
Small Junction Box for Photovoltaic Panels

1. SCOPE

1.1 Content

This specification covers the performance, tests and quality standards for a connecting system which allows the el. connection of photovoltaic (PV) panels.

By this, corresponding connectors are connected with a terminal box, which is located on the solar panel with connector. The box has always the keyed (+/-) pin-connector.

Furthermore, there are other options of connection boxes available that allow direct wire connection through integrated wire glands.

Each solar box allows by spring force contact means the connection of contact foils, which are located at the respective solar panel. Each connection box has the opportunity to connect contact foils exiting the photovoltaic panel with spring contact. The box can be assembled with diodes or jumpers (only solid leads) depending on contact foils or connection means.

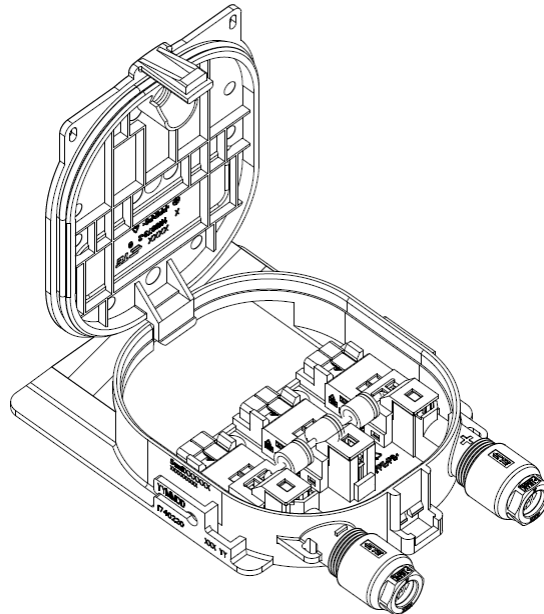


Fig. 1 PN 2270285-1 (no cable ass'y shown, for reference only)

1.2 Qualification

When tests are performed the following specified specifications and standards shall be used. All inspections shall be performed using the applicable inspection plan and product drawing.

2. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the events of conflict between the requirements of this specification and the product drawing or of conflict between the requirements of this specification and the referenced documents, this specification shall take precedence.

2.1 TE Connectivity Documents

- Test Specifications
Application Specification 114-18488-1
- Customer drawing and name
TE Drawing 2270285
- Model Code
The side-printed model code on the box describes the configuration of the box as well as components used (see Figure 2). For this specification the Connecting boxes are marked according spec 404-74000-1.

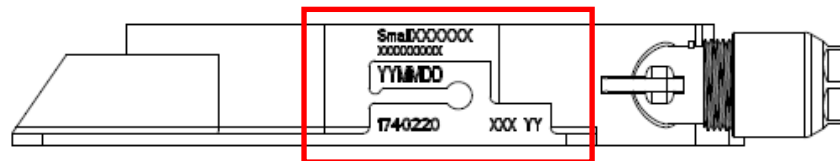


Fig. 2 Connection box shown with Model Code (for reference only)

2.2 Other Documents

- DIN IEC 60512 Electromechanical components for electronic equipment, basic testing procedures and measuring methods
Edition: 04.1995
- DIN EN 60068-2-11 Environmental testing Part 2; Tests; Test Ka: Salt mist
Edition: 02.2000
- DIN IEC 60068-2-21 Electrical engineering, Environmental testing; Tests; Test U: Robustness of terminations and integral mounting devices
Edition: 01.1989
- DIN IEC 60068-2-3 Electrical engineering, Environmental testing; Tests; Test Ca: Damp heat, steady state
Edition: 01.1989
- DIN EN 60529 Protection Degree Housing
Edition: Nov. 1992
- DIN EN 60999-1 Allgem. Anforderungen für schraubenlose Klemmstellen
IEC 60999-1 Edition Dez. 2000
- EN 61215 Design qualification and type approval
Edition: Oct. 1996
- Safety class II
- IEC62790:2014 Junction boxes for photovoltaic modules – Safety requirements and tests

3. REQUIREMENTS

3.1 Design and Construction

Product shall be of the design, construction and physical dimensions specified on the applicable production drawing.

3.2 Materials

Descriptions for material see drawings.

3.3 Ratings

A	Rated voltage / Box For UL Rated impulse voltage Rated module Max working voltage	1000 V 600 V 12 kV < 50 V
B	Current carrying capability see current carrying TÜV Rheinland Rated bypass current (I_{sc}) TÜV Rheinland Rated Reverse current	Page 16 see TÜV Rheinland certification 30 A
C	Operating temperature	-40 °C to 115 °C *
D	Storage temperature	-40 °C to 85 °C
*) Ambient temperature (per IEC 85 °C / per UL 75 °C) plus heating up by current		
E	Degree of protection Box	IP 65
F	Wire diameter for internal wiring, solid	1.5 mm ²
H	Dimensions of the Box	typ. 138 mm x 90 mm x 22 mm
J	Pollution degree	3 (2 inside enclosure)
K	Termination and connection	Outer connection: connector or cable gland / inner connection: spring clamp and foil spring

3.4 Performance and Test Description

The product is designed to meet the electrical, mechanical and environmental performance requirements specified in Para. 3.5. All tests are performed at conditions per DIN IEC 60512 and DIN IEC 60068 unless otherwise specified.

The test and sequence describe in 3.5 are tested internally by TE Connectivity.

3.5 Test Requirements and Procedures

Test Description	Requirement	Procedure according
GENERAL INSPECTIONS		
Visual and dimensional examination	Meets requirements of product drawing	DIN IEC 60512-2, Test 1a and 1b
ELECTRICAL INSPECTIONS		
Voltage proof	Value and nature of test voltage: 5 kV dc	DIN IEC 60512-2, test 4a Time of testing: 60s
Isolation test	2000 V dc R > 400 MΩ at 500 V dc	E DIN IEC 61215 10.3
Voltage Proof SK II	4250 V _{eff} ac between active parts and metal foil at housing	Safety Class II, then Impulse Voltage Proof SK II
Isolation resistance	7 mm Watersolvent R > 400 MΩ	E DIN IEC 61215 10.15
Bypass-Diode	T _{amb} =75°C , I ₂ =1.25*I ₁ 1 Bypass-Diode I ₁ =5 A 2 Bypass-Diode I ₁ =4 A T _{Diode} < T _{junc}	E DIN IEC 61215 10.18
Overall resistance (DC)	Resistance for each contact point < 5 mΩ	DIN IEC 60512-2, test 2b
Current carrying capacity (derating-curve)	I _{max} /Box = 20 A , ΔT = 30 K See derating-curve page 16	DIN IEC 60512-3, test 5a/5b
MECHANICAL INSPECTIONS		
Protection Degree	IP 65, then voltage proof SK II	DIN EN 60529
Engaging – and separating forces of connector	Disconnect Min: 40 N	DIN IEC 60512-8 Test 15f Actuating speed 25 mm/min
Polarization	Mating force: 80 N	DIN IEC 60512-7 test 13e
Vibration (sinus)	No physical damage. No discontinuities greater than t > 1 μs Freq. 10-60 Hz => 0.7 mm(pk/pk) 60-500 Hz/5g 2.5 hours per axis 3 axis direction 1 oct./min	DIN IEC 60512-4, test 6d
ENVIRONMENTAL INSPECTIONS		

Heat secureness of isolation parts	240 hours / 115 °C No physical damage	Safety Class II then protection degree test
Hot wire	960 °C for isolation material carrying active parts, other 750 °C Not testable	DIN EN 60695-2-1/1
Change of temperature	I = 2 A No physical damage. Maximum over all resistances must not be exceeded	E DIN IEC 61215 10.11 T _a = -40 °C T _b = 85 °C Number of cycles: 50
Change of temperature	I = 2 A No physical damage. Maximum over all resistances must not be exceeded.	E DIN IEC 61215 10.11 T _a = -40 °C T _b = 85 °C Number of cycles: 200
Damp / Freezing test	No physical damage. Maximum over all resistances must not be exceeded. No discontinuous.	EN 61215 10.12 Temperature: 85 °C Temperature: -40 °C Rel. humidity: 85 % Number of cycles: 10
Damp heat	No physical damage	DIN IEC 60068-2-3, test Ca Temperature 85 °C Rel. humidity: 85 % Duration: 1000 h
Salt mist test	2 weeks / at position of use Maximum over all resistances must not be exceeded.	DIN EN 60068-2-11 Ka
Heat Dissipation	No exceed of max. operating Temperature depending on configuration Max. 10 W	See appendix
Rapid change of temperature	No physical damage	DIN IEC 60512-6 test 11d T _a = -40 °C, T _b = 115 °C t _a = 15 min. t _b = 15 min. Number of cycles: 100
Industrial atmosphere	No physical damage	IEC 60068-2-60 Test Ke/ meth. 4 75 % damp / rel., T = 25 °C Duration timer: 10 Days

3.6 Qualification and Requalification Test Sequences

Test	Test group ⁽¹⁾											
	A	B	C	D	E	F	G	H	I	J	K	L
	Test sequence ⁽²⁾											
Visual and dimensional examination	1, 5	1, 6	1, 6	1, 7	1, 5	1, 6	1, 4	1, 4	1, 5	1, 3	1, 5	
Voltage proof						5						
Isolation test	2, 4	3, 5	3	2, 6								
Voltage Proof SK II					4							
Isolation resistance				3, 5								
Bypass-Diode	3											
Overall resistance (DC)		2	2, 5			2, 4			2, 4		2, 4	
Current carrying capacity (derating-curve)						3						
Protection Degree					3							
Engaging – and separating forces of connector							2					
Polarization							3					
Vibration (sinusoidal)								3				
Heat secureness of isolation parts					2							
Change of temperature 50 cycles			4									
Change of temperature 200 cycles		4										
Damp / Freezing test			5									
Damp heat				4								
Salt mist test									3			
Heat Dissipation										2		
Rapid change of temperature								2				
Industrial atmosphere											3	

(1) See Para. 4.1 A

(2) Numbers indicate sequence in which tests are performed.

Classification of test groups:
Groups A, B, C, D, E, F, G, H, I, J, K & L

4. QUALITY ASSURANCE PROVISIONS

4.1 Qualification Testing

A Sample selection

The samples shall be prepared in accordance with product drawings. They shall be selected at random from current production.

Test groups consists of:

Test group A:	Complete assemblies
Test group B:	Complete assemblies
Test group C:	Complete assemblies
Test group D:	Complete assemblies
Test group E:	Complete assemblies
Test group F:	Complete assemblies
Test group G:	Complete assemblies
Test group H:	Complete assemblies
Test group I:	Complete assemblies
Test group J:	Complete assemblies
Test group K:	Complete assemblies
Test group L:	Complete assemblies incl. solar panels

B Test sequence

The samples shall be prepared in accordance with product drawings. They shall be selected at random from current production.

4.2 Requalification Testing

If changes significantly affecting form, fit, or function are made to the product or to the manufacturing process, product assurance shall coordinate requalification testing, consisting of all or part of the original testing sequence as determined by development/product, quality, and reliability engineering.

5. ACCEPTANCE

Acceptance is based on verification that the product meets the requirements of Para. 3.5. Failures attributed to equipment, test setup, or operator deficiencies shall not disqualify the product. When product failure occurs, corrective action shall be taken, and samples resubmitted for qualification. Testing to confirm corrective action is required before resubmittal.

6. QUALITY CONFORMANCE INSPECTION

The applicable TE Connectivity quality inspection plan will specify the sampling acceptable quality level to be used. Dimensional and functional requirements shall be in accordance with the applicable product drawing and this specification.

7. TÜV CERTIFICATION / UL-FILE

TÜV Rheinland certification: see certification number **R60083028 new number pending**
UL certification: see UL file number E226440.

List of product variations in TÜV Rheinland certification ⁽¹⁾ ⁽²⁾:

- SMALL3GBN2M
- SMALL3GBN2I
- SMALL3GAN2I
- SMALL3GBN2E
- SMALL3GBA2N
- SMALL3GBA2I
- SMALL3GBA2E
- SMALL2GBA1E
- SMALL3GFN2E
- SMALL2GEN1E
- SMALL3GBN1I
- SMALL3GBN1E
- SMALL3GBA1I
- SMALL3GBA1M
- SMALL3GBA1E
- SMALL3GCN2I
- SMALL3GDN2I
- SMALL3GFN2I
- SMALL2GEN1I
- SMALL2GBN1M

Approved components by TÜV Rheinland

- TE Connectivity diode F1200D 108-106119
- TE Connectivity diode SL1110B 108-2444
- TE Connectivity diode SL1200B
- TE Connectivity diode SL1515B 108-106133
- TE Connectivity connector: PV4-S1b40 (b= M(ale) or F(emale)) TÜV Rheinland cert.: R 60148776
- TE Connectivity connector: PV4-S0b40 (b= M(ale) or F(emale)) TÜV Rheinland cert.: R 60148776
- Stäubli Electrical Connectors AG: PV-KBT4/xy-UR & PV-KST4/xy-UR
- TE Connectivity, cable PN 2270245-x, 4 mm² (12 AWG), TÜV Rheinland cert.: R 50504531 & R 50504536. Type designation: SLKC1B4.
- TE Connectivity, cable PN 2270260-x, 4 mm² (12 AWG), TÜV Rheinland cert.: R 50504531 & R 50504536. Type designation: SLKC0B4.
- TE Connectivity, cable PN 2270245-x, 4 mm² (12 AWG), TÜV Rheinland cert.: R 50504531 & R 50504536. Type designation: SLKC1B4.
- TE Connectivity, cable PN 2270260-x, 4 mm² (12 AWG), TÜV Rheinland cert.: R 50504531 & R 50504536. Type designation: SLKC0B4.
- Kunshan Byson Electronics Co., Ltd., cable PN 6352D, 4 mm² (10 AWG), TÜV Rheinland cert R50404890 & R50357489.
- Changshu JHOSIN Communication Technology Co., Ltd., cable PN DPN4012A09_REV.A/6, 4 mm² (10 AWG), TÜV Rheinland cert R50413335 & R50325448.
- Krempel backsheet AKASOL® PTL 3 HR 1000V
- DUNMORE backsheet DUNSOLAR DS 475
- DUNMORE backsheet DUNSOLAR DS 450
- DUNMORE backsheet DUNSOLAR DS 375
- Dow Corning Type PV804

(1) Model code placeholder refer to TE SOLARLOK Model Key: 404-74000-1

(2) Rated Input Current:

E = 6.5 A (PVF- or PET-foil or Glass SL1200B)
E = 7 A (glass, Diode: F1200D)
I = 10.5 A (PVF- or PET-foil or Glass, Diode: SL 1110B)
M = 14 A (PVF- or PET-foil or Glass, Diode: SL1515B)

Annex A Documentation Change Record

Version	Clause	Page	Change Description
D1	2.2	5	Change the industry document of DIN V-VDE V 0126 to EN50548:2011+A1:2013
	3.3	6	Add Rated impulse voltage, Rated Module working voltage, Pollution degree, TUV Rated reverse current, TUV Rated bypass current, Termination and connection
	7	17	According to TUV requirement, add the list of product variations in TUV Rheinland certification
E	2.2	5	Change the industry document to IEC62790:2014 Junction boxes for photovoltaic modules – Safety requirements and tests
	7	17	List new model type SMALL3GEN2I
	Various	Various	Change format
F	Various	Various	Update the TÜV list, removed derating curve
F1	All	All	Added license holder
F2	Various	Various	Removed “not testable” form the specification and clear up the diodes.
F3	7	8	Cables updated
F4	7	8	Cables updated