

**TÜV Rheinland Energie und Umwelt GmbH  
Renewable Energies**

## **Test Report**

**Mechanical Load Test  
according to IEC 61215:2005**

**TÜV Report No. 21214714**

**Cologne, October 2010**



**DAT-P-226/06-01**



**Report No: 21214714**

on

mechanical load test  
according to IEC 61215:2005


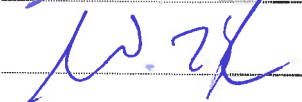
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<b>TEST REPORT</b> <b>IEC 61215:2005</b> <b>Crystalline Silicon Terrestrial Photovoltaic (PV) Modules-</b> <b>Design qualification and type approval</b>	
Report Reference No .....	21214714
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<b>Applicant's name</b> .....	TriEnergy GmbH   TRITEC Logistics
Address .....	Boschstraße 2/4 71287 Weissach
<b>Test specification:</b>	
Standard .....	IEC 61215:2005, Second Edition
Test procedure .....	Mechanical Load Test
Test sample .....	Kyocera; KD 215 GH-2 PU
Mounting system .....	TriEnergy; TRI-ROOF
<b>Test Report Form No</b> .....	IEC61215C
Test Report Form Originator .....	TÜV Rheinland Immissionsschutz und Energiesysteme GmbH
Master TRF .....	Dated 2008-05
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<b>Test item description</b> .....	Photovoltaic (PV) Module(s)
Manufacturer .....	Kyocera
Model/Type .....	KD 215 GH-2 PU
Ratings .....	210 – 240 W

## 1. Summary of testing

### Basic:

The mechanical load test according to IEC 61215:2005 was performed on the below listed mounting system and PV-modules with three cycles of tensile and pressure load, each for one hour per cycle.

The PV-module type KD 215 GH-2 PU was tested with 2400 Pa tensile and pressure load.

AN extension to heavy snow load with 5400 Pa was also performed, while the module was supported by an additional profile.

The mechanical load test of the EN IEC 61215:2005 standard and all relevant control measurements (I-V-curve measurements, insulation test wet-leakage current test) were passed according to its regulations of the pass criteria. It is therefore declared that the tested combination of module types and mounting system can be used in regions with basic conditions that are equal to the test conditions.

.Subject	Manufacturer	Type
PV-module	Kyocera	KD 215 GH-2 PU
Mounting system	TriEnergy	TRI-ROOF

### Tests performed (name of test and test clause):

	Code	Qualification Test	location
	10.1	Visual Inspection	TÜV Laboratory Cologne
	10.2	Maximum Power Determination	TÜV Laboratory Cologne
	10.3	Insulation Test	TÜV Laboratory Cologne
	10.15	Wet Leakage Test	TÜV Laboratory Cologne
	10.16	Mechanical Load Test	TÜV Laboratory Cologne

## 2. General information

<b>Test item particulars:</b>			
Abbreviations used in the report:			
STC	– Standard Test Conditions	Pmpp	– Maximum power
Imp	– Maximum power current	Vmpp	– Maximum power voltage
Isc	– Short circuit current	Voc	– Open circuit voltage
FF	– Fill factor		
<b>Possible test case verdicts:</b>			
- test case does not apply to the test object.....: N/A			
- test object does meet the requirement.....: Pass (P)			
- test object does not meet the requirement.....: Fail (F)			
Date of receipt of test item.....: 27.09.2010			
Date(s) of performance of tests .....: From 30.09.2010 to 26.10.2010			
<b>General remarks:</b>			
The test verdicts 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 Issuing testing laboratory. “(see Enclosure #)” refers to additional information appended to the report. “(see appended table)” refers to a table appended to the report.			
Throughout this report a point is used as the decimal separator.			
<b>General product information and considerations:</b>			
<b>Product Electrical Ratings:</b>			
Module type	KD 215 GH-2 PU		
Pmpp [W]	215 ± 5/3 %		
Vmpp [V]	26.6		
Imp [A]	8.09		
Voc [V]	33.2		
Isc [A]	8.78		
Maximum system voltage [V]	1000		

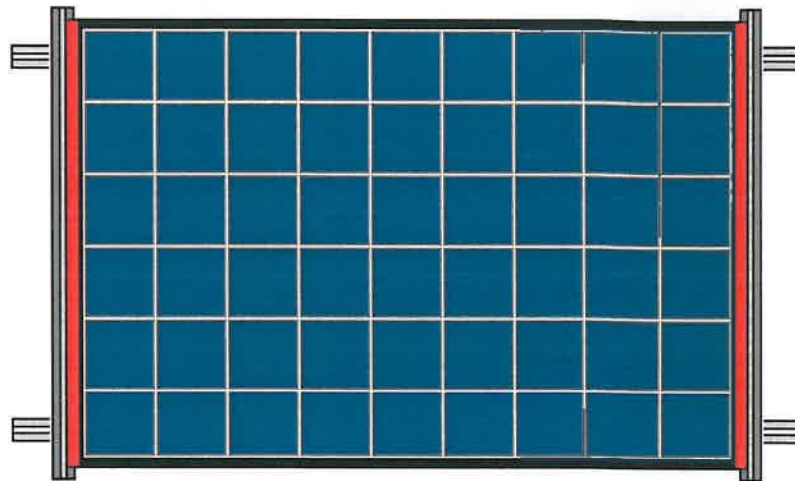
### 3. Testing procedure

#### Mounting description:

The mechanical load test was performed on Kyocera, KD 215 GH-2 PU PV-Modules, mounted on TRI-ROOF mounting system. The installation was done according to the installation manual with one module. The mechanical load test with 2400 Pa and 5400 Pa were performed on different modules.

#### Module group assignment:

Sample #	Sample S/N	Mounting System
20100005384	106QZR819021889	Ref
20100005385	106QZR818921899	TRI-ROOF
20100005386	106QZR814021969	TRI-ROOF



#### 4. Tables

##### 4.1. Visual inspection (Initial) (10.1)

Test Date [DD/MM/YYYY] .....	30.09.2010	—
Sample #	Nature and position of initial findings – comments or attach photos	—
20100005384	No visual defects	P
20100005385	No visual defects	P
20100005386	No visual defects	P
Supplementary information:		

##### 4.2. Maximum power determination (Initial) (10.2)

Test Date [DD/MM/YYYY] .....	05.10.2010	—				
Module temperature [°C] .....	Corrected to 25 °C	—				
Irradiance [W/m <sup>2</sup> ] .....	1000	—				
Sample #	Pmpp [W]	Vmpp [V]	Impp [A]	Voc [V]	Isc [A]	FF [%]
20100005384	211.2	26.8	7.87	33.3	8.60	73.7
20100005385	211.7	26.5	7.99	33.4	8.58	74.0
20100005386	213.0	27.0	7.90	33.4	8.55	74.7
Supplementary information:						

##### 4.3. Insulation test (Initial) (10.3)

Test Date [DD/MM/YYYY] .....	30.09.2010					—
Test Voltage applied [V] .....	6000					—
Sample #	Measured	Area	Result*	Dielectric breakdown		Verdict
	GΩ	m <sup>2</sup>	GΩ * m <sup>2</sup>	Yes (description)	No	
20100005384	35	1.69	59	-	X	P
20100005385	27	1.69	45	-	X	P
20100005386	26	1.69	45	-	X	P
* Minimum requirement acc. to the standard is 0.04 GΩ*m <sup>2</sup>						
Supplementary information:						

**4.4. Wet leakage current test (Initial) (10.15)**

Test Date [DD/MM/YYYY] .....	30.09.2010				—
Test Voltage applied [V] .....	1000				—
Solution resistivity [ $\Omega$ cm] .....	< 3,500 $\Omega$ cm				
Surface tension [ $\text{Nm}^{-2}$ ] .....	< 0,003 $\text{Nm}^{-2}$				
Solution temperature [ $^{\circ}\text{C}$ ] .....	22 $\pm$ 3 $^{\circ}\text{C}$				
Sample #	Measured	Area	Result*	Verdict	
	M $\Omega$	m $^2$	M $\Omega$ * m $^2$		
20100005384	3050	1.69	5155	P	
20100005385	2980	1.69	5036	P	
20100005386	2770	1.69	4681	P	
* Minimum requirement acc. to the standard is 40 M $\Omega$ *m $^2$					
Supplementary information:					

**4.5. Mechanical load test 2400 Pa(10.16)**

Test Date [DD/MM/YYYY].....	21.10.2010				—
Mechanical load applied to front side [Pa] .....	2400				—
Mechanical load applied to back side [Pa].....	2400				—
Sample #	Electrical continuity of module during the test (open circuits or no)				
20100005385	Yes				P
Supplementary information: Load was applied pneumatically;					

**4.5.1. Visual inspection after mechanical load test (10.1)**

Test Date [DD/MM/YYYY].....	21.10.2010				—
Sample #	Nature and position of initial findings – comments or attach photos				
20100005385	No visual defects				P
Supplementary information:					

**4.5.2. Maximum power determination after mechanical load test (10.2)**

Test Date [DD/MM/YYYY].....	25.10.2010						—
Module temperature [ $^{\circ}\text{C}$ ] .....	Corrected to 25 $^{\circ}\text{C}$						—
Irradiance [ $\text{W} / \text{m}^2$ ] .....	1000						—
Sample #	Pmpp [W]	Vmpp [V]	Impp [A]	Voc [V]	Isc [A]	FF [%]	Degradation [%]
20100005385	212.8	26.9	7.90	33.3	8.59	74.4	0.7
Supplementary information:							

**4.5.3. Insulation test after mechanical load test (10.3)**

Test Date [DD/MM/YYYY] .....				25.10.2010		—
Test Voltage applied [V] .....				6000		—
Sample #	Measured	Area	Result*	Dielectric breakdown		Verdict
	GΩ	m <sup>2</sup>	GΩ * m <sup>2</sup>	Yes (description)	No	
20100005385	136	1.69	230	-	X	P
* Minimum requirement acc. to the standard is 0.04 GΩ*m <sup>2</sup>						
Supplementary information:						

**4.5.4. Wet leakage current test (10.15)**

Test Date [DD/MM/YYYY] .....				25.10.2010		—
Test Voltage applied [V] .....				1000		—
Solution resistivity [Ω cm] .....				< 3,500 Ω cm		
Surface tension [Nm <sup>-2</sup> ] .....				< 0,003 Nm <sup>-2</sup>		
Solution temperature [°C] .....				22 ± 3°C		
Sample #	Measured	Area	Result*	Verdict		
	MΩ	m <sup>2</sup>	MΩ * m <sup>2</sup>			
20100005385	3300	1.69	5577	P		
* Minimum requirement acc. to the standard is 40 MΩ*m <sup>2</sup>						
Supplementary information:						

**4.6. Mechanical load test 5400 Pa (10.16)**

Test Date [DD/MM/YYYY] .....				25.10.2010		—
Mechanical load applied to front side [Pa] .....				2400 / 5400		—
Mechanical load applied to back side [Pa] .....				2400		—
Sample #	Electrical continuity of module during the test (open circuits or no)					Verdict
20100005386	Yes					P
Supplementary information: Load was applied pneumatically;						

**4.6.1. Visual inspection after mechanical load test (10.1)**

Test Date [DD/MM/YYYY] .....				25.10.2010		—
Sample #	Nature and position of initial findings – comments or attach photos					Verdict
20100005386	No visual defects					P
Supplementary information:						

**4.6.2. Maximum power determination after mechanical load test (10.2)**

Test Date [DD/MM/YYYY].....:		25.10.2010					—	
Module temperature [°C] .....		Corrected to 25°C					—	
Irradiance [W / m <sup>2</sup> ] .....		1000					—	
Sample #	Pmpp [W]	Vmpp [V]	I <sub>mp</sub> [A]	Voc [V]	Isc [A]	FF [%]	Degradation [%]	
20100005386	212.7	26.9	7.91	33.3	8.55	74.7	0.5	
Supplementary information:								

**4.6.3. Insulation test after mechanical load test (10.3)**

Test Date [DD/MM/YYYY] .....		25.10.2010				—	
Test Voltage applied [V] .....		6000				—	
Sample #	Measured	Area	Result*	Dielectric breakdown		Verdict	
	GΩ	m <sup>2</sup>	GΩ * m <sup>2</sup>	Yes (description)	No		
20100005386	73	1.69	123	-	X	P	
* Minimum requirement acc. to the standard is 0.04 GΩ*m <sup>2</sup>							
Supplementary information:							

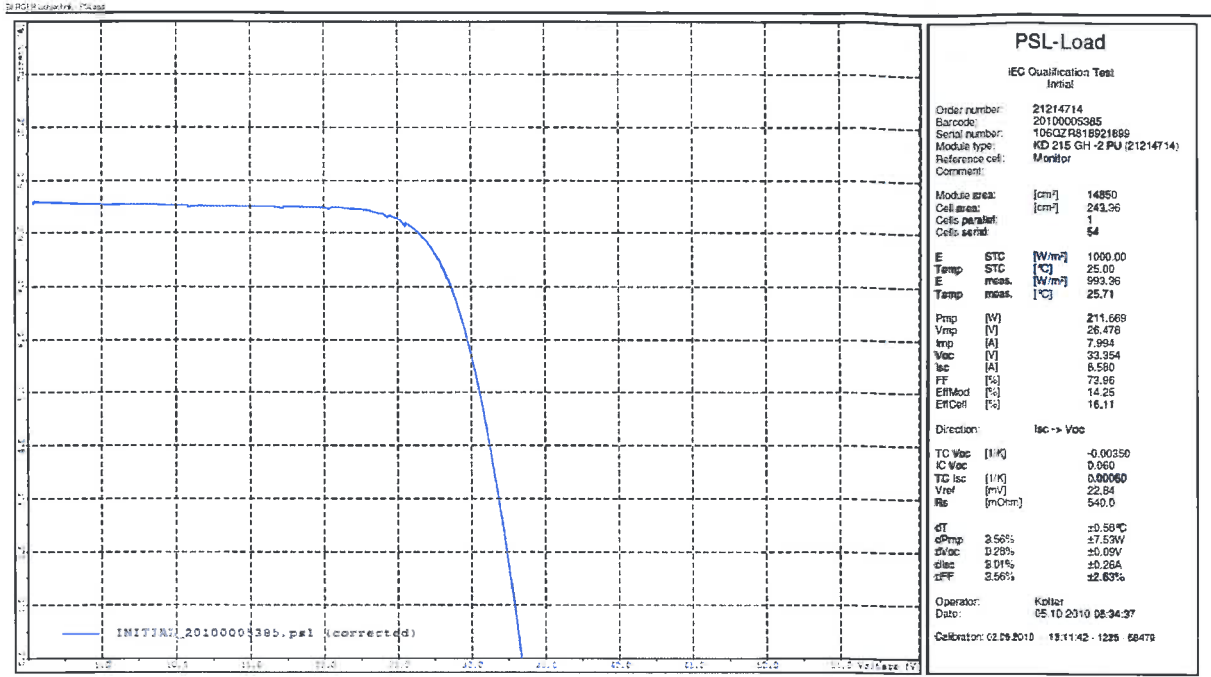
**4.6.4. Wet leakage current test (10.15)**

Test Date [DD/MM/YYYY] .....		25.10.2010				—	
Test Voltage applied [V] .....		1000				—	
Solution resistivity [Ω cm] .....		< 3,500 Ω cm					
Surface tension [Nm <sup>-2</sup> ] .....		< 0,003 Nm <sup>-2</sup>					
Solution temperature [°C] .....		22 ± 3°C					
Sample #	Measured	Area	Result*	Verdict			
	MΩ	m <sup>2</sup>	MΩ * m <sup>2</sup>				
20100005386	3480	1.69	5881	P			
* Minimum requirement acc. to the standard is 40 MΩ*m <sup>2</sup>							
Supplementary information:							

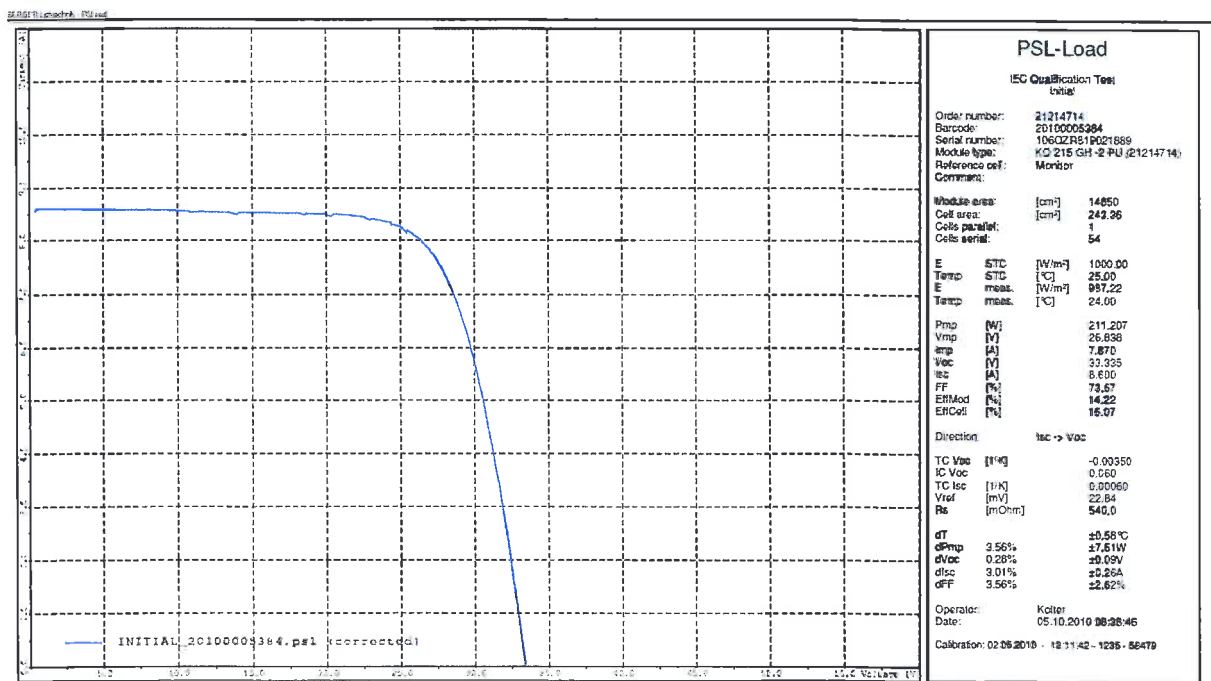
**Annex 1: Statement of the estimated uncertainty of the test verdicts**

- Electrical performance rating is outside the scope of IEC 61215:2005 qualification testing. The verdicts of performance rating are only related to the test samples that were subjected to the tests. They cannot be generalised to the modules from the series production.
- The calibration to STC was performed with a class AAA solar simulator. The extended measurement uncertainty is:
  - o  $2\sigma P_{mpp} \leq \pm 2.5 \%$
  - o  $2\sigma I_{SC} \leq \pm 2.3 \%$
  - o  $2\sigma V_{OC} \leq \pm 1 \%$
- Relative measurements were performed with a flash type solar simulator.
- The accuracy of reproduction of measurements with the solar simulator is less than  $\pm 1\%$ .

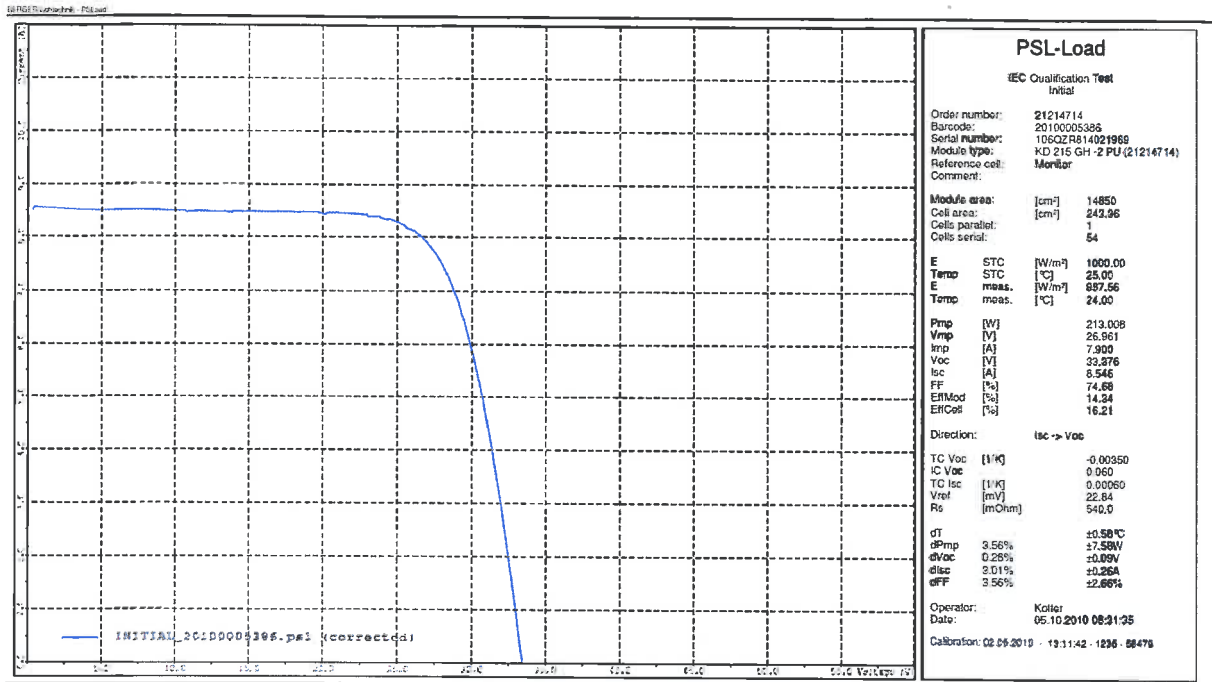
**Annex 2: Measurement reports**



02.11.2010 INITIAL\_20100005385.psl



02.11.2010 INITIAL\_20100005384.psl



02.11.2010 INITIAL\_20100005386.ps

**Annex 3: Photos of modules and visual defects**

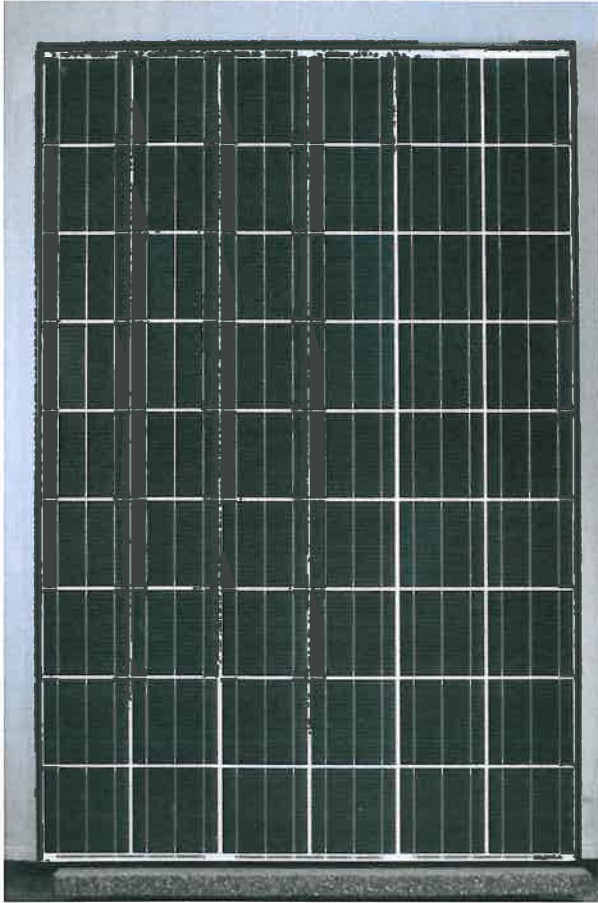


Fig. 1: front view of test sample



Fig. 2: rear view of test sample

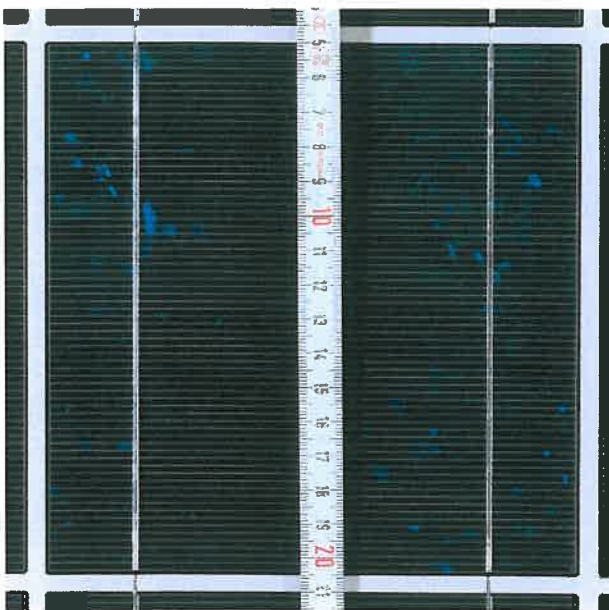


Fig. 3: detail view of solar cell

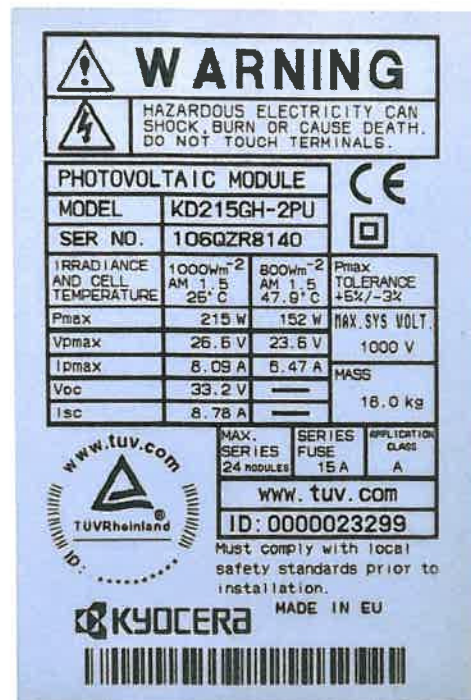


Fig. 4: detail view of type label



Fig. 5: detail view of closed junction box



Fig. 6: detail view of cables/ connections

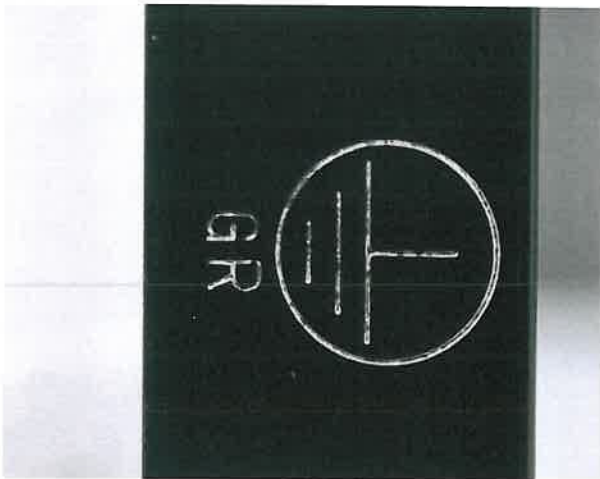


Fig. 7: detail view of grounding marking



Fig. 8: detail view of frame connection



Fig. 9: Mechanical Load



Fig. 10: Mechanical Load

