



# TEST REPORT

N° 131244-663693Ev

English version – Original in French

**ISSUED TO** : **A RAYMOND Energie SAS**  
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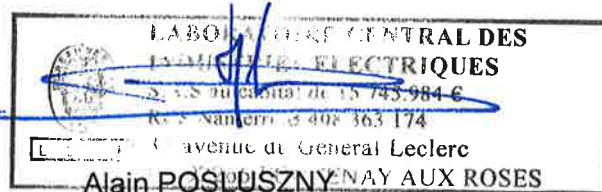
**OBJECT** : **Tests according to a particular protocol on PV fastener device (réf. : 'PowAR Snap S') associated with system (Standard Strut Rail') protective grounding of photovoltaic panel.**

**Carried out tests** : September to November 2014

This document contains 10 pages

Fontenay-aux-Roses, on 2014/11/18

Technical manager,



Original in French signed  
by Alain POSLUSZNY

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## 1. OBJECT

The purpose of the tests was to verify the electrical performances of a photovoltaic module fastener assuring the grounding of panels.

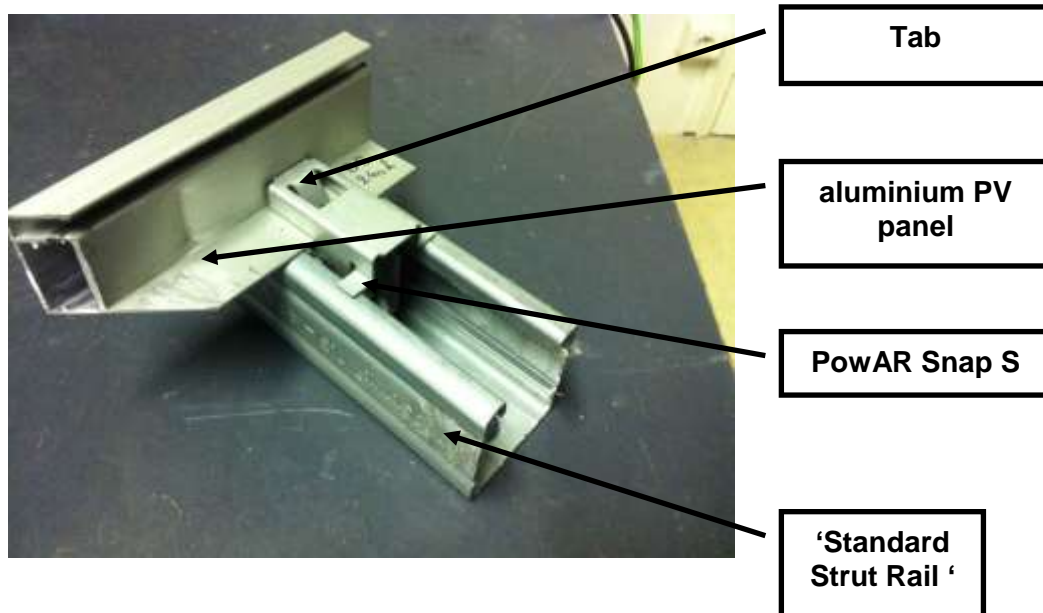
## 2. TESTED SAMPLES

The role of the device is to mechanically fasten the module while allowing earthing continuity between the aluminum framework (insulated surface) of a photovoltaic panel and the support (Standard Strut Rail).

### **Fastener used with Standard Strut Rail system : 'PowAR Snap S'**

The fastener is manually inserted onto the panel. During this operation, the teeth of the tab (upper part of the fastener) scratch the insulation and penetrate into the metal frame. Then, the assembly is mounted onto the support by snapping.

### **Standard Strut Rail with fastener 'PowAR Snap S' :**





### **3. TEST PROGRAM**

The testing program was as follows:

- Ground continuity test (10A, 25A et 40A), with sanctions of IEC 60439-1 (2004) - § 8.2.4.1, (Results from the LCIE test report No. 130375-662487 Cr2014-10-01).
- Salt mist test, NF EN 60068-2-11 (1999),
- Sulfur dioxide test (SO<sub>2</sub>) with general condensation of moisture NF EN ISO 6988 (April 1995).
- Lightning current wave test, (Results from the LCIE test report No. 130375-662487 Cr2014-10-01).

#### 4. PROCEDURES

##### 4.1 Ground continuity test

###### Methods :

The test intended to measure the electrical resistance of the fastener ("PowAR snap S") achieving the connection between the photovoltaic panel and a standard "Strut" rail profile.

The fastener has been assembled onto the module frame by the applicant (A RAYMOND).

The laboratory has snapped the assembly onto a standard "strut" rail.

Test was performed by injecting a current between the frame and the support. Current values selected were successively 10A, 25A and 40A.

##### Sample used for ground continuity test

###### **'PowAR Snap S'**



###### Sanction :

Measured resistance are specified to be below 100mΩ.

Results :

Tested association	Current (A)	Resistance (mΩ)
‘PowAR Snap S’ Standard Strut Rail + framework	10	6.1
	25	6.2
	40	6.6

Result : **PASS**

**4.2 Salt mist test**

The sample consisted of a piece of frame equipped with a fastener (“PowAR snap S”) and ‘Standard Strut Rail’ system.

The fastener has been assembled onto the module frame by the applicant (A RAYMOND).

The laboratory has snapped the assembly onto a standard “strut” rail.

After performing the measurement of contact resistance, the sample was submitted to a salt mist test for a period of **240 hours**.

Following this conditioning, the sample was rinsed with water, then dried.

A new resistance measurement was then performed.

Test conditions :

Duration : 240h  
 Temperature : 35± 2 °C  
 Orientation : horizontale  
 pH : 6.5 to 7.2

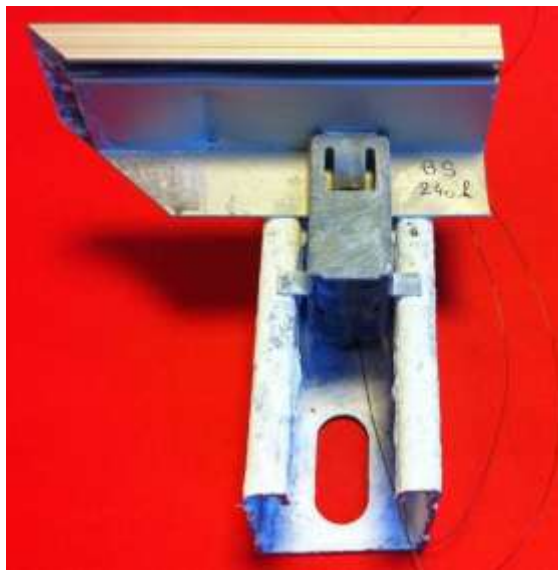
Results :

Tested association	Current (A)	Resistance (mΩ)	
		Before Salt mist test 240h	After Salt mist test 240h
‘PowAR Snap S’ Standard Strut Rail + framework	10	16.5	33.6

**Sample during the salt mist test**



**Sample after the salt mist test**



**Result : PASS**

### **4.3 Sulfur dioxide test (SO<sub>2</sub>) with general condensation of moisture**

The sample consisted of a piece of frame equipped with a fastener ("PowAR snap S") and 'Standard Strut Rail' system.

The fastener has been assembled onto the module frame by the applicant (A RAYMOND).

The laboratory has snapped the assembly onto a standard "strut" rail.

After performing the measurement of contact resistance, the sample was submitted to a Sulfur dioxide test with general condensation of moisture

Following this conditioning, a new resistance measurement was then performed.

#### **Test conditions :**

- Temperature of oven : 40± 2 °C
- S<sub>2</sub> concentration : 0.067 %
- Humidity : 100 %
- Duration of the test : 168 hours
- Duration of the cycle : 24 hours
- Description of the cycle : Exposure to SO<sub>2</sub> with moist air for 8 hours at ambient conditions during 16 hours (23°C and humidity 75% max.)

#### **Results :**

Tested association	Current (A)	Resistance (mΩ)	
		Before SO <sub>2</sub>	After SO <sub>2</sub>
'PowAR Snap S' Standard Strut Rail + framework	10	24.9	27.4

#### **Sample during SO<sub>2</sub> test**



**Sample after SO2 test**



**Result : PASS**

**4.4 Impulse current wave test**

Tests were performed on one new sample identical to the one used in 4.2.  
 The contact resistance measurements were performed before and after testing of current waves of impulse. The current was '8/20µs' form.  
 An impulse wave current was applied to the set.  
 On the first sample, the amplitude was set to 20kA peak.

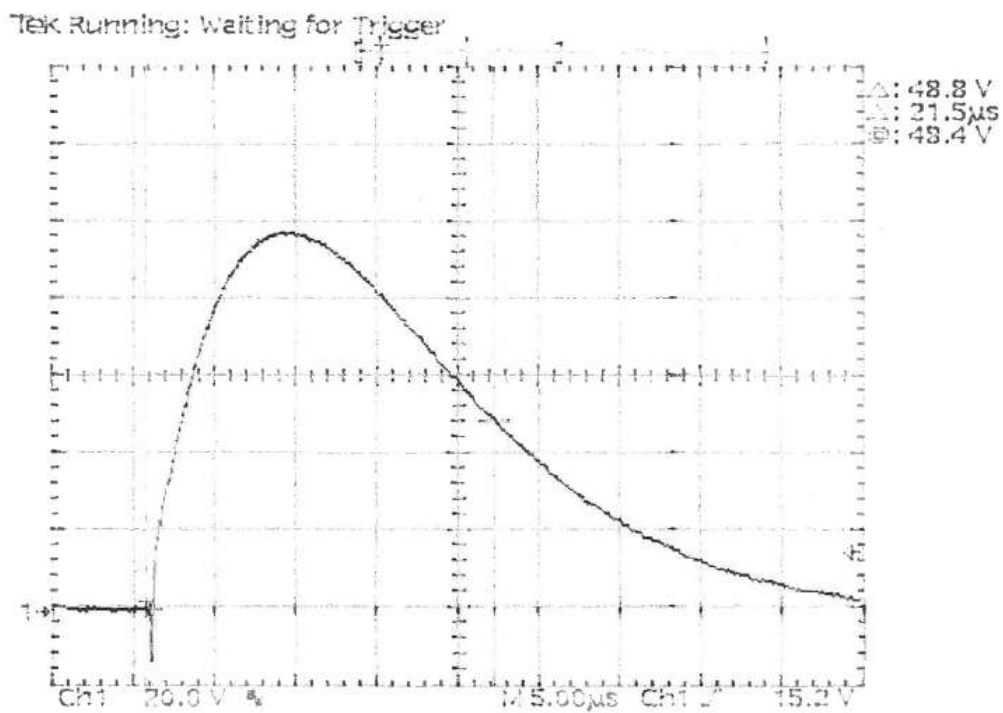
**Results :**

Obtained form 20kA : 6.8/21.5µs

Current amplitude (kA)	Tested association	Courant (A)	Résistance (mΩ)	
			Before	After
19.5	'PowAR Snap S' Standard Strut Rail + framework	10	1.56	5.7



**Current wave : example 20kA peak (4kA / division)**



**Result : PASS**



Annex n° 1

**MAXIMUM UNCERTAINTIES CHART**

This chart shows the maximum uncertainty values according to tests that may be related in this document

Test	Measurement uncertainty ( k = 2 )
Temperature rise tests of terminals	± 2 K
Breaking tests	
- Current	± 4.5 %
- Voltage	± 1.6 %
- Peak current	± 4.5 %
- Peak voltage	± 1,6 %
- Time	± 2.8 %
- Joule integral	± 7.3 %
Power dissipation	± 1 %
Dielectric strength verification	± 4.5 %
Impulse withstand voltage 1.2/50 (voltage amplitude)	± 4 %
Insulation resistance measurement	± 6 %
Ball-pressure test – impression measurement	- 0 mm + 0.25 mm
Comparative tracking index measurement	± 25 V
Power measurement	± 2 %
Current measurement	± 2.1 %
Hammer test – Impact energy	± 0.013 J
Voltage measurement	± 2.1 %
Resistance measurement	± 2 %
Leakage current measurement	± 2 %
Time or time interval	
• Range from 1s to 9 min	± 0.3 s
• Range > 9 min	± 0.1 %
Humidity measurement (hygroscopic treatment, conditioning)	
• 50 % RH to 90 % RH	± 3 % RH
• > 90 % RH	± 4 % RH
Force measurement (dynamometer) for mechanical strength test, pull test, test probe entry	± 2.5 %
Mass measurement (weight)	
• 0 g to 5 kg (0 N to 49.05 N)	± 0.2 %
• 5 kg to 9 kg (49.05 N to 88.29 N)	± 3 g (± 0.03 N)
• 9 kg to 50 kg (88.29 N to 490.5 N)	± 14 g (± 0.14 N)
Earth resistance measurement	± 2 %
Clearance and creepage distances measurement and other dimensional measurements performed with a calliper rule	± 0.13 mm
Dimensional measurement performed with a rule	± 0.7 mm
Dimensional and angle measurements performed with profile projector	± 7 µm ± 0,07°
Needle flame test – Flame height	± 1.8 mm
Lightning impulse-voltage test	
- Impulse amplitude	± 2 %
- Rising and falling time	± 7 %
- Impulse tail duration	± 5 %

**k = coverage factor**