence of a specification the acceptance of a specification the acceptance conditions of this standard shall at least apply		P
11.4	Combination of test conditions for the first characteristic numeral		P
	Designation with a first characteristic numeral implies that all test conditions are met for this numeral:		P
	Table 5 – Test conditions for degrees of protection indicated by the first characteristic numeral		--

First characteristic numeral	Test for protection against	
	access to hazardous parts	solid foreign objects
0	No test required	No test required
1	The sphere of 50 mm ⌀ shall not fully penetrate and adequate clearance shall be kept	
2	The jointed test finger may penetrate up to its 80 mm length, but adequate clearance shall be kept	The sphere of 12,5 mm ⌀ shall not fully penetrate
3	The test rod of 2,5 mm ⌀ shall not penetrate and adequate clearance shall be kept	
4	The test wire of 1,0 mm ⌀ shall not penetrate and adequate clearance shall be kept	
5	The test wire of 1,0 mm 0 shall not penetrate and adequate clearance shall be kept	Dust-protected as specified in table 2
6	The test wire of 1,0 mm 0 shall not penetrate and adequate clearance shall be kept	Dust-tight as specified in table 2
In the case of the first characteristic numerals 1 and 2, "not fully penetrate" means that the full diameter of the sphere shall not pass through an opening of the enclosure.		

11.5	Empty enclosures		N/A
	If the enclosure is tested without equipment inside, detailed requirements shall be indicated by the enclosure manufacturer in his instructions for the arrangement and spacing of hazardous parts or parts which might be affected by the penetration of foreign objects or water.		N/A
	The manufacturer of the final assembly shall ensure that after the electrical equipment is enclosed the enclosure meets the declared degree of protection of the final product.		N/A
12	**TESTS FOR PROTECTION AGAINST ACCESS TO HAZARDOUS PARTS INDICATED BY THE FIRST CHARACTERISTIC NUMERAL**		P
12.1	Access probes		P

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	Access probes to test the protection of persons against access to hazardous parts are given in table 6.	No electric shock hazard in product.	P
12.2	Test conditions		P
	The access probe is pushed against or (in case of the test for first characteristic numeral 2) inserted through any openings of the enclosure with the force specified in table 6.		N/A
	For tests on low-voltage equipment, a low-voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp should be connected between the probe and the hazardous parts inside the enclosure. Hazardous live parts covered only with varnish or paint, or protected by oxidation or by a similar process, are covered by a metal foil electrically connected to those parts which are normally live in operation.		P
	The signal-circuit method should also be applied to the hazardous moving parts of high-voltage equipment.		N/A
	Internal moving parts may be operated slowly, where this is possibile.		N/A
12.3	Acceptance conditions		P
	The protection is satisfactory if adequate clearance is kept between the access probe and hazardous parts.		P
	For the test of first characteristic numeral 1, the access probe 50 mm diameter shall not completely pass through the opening.		N/A
	For the test of first characteristic numeral 2, the jointed test finger may penetrate to its 80 mm length, but the stop face (Ø 50 mm x 20 mm) shall not pass through the opening. Starting from the straight position, both joints of the test finger shall be successively bent through an angle of up to 90° with respect to the axis of the adjoiningnsection of the finger and shall be placed in every possible position.		N/A
	See Annex A for further clarification.		N/A
	Adequate clearance means:		--
12.3.1	For low-voltage equipment (rated voltages not exceeding 1000 V a.c. and 1500 V d.c.)		P
	The access probe shall not touch hazardous live parts.		P
	If adequate clearance is verified by a signal circuit between the probe and hazardous parts, the lamp shall not light.		N/A
12.3.2	For high-voltage equipment (rated voltages exceeding 1000 V a.c. and 1500 V d.c.)		N/A

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	When the access probe is placed in the most unfavourable position(s), the equipment shall be capable of withstanding the dielectric tests as specified in the relevant product standard applicable to the equipment.		N/A
	Verification may be made either by dielectric test or by inspection of the specified clearance dimension in air which would ensure that the tests would be satisfactory under the most unfavourable electric field configuration (see IEC 71-2).		N/A
	In the case where an enclosure includes sections at different voltage levels the appropriate acceptance conditions for adequate clearance shall be applied for each section.		N/A
12.3.3	For equipment with hazardous mechanical parts		N/A
	The access probe shall not touch hazardous mechanical parts.		N/A
	If adequate clearance is verified by a signal circuit between the probe and hazardous parts, the lamp shall not light.		N/A
13	**TESTS FOR PROTECTION AGAINST SOLID FOREIGN OBJECTS INDICATED BY THE FIRST CHARACTERISTIC NUMERAL**		P
13.1	Test means		--
	Test means and the main test conditions are given in table 7.	IP6X	P
	Table 7 – Test means for the tests for protection against solid foreign objects		--

First characteristic numeral	Test means (object probes and dust chamber)	Test force	Test conditions, see
0	No test required	–	–
1	Rigid sphere without handle or guard $50^{+0,05}_{0}$ mm diameter	50 N ± 10 %	13.2
2	Rigid sphere without handle or guard $12,5^{+0,2}_{0}$ mm diameter	30 N ± 10 %	13.2
3	Rigid steel rod $2,5^{+0,05}_{0}$ mm diameter with edges free from burrs	3 N ± 10 %	13.2
4	Rigid steel rod $1,0^{+0,05}_{0}$ mm diameter with edges free from burrs	1 N ± 10 %	13.2
5	Dust chamber figure 2, with or without underpressure	–	13.4 + 13.5
6	Dust chamber figure 2, with under-pressure	–	13.4 + 13.6

13.2	Test conditions for first characteristic numerals 1, 2, 3, 4		N/A
	The object probe is pushed against any openings of the enclosure with the force specified in table 7.		N/A
13.3	Acceptance conditions for first characteristic numerals 1, 2, 3, 4		N/A

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	The protection is satisfactory if the full diameter of the probe specified in table 7 does not pass through any opening.		N/A
13.4	Dust test for first characteristic numerals 5 and 6		P
	The test is made using a dust chamber incorporating the basic principles shown in Fig. 2 whereby the powder circulation pump may be replaced by other means suitable to maintain the talcum powder in suspension in a closed test chamber. The talcum powder used shall be able to pass through a square-meshed sieve the nominal wire diameter of which is 50 µm and the nominal width of a gap between wires 75 µm. The amount of talcum powder to be used is 2 kg per cubic metre of the test chamber volume. It shall not have been used for more than 20 tests.		P
	Enclosures are of necessity in one of two categories:		P
	Category 1: Enclosures where the normal working cycle of the equipment causes reductions in air pressure within the enclosure below that of the surrounding air, e.g., due to thermal cycling effects.		P
	Category 2: Enclosures where no pressure difference relative to the surrounding air is present		N/A
	Category 1 enclosures:		P
	The enclosure under test is supported inside the test chamber and the pressure inside the enclosure is maintained below the surrounding atmospheric pressure by a vacuum pump.		P
	The suction connection shall be made to a hole specially provided for this test.		N/A
	If not otherwise specified in the relevant product standard, this hole shall be in the vicinity of the vulnerable parts.		P
	If it is impracticable to make a special hole, the suction connection shall be made to the cable inlet hole.		N/A
	If there are other holes (e.g., more cable inlet holes or drain-holes) these shall be treated as intended for normal use on site.		N/A
	The object of the test is to draw into the enclosure, by means of depression, a volume of air 80 times the volume of the sample enclosure tested without exceeding the extraction rate of 60 volumes per hour.		P
	In no event shall the depression exceed 2 kPa (20 mbar) on the manometer shown in Fig. 2.		P
	If an extraction rate of 40 to 60 volumes per hour is obtained the duration of the test is 2 h.		N/A

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	If, with a maximum depression of 2 kPa (20 mbar), the extraction rate is less than 40 volumes per hour, the test is continued until 80 volumes have been drawn through, or a period of 8 h has elapsed.		P
	or a period of 8 h has elapsed.		N/A
	Category 2 enclosures:		N/A
	The enclosure under test is supported in its normal operating position inside the test chamber, but is not connected to a vacuum pump.		N/A
	Any drain-hole normally open shall be left open for the duration of the test.		N/A
	The test shall be continued for a period of 8 h		N/A
	Category 1 and category 2 enclosures:		N/A
	If it is impracticable to test the complete enclosure in the test chamber, one of the following procedures shall be applied:		N/A
	- testing of individually enclosed sections of the enclosure;.		N/A
	- testing of representative parts of the enclosure, comprising components such as doors, ventilation openings, joints, shaft seals, etc., in position during test;		N/A
	- testing of a smaller enclosure having the same full-scale design details.		N/A
	In the last two cases, the volume of air to be drawn through the enclosure under test shall be the same as for the whole enclosure in full scale		N/A
13.5	Special conditions for first characteristic numeral 5		N/A
13.5.1	Test conditions for first characteristic numeral 5		N/A
	The enclosure shall be deemed category 1 unless the relevant product standard for the equipment specifies that the enclosure is category 2.		N/A
13.5.2	Acceptance conditions for first characteristic numeral 5		N/A
	The protection is satisfactory if, on inspection, talcum powder has not accumulated in a quantity or location such that, as with any other kind of dust, it could interfere with the correct operation of the equipment or impair safety.		N/A
	Except for special cases to be clearly specified in the relevant product standard, no dust shall deposit where it could lead to tracking along the creepage distances.		N/A
13.6	Special conditions for first characteristic numeral 6		P
13.6.1	Test conditions for first characteristic numeral 6		P

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	The enclosure shall be deemed category 1, whether reductions in pressure below the atmospheric pressure are present or not.		P
13.6.2	Acceptance conditions for first characteristic numeral 6		P
	The protection is satisfactory if no deposit of dust is observable inside the enclosure at the end of the test.	No dust entry into enclosure	P
14	**TESTS FOR PROTECTION AGAINST WATER INDICATED BY THE SECOND CHARACTERISTIC NUMERAL**		P
14.1	Test means		--
	The test means and the main test conditions are given in table 8.	IPX7	P

Table 8 – Test means and main test conditions for the tests for protection against water

Second characteristic numeral	Test means	Water flow rate	Duration of test	Test conditions, see
0	No test required	–	–	–
1	Drip box Figure 3 Enclosure on turntable	$1^{+0,5}_{0}$ mm/min	10 min	14.2.1
2	Drip box Figure 3 Enclosure in 4 fixed positions of 15° tilt	$3^{+0,5}_{0}$ mm/min	2,5 min for each position of tilt	14.2.2
3	Oscillating tube Figure 4 Spray ± 60° from vertical, distance max. 200 mm or Spray nozzle Figure 5 Spray ± 60° from vertical	0,07 l/min ± 5 % per hole, multiplied by number of holes 10 l/min ± 5 %	10 min 1 min/m² at least 5 min	14.2.3 a) 14.2.3 b)
4	As for numeral 3 Spray ± 180° from vertical	As for numeral 3		14.2.4
5	Water jet hose nozzle Figure 6 Nozzle 6,3 mm diameter, distance 2,5 m to 3 m	12,5 l/min ± 5 %	1 min/m² at least 3 min	14.2.5
6	Water jet hose nozzle Figure 6 Nozzle 12,5 mm diameter, distance 2,5 m to 3 m	100 l/min ± 5 %	1 min/m² at least 3 min	14.2.6
7	Immersion tank Water-level on enclosure: 0,15 m above top 1 m above bottom	–	30 min	14.2.7
8	Immersion tank Water-level: by agreement	–	by agreement	14.2.8
9	Fan jet nozzle Figure 7 Test of small enclosure on turntable Figure 12 Turntable speed (5 ± 1) r/min Spray at 0°, 30°, 60°, 90° Or Test of large enclosures as per intended use Spray from all practical directions Distance (175 ± 25) mm	(15 ± 1) l/min	 30 s per position 1 min/m2 at least 3 min	14.2.9 a) 14.2.9 b)

			--
14.2	Test conditions		--

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	Test means and main test conditions are given in table 8.		P
	Details concerning compliance of degrees of protection – in particular for second characteristic numerals 5/6/9 (water jets) and numerals 7/8 (immersion) – are given in Clause 6.		P
	The tests are conducted with fresh water.		P
	During the tests for IPX1 to IPX6 the water temperature should not differ by more than 5 K from the temperature of the specimen under test.	IPX7	N/A
	If the water temperature is more than 5 K below the temperature of the specimen a pressure balance shall be provided for the enclosure.		N/A
	For IPX7 and IPX9 details of the water temperature are given in 14.2.7 and 14.2.9 respectively.		P
	During the test, the moisture contained inside the enclosure may partly condense. The dew which may thus deposit shall not be mistaken for an ingress of water.		P
	For the purpose of the tests, the surface area of the enclosure is calculated with a tolerance of 10%.		P
	Adequate safety precautions should be taken when testing the equipment in the energized condition		N/A
14.2.1	Test for second characteristic numeral 1 with the drip box		N/A
	The test is made with a device which produces a uniform flow of water drops over the whole area of the enclosure.		N/A
	The turntable on which the enclosure is placed has a rotation speed of 1 r/min and the eccentricity (distance between turntable axis and specimen axis) is approximately 100 mm.		N/A
	The enclosure under test is placed in its normal operating position under the drip box, the base of which is larger than that of the enclosure.		N/A
	Except for enclosures designed for wall or ceiling mounting, the support for the enclosure under test should be smaller than the base of the enclosure.		N/A
	An enclosure normally fixed to a wall or ceiling is fixed in its normal position of use to a wooden board having dimensions which are equal to those of that surface of the enclosure which is in contact with the wall or ceiling when the enclosure is mounted as in normal use.		N/A
	The duration of test is 10 min.		N/A
14.2.2	Test for second characteristic numeral 2 with the drip box		N/A
	The dripping device is the same as specified in 14.2.1 adjusted to provide the water flow rate specified in table 8.		N/A

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	The table on which the enclosure is placed does not turn as in the case of the test for the second characteristic numeral 1.		N/A
	The enclosure is tested for 2,5 min in each of four fixed positions of tilt. These positions are 15° on either side of the vertical in two mutually perpendicular planes (see Fig. 3b).		N/A
	The total duration of the test is 10 min.		N/A
14.2.3	Test for second characteristic numeral 3 with oscillating tube or spray nozzle		N/A
	The test is made using one of the two test devices described in Fig. 4 and in Fig. 5 in accordance with the relevant product standard.		N/A
	a) Conditions when using the test device as in Fig. 4 (oscillating tube)		N/A
	The total flow rate is adjusted as specified in table 9 and is measured with a flow meter.		N/A
	The oscillating tube is provided with spray holes over an arc of 60° either side of the centre point. The support is not perforated.		N/A
	The enclosure to be tested is placed at the centre point of the semicircle. The tube is caused to oscillate through an angle of 120°, 60° on either side of the vertical, the time for one complete oscillation (2 × 120°) being about 4 s and the test duration being 5 min.		N/A
	The enclosure is then turned through an horizontal angle of 90° and the test is continued for a further 5 min.		N/A
	The maximum acceptable radius of the oscillating tube is 1 600 mm.		N/A
	If for certain types of apparatus it is not possible to wet all parts of the enclosure under test, the support of the enclosure may be moved up or down. The hand-held test device as in figure 5 (spray nozzle) should be used as a preference in such cases. b) Conditions when using the test device as in figure 5 (spray nozzle):		N/A
	b) Conditions when using the test device as in Fig. 5 (spray nozzle)		N/A
	The counterbalanced shield is in place for this test.		N/A
	The water pressure is adjusted to give the specified delivery rate. The pressure to achieve this delivery rate will be in the range of 50 kPa to 150 kPa. It should be kept constant during the test.		N/A
	The test duration is 1 min/m2 of the calculated surface area of the enclosure (excluding any mounting surface), with a minimum duration of 5 min.		N/A
14.2.4	Test for second characteristic numeral 4 with oscillating tube or spray nozzle		N/A

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	The test is made using one of the two test devices described in Fig. 4 and in Fig. 5 in accordance with the relevant product standard.		N/A
	a) Conditions when using the test device as in Fig. 4 (oscillating tube):		N/A
	The oscillating tube has spray holes over the whole 180" of the semicircle. The total flow rate is adjusted as specified in table 9 and is measured with a flow meter.	IPX7	N/A
	The tube is caused to oscillate through an angle of almost 360°, 180° on either side of the vertical, the time for one complete oscillation (2 × 360°) being about 12 s.		N/A
	The duration of the test is 10 min.		N/A
	If not specified otherwise in the relevant product standard, the support for the enclosure under test is perforated so as to avoid acting as a baffle and the enclosure is sprayed from every direction by oscillating the tube to the limit of its travel in each direction.		N/A
	b) Conditions when using the test device as in Fig. 5 (spray nozzle):		N/A
	The counterbalanced shield is removed from the spray nozzle and the enclosure is sprayed from all practicable directions.		N/A
	The rate of water flow and the spraying time per unit area are as specified in 14.2.3.		N/A
	Table 9 – Total water flow rate q_V under IPX3 and IPX4 test conditions – Mean flow rate per hole q_{Vl} = 0,07 l/min		--

Tube radius R mm	Degree IPX3		Degree IPX4	
	Number of open holes N [1)]	Total water flow q_V l/min	Number of open holes N [1)]	Total water flow q_V l/min
200	8	0,56	12	0,84
400	16	1,1	25	1,8
600	25	1,8	37	2,6
800	33	2,3	50	3,5
1 000	41	2,9	62	4,3
1 200	50	3,5	75	5,3
1 400	58	4,1	87	6,1
1 600	67	4,7	100	7,0

1) Depending on the actual arrangement of the hole centres at the specified distance, the number of open holes N may be increased by 1.

14.2.5	Test for second characteristic numeral 5 with the 6,3 mm nozzle		N/A
	The test is made by spraying the enclosure from all practicable directions with a stream of water from a standard test nozzle as shown in Fig. 6.		N/A
	The conditions to be observed are as follows:		N/A
	- internal diameter of the nozzle: 6,3 mm;		N/A
	- delivery rate: 12,5 l/min ± 5%;		N/A

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	- water pressure: to be adjusted to achieve the specified delivery rate;		N/A
	- core of the substantial stream: circle of approximately 40 mm diameter at 2,5 m distance from nozzle;		N/A
	- test duration per square metre of enclosure surface area likely to be sprayed: 1 min;		N/A
	- minimum test duration: 3 min;		N/A
	- distance from nozzle to enclosure surface: between 2,5 and 3 m		N/A
14.2.6	Test for second characteristic numeral 6 with the 12,5 mm nozzle		N/A
	The test is made by spraying the enclosure from all practicable directions with a stream of water from a standard test nozzle as shown in Fig. 6.		N/A
	The conditions to be observed are as follows:		N/A
	- internal diameter of the nozzle: 12,5 mm;		N/A
	- delivery rate: 100 l/min ± 5%;.		N/A
	- water pressure: to be adjusted to achieve the specified delivery rate;		N/A
	- core of the substantial stream: circle of approximately 120 mm diameter at 2,5 m distance from nozzle;		N/A
	- test duration per square metre of enclosure surface area likely to be sprayed: 1 min;		N/A
	- minimum test duration: 3 min;		N/A
	- distance from nozzle to enclosure surface: between 2,5 and 3 m.		N/A
14.2.7	Test for second characteristic numeral 7: temporary immersion between 0,15 and 1 m		P
	The test is made by completely immersing the enclosure in water in its service position as specified by the manufacturer so that the following conditions are satisfied:		P
	a) the lowest point of enclosures with a height less than 850 mm is located 1000 mm below the surface of the water		P
	b) the highest point of enclosures with a height equal to or greater than 850 mm is located 150 mm below the surface of the water;		N/A
	c) the duration of the test is 30 min;		P
	d) the water temperature does not differ from that of the equipment by more than 5 K.		P
	However, a modified requirement may be specified in the relevant product standard if the tests are to be made when the equipment is energized and/or its parts in motion		P

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
14.2.8	Test for second characteristic numeral 8: continuous immersion subject to agreement		N/A
	Unless there is a relevant product standard, the test conditions are subject to agreement between manufacturer and user,		N/A
	but they shall be more severe than those prescribed in 14.2.7		N/A
	And they shall take account of the condition that the enclosure will be continuously immersed in actual use.		N/A
14.2.9	Test for second characteristic numeral 9 by high pressure and temperature water jetting		N/A
	The test is made by spraying the enclosure with a stream of water from a standard test nozzle as shown in Figures 7, 8 and 9.		N/A
	The set-up for measuring the impact force of the water jet is given in Figure 10.		N/A
	The distribution force shall be verified at upper and lower limits of distance tolerance range (see Figure 11).		N/A
	a) For small enclosures (largest dimension less than 250 mm), the enclosure shall be mounted on the test device shown in Figure 12.		N/A
	– turntable speed: 5 r/min ± 1 r/min		N/A
	– spray positions: 0°, 30°, 60°, 90°		N/A
	The test duration is 30 s per position.		N/A
	b) For large enclosures (largest dimension greater than or equal to 250 mm), the enclosure shall be mounted as per intended use. The entire exposed surface area of the enclosure shall be subjected to the spray at some point during the test procedure.		N/A
	– spray positions: the enclosure shall be sprayed from all practical directions covering the entire surface area and the spray shall be, as far as possible, perpendicular to the sprayed surface.		N/A
	– distance between nozzle and sample under test shall be 175 ± 25 mm.		N/A
	The test duration is 1 min/m^2 of the calculated surface area of the enclosure (excluding any mounting surface), with a minimum duration of 3 min.		N/A
14.3	Acceptance conditions		P
	After testing in accordance with the appropriate requirements of 14.2.1 to 14.2.9 the enclosure shall be inspected for ingress of water.	No water entry into internal.	P

IEC 60529			
Clause	Requirement + Test	Result - Remark	Verdict
	It is the responsibility of the relevant Technical Committee to specify the amount of water which may be allowed to enter the enclosure and the details of a dieletric strength test, if any.		N/A
	In general, if any water has entered, it shall not:		N/A
	- be sufficient to interfere with the correct operation of the equipment or impair safety;	No electric shock hazard in product	N/A
	- deposit on insulation parts where it could lead to tracking along the creepage distances;		N/A
	- reach live parts or windings not designed to operate when wet;		N/A
	- accumulate near the cable end or enter the cable if any.		N/A
	If the enclosure is provided with drain-holes, it should be proved by inspection that any water which enters does not accumulate and that it drains away without doing any harm to the equipment.		N/A
	For enclosures without drain-holes, the relevant product standard shall specify the acceptance conditions if water can accumulate to reach live parts		N/A
15	**TESTS FOR PROTECTION AGAINST ACCESS TO HAZARDOUS PARTS INDICATED BY THE ADDITIONAL LETTER**		N/A
ZA	**ANNEX ZA (NORMATIVE)** Other International Publications quoted in this standard with the references of the relevant European Publications		N/A
	When the International Publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.	(EN 60529)	N/A

Photo documentation

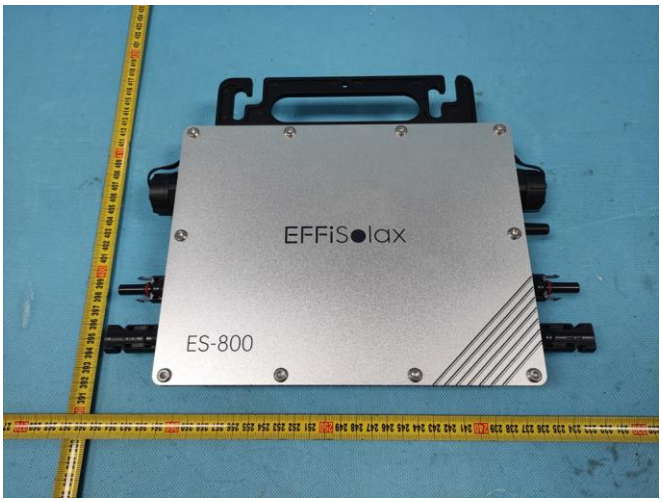


Photo 1 Sample before testing

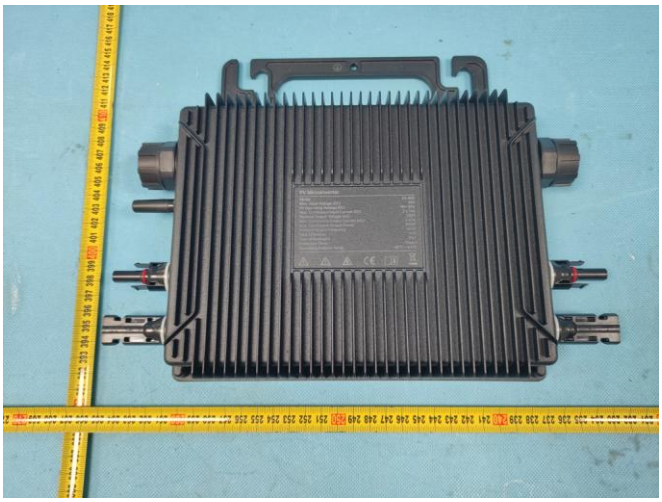


Photo 2 Sample before testing

Photo 3 After the dust-proof test

Photo 4 In the waterproof test

Photo 5 After the IP67 test, no water and dust entry into internal.

Photo 6 After the IP67 test, no water and dust entry into internal.

--- END OF THIS REPORT---