Test Report issued under the responsibility of:

DEKRA

# TEST REPORT
## IEC 62852
## Connector for DC – application in photovoltaic systems – Safety requirements and tests

| | |
|---|---|
| **Report Number. ..... :** | 2257781.50 |
| **Date of issue ..... :** | 2021-08-06 |
| **Total number of pages ..... :** | 15 |
| **Name of Testing Laboratory preparing the Report ..... :** | DEKRA Certification B.V. |
| **Applicant's name ..... :** | Duramotion B.V. |
| **Address ..... :** | De Koumen 35<br>6433 KG Hoensbroek, The Netherlands. |
| **Test specification:** | |
| **Standard ..... :** | IEC 62852:2014 |
| **Test procedure ..... :** | CB Scheme |
| **Non-standard test method ..... :** | N/A |
| **Test Report Form No. ..... :** | IEC 62852A |
| **Test Report Form(s) Originator.... :** | DEKRA Certification B.V. |
| **Master TRF ..... :** | Dated 2020-03-13 |



If this Test Report Form is used by non-IECEE members, the IECEE/IEC logo and the reference to the CB Scheme procedure shall be removed.

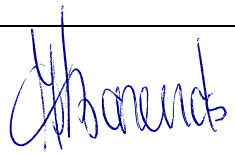
**This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.**

**General disclaimer:**

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 Issuing CB Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the NCB, responsible for this Test Report.

| | |
|---|---|
| **Test item description..... :** | Photovoltaic system connectors |
| **Trade Mark(s)..... :** | SOLINQ, Amphenol®, STÄUBLI, Weidmüller |
| **Manufacturer..... :** | SOLINQ; Amphenol; STAUBLE; Weidmüller |
| **Model/Type reference..... :** | 46010CM&46010CF; HELIOS H4; MC4; PV-STICK |
| **Ratings..... :** | 1000 V, IP68(1 h / 1 m), ULT 105°C |

**Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):**

| | | | |
|---|---|---|---|
| ☒ | **CB Testing Laboratory:** | DEKRA Certification B.V. | |
| **Testing location/ address.....:** | | Meander 1051, 6825 MJ Arnhem<br>The Netherlands | |
| **Tested by (name, function, signature).....:** | | T. Cai |  |
| **Approved by (name, function, signature)...:** | | H.R.M. Barends |  |
| ☐ | **Testing procedure: CTF Stage 1:** | | |
| **Testing location/ address.....:** | | | |
| **Tested by (name, function, signature).....:** | | | |
| **Approved by (name, function, signature)...:** | | | |
| ☐ | **Testing procedure: CTF Stage 2:** | | |
| **Testing location/ address.....:** | | | |
| **Tested by (name + signature) .....:** | | | |
| **Witnessed by (name, function, signature)..:** | | | |
| **Approved by (name, function, signature)...:** | | | |
| ☐ | **Testing procedure: CTF Stage 3:** | | |
| ☐ | **Testing procedure: CTF Stage 4:** | | |
| **Testing location/ address.....:** | | | |
| **Tested by (name, function, signature).....:** | | | |
| **Witnessed by (name, function, signature)..:** | | | |
| **Approved by (name, function, signature)...:** | | | |
| **Supervised by (name, function, signature) :** | | | |

**List of Attachments (including a total number of pages in each attachment):**

**Summary of testing:**

| **Tests performed (name of test and test clause):** | **Testing location:** |
|---|---|
| Mechanical test group A: A5, A10<br>Service life test group B: B1, B2, B3<br>Thermal test group D: D1, D2, D3, D4<br>Degree of protection test group F: F1, F2, F3 | DEKRA Certifications B.V.<br>Meander 1051, 6825 MJ Arnhem,<br>The Netherlands |

**Summary of compliance with National Differences (List of countries addressed):**

☐ **The product fulfils the requirements of _____ (insert standard number and edition and delete the text in parenthesis, leave it blank or delete the whole sentence, if not applicable)**

**Statement concerning the uncertainty of the measurement systems used for the tests**
(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

**Procedure number, issue date and title:**

Calculations leading to the reported values are on file with the NCB and testing laboratory that conducted the testing.

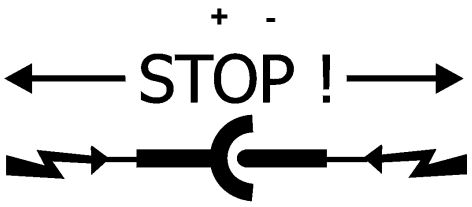
☐ **Statement not required by the standard used for type testing**

(Note: When IEC or ISO standard requires a statement concerning the uncertainty of the measurement systems used for tests, this should be reported above. The informative text in parenthesis should be delete in both cases after selecting the applicable option)

**Copy of marking plate:**

**The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.**

**46010CM&46010CF, HELIOS H4, MC4, PV-STICK**




**Do not disconnect under load**

| | |
|---|---|
| **Test item particulars .....:** | Photovoltaic system connectors |
| **Classification of installation and use.....:** | Free connector |
| **Supply Connection .....:** | Non-rewirable connector |
| **Possible test case verdicts:** | |
| **- test case does not apply to the test object..... :** | N/A |
| **- test object does meet the requirement..... :** | P (Pass) |
| **- test object does not meet the requirement..... :** | F (Fail) |
| **Testing ..... :** | |
| **Date of receipt of test item..... :** | 2021-06-11 |
| **Date (s) of performance of tests ..... :** | 2021-06-15 to 2021-08-06 |

**General remarks:**

"(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 ☒ comma / ☐ point is used as the decimal separator.**

**Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:**

| | |
|---|---|
| The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided.....: | ☐ **Yes**<br>☒ **Not applicable** |

**When differences exist; they shall be identified in the General product information section.**

**Name and address of factory (ies)..... :** N/A

**General product information and other remarks:**

Maximum current between different combinations:

| Combination between manufacture | Max. Current (A) |
|---|---|
| SOLINQ + Amphenol | 32 |
| SOLINQ + STAUBLE | 33 |
| SOLINQ + Weidmüller | 30 |

| IEC 62852 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| **5** | **CONSTRUCTIONAL REQUIREMENTS AND PERFORMANCE** | | |
| **5.15.2** | **Contact retention in insert (test phase A5)** | | |
| | Test load is three times the specified insertion force (mating) of one contact or the specified insertion force of one contact plus 50N, whichever is less | | P |
| | Contacts safety retained | | P |
| | No axial displacement likely to impair normal operation | | P |
| **5.17** | **Connector with locking device (test phase A10)** | | |
| | Connectors with locking device or with snap-in device withstand a load of at least 80N with a rate of 10N/sec withdrawal force | | P |
| | No disengagement of the connectors is possible. | | P |
| 5.17 | No damage occurred which could impair normal use | | P |
| **6** | **TESTS** | | |
| **Table 9 B1** | **Initial measurement (Contact resistance measurement) (test phase B1)** | | |
| | Test current: 1 A | | |
| | Reference value for subsequent measurement: | See table B1 | P |
| **6.3.5** | **Mechanical operations (test phase B2)** | | |
| | Operating cycles | 50 | P |
| | Insertion speed: 0,01 m/s | | P |
| | Rest: 30 s | | P |
| 5.11.1 | No damage occurred which could impair normal use | | P |
| **Table 9 B3** | **Final measurement (Contact resistance measurement) (test phase B3)** | | |
| | Test current: 1 A | | |
| | $R2 \leqq 1{,}5\ R1$ or $R2 \leqq 5$ mohm + R1 | See table B3 | P |
| 6.3.8.b | Dielectric strength: IEC 60512 / Test 4a | | |
| | Test voltage: | 6 000 V | P |
| 5.10 | No breakdown or flashover of the test voltage | | P |
| **Table 9 D1** | **Initial measurement (Contact resistance measurement) (test phase D1)** | | |
| | Test current: 1 A | | |
| | Reference value for subsequent measurement: | See table D1 | P |

| IEC 62852 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| **6.3.4** | **Temperature rise test: IEC 60512 - test 5a (test phase D2)** | | |
| | Test conductor length: | 550 mm | P |
| | Test conductor: | 4 mm² as delivered | P |
| | Test current: | See table D2 | P |
| | Ambient temperature – components: | 85 °C | P |
| | Upper limit temperature – components: | 105 °C | P |
| 5.13 | The upper limiting temperature specified for the specimen is not exceeded | See table D2 | P |
| **Table 9 D3** | **Dry heat: IEC 60512 - test 11i (test phase D3)** | | |
| | Test duration: | 1000 h | P |
| | Upper temperature limit: | 105 °C | P |
| **Table 9 D4** | **Final measurement (Contact resistance measurement) (test phase D4)** | | |
| | No visual damage, no cracks on insulations parts likely to impair safety | | P |
| | Internal insulation doesn't show any damages likely to impair safety | | P |
| | Final measurement: IEC 60512 - test 2b | | |
| | Test current: 1 A | | |
| | R2 ≦ 1,5 R1 or R2 ≦ 5 mohm + R1 | See table D4 | P |
| **6.3.3.1** | **Protection against electric shock (test phase F1)** | | |
| | Connectors are tested by the test probe 11 according to IEC 61032 with a test force of 10N. All lids and cover which are remove without a tool are disconnected | | P |
| 5.4.1 | Connectors are so designed, that after mounting, its live parts are not accessible by the IEC test finger in accordance with IEC 60529. No live parts accessible | | P |
| 5.4.2 | Protection against electric shock have been ensured also during insertion and withdrawal. This is proved by the IEC test probe 11 in accordance with IEC 61032 with a test force of 10N at disengaged connectors. No live parts accessible | | P |
| **6.3.3.2** | **Degree of protection IP code: IEC 60529 (test phase F2)** | | |
| | IP-Degree of protection | IP68 (1 h / 1 m) | P |
| 5.9 | Maximum and minimum cross- section connected..: | 4 mm² | P |
| | No ingress of dust | | P |
| | No ingress of water | | P |

| IEC 62852 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |
| **6.3.8 b)** | **Dielectric strength: IEC 60512 - Test 4a (test phase F3)** | | |
| | Dielectric strength: IEC 60512 / Test 4a | | |
| | Test voltage……..: | 6 000 V | P |
| 5.10 | No breakdown or flashover of the test voltage | | P |

| IEC 62852 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| | **TABLE B1: Initial measurements (Contact resistance)** | | | | P |
|---|---|---|---|---|---|
| Test current ..... : | | 1 A | | | — |
| Combination | | Test sample | | | |
| **46010CM + HELIOS H4 female** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,14 | 0,16 | 0,16 | P |
| | R1 [mΩ] | 0,14 | 0,16 | 0,16 | |
| **46010CF + HELIOS H4 male** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,13 | 0,14 | 0,15 | P |
| | R1 [mΩ] | 0,13 | 0,14 | 0,15 | |
| **46010CM + MC4 female** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,16 | 0,14 | 0,13 | P |
| | R1 [mΩ] | 0,16 | 0,14 | 0,13 | |
| **46010CF + MC4 male** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,14 | 0,13 | 0,12 | P |
| | R1 [mΩ] | 0,14 | 0,13 | 0,12 | |
| **46010CM + PV-STICK female** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,22 | 0,22 | 0,28 | P |
| | R1 [mΩ] | 0,22 | 0,22 | 0,28 | |
| **46010CF + PV-STICK male** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,25 | 0,23 | 0,25 | P |
| | R1 [mΩ] | 0,25 | 0,23 | 0,25 | |
| supplementary information: | | | | | |

| IEC 62852 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| | **TABLE B3: Final measurements (Contact resistance)** | | | | P |
|---|---|---|---|---|---|
| Test current .....: | | 1 A | | | — |
| Number of cycles of B2 ..... : | | 50 | | | — |
| Condition ..... : | | R2max ≤ 1,5R1 or **R2max ≤ 5 mΩ + R1** | | | — |
| | | Test sample | | | |
| **46010CM + HELIOS H4 female** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,14 | 5,16 | 5,16 | P |
| | ΔU2 [mV] | 0,19 | 0,20 | 0,19 | |
| | R2 [mΩ] | 0,19 | 0,20 | 0,19 | |
| **46010CF + HELIOS H4 male** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,13 | 5,14 | 5,15 | P |
| | ΔU2 [mV] | 0,18 | 0,19 | 0,21 | |
| | R2 [mΩ] | 0,18 | 0,19 | 0,21 | |
| **46010CM + MC4 female** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,13 | 5,14 | 5,15 | P |
| | ΔU2 [mV] | 0,19 | 0,18 | 0,16 | |
| | R2 [mΩ] | 0,19 | 0,18 | 0,16 | |
| **46010CF + MC4 male** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,14 | 5,13 | 5,12 | P |
| | ΔU2 [mV] | 0,15 | 0,16 | 0,15 | |
| | R2 [mΩ] | 0,15 | 0,16 | 0,15 | |
| **46010CM + PV-STICK female** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,22 | 5,22 | 5,28 | P |
| | ΔU2 [mV] | 0,29 | 0,27 | 0,32 | |
| | R2 [mΩ] | 0,29 | 0,27 | 0,32 | |
| **46010CF + PV-STICK male** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,25 | 5,23 | 5,25 | P |
| | ΔU2 [mV] | 0,29 | 0,28 | 0,28 | |
| | R2 [mΩ] | 0,29 | 0,28 | 0,28 | |
| supplementary information: | | | | | |

| IEC 62852 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| | **TABLE D1: Initial measurements (Contact resistance)** | | | | P |
|---|---|---|---|---|---|
| Test current ..... : | | 1 A | | | — |
| Combination | | Test sample | | | |
| **46010CM + HELIOS H4 female** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,13 | 0,13 | 0,15 | P |
| | R1 [mΩ] | 0,13 | 0,13 | 0,15 | |
| **46010CF + HELIOS H4 male** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,12 | 0,12 | 0,13 | P |
| | R1 [mΩ] | 0,12 | 0,12 | 0,13 | |
| **46010CM + MC4 female** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,13 | 0,16 | 0,14 | P |
| | R1 [mΩ] | 0,13 | 0,16 | 0,14 | |
| **46010CF + MC4 male** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,13 | 0,13 | 0,11 | P |
| | R1 [mΩ] | 0,13 | 0,13 | 0,11 | |
| **46010CM + PV-STICK female** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,24 | 0,27 | 0,25 | P |
| | R1 [mΩ] | 0,24 | 0,27 | 0,25 | |
| **46010CF + PV-STICK male** | Contact | 1 | 2 | 3 | — |
| | ΔU1 [mV] | 0,24 | 0,25 | 0,22 | P |
| | R1 [mΩ] | 0,24 | 0,25 | 0,22 | |
| supplementary information: | | | | | |

| IEC 62852 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

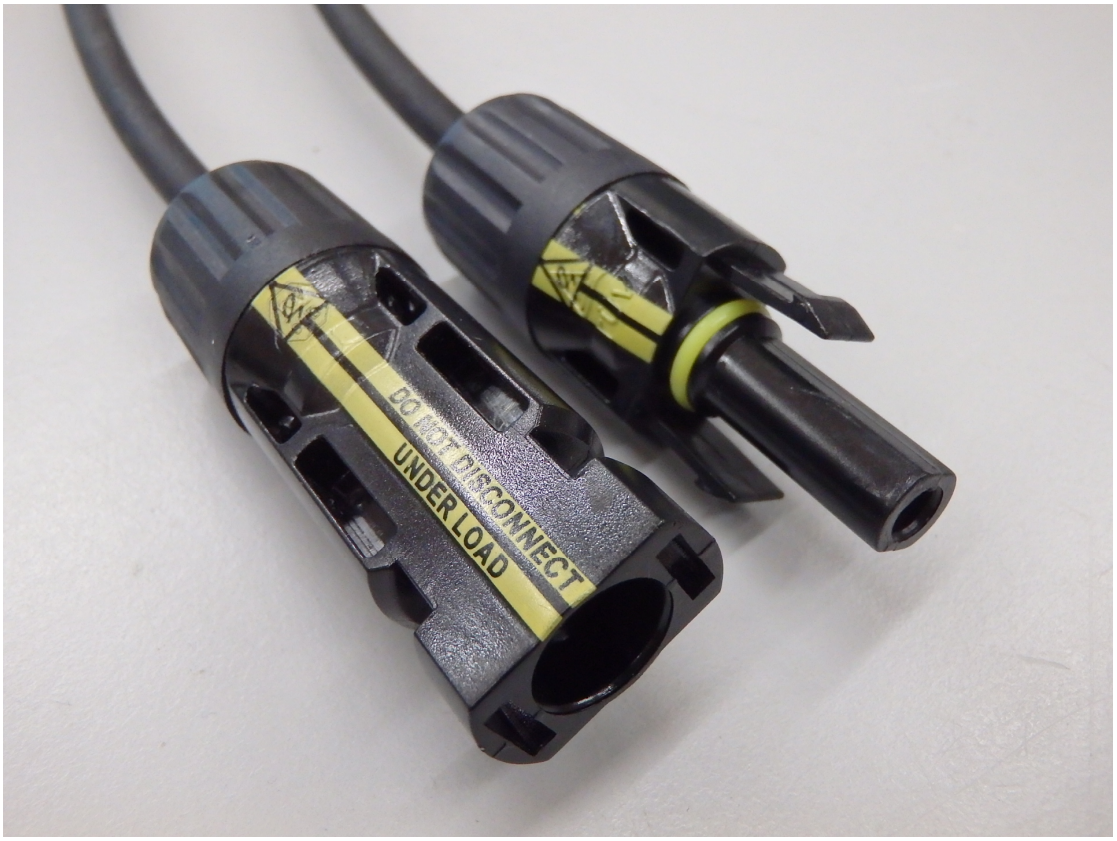
| | | | |
|---|---|---|---|
| | **TABLE D2: Temperature Rise test** | | **P** |
| | **Test Current (A)..... :** | See below | — |
| | **Test Conductor Length(mm)..... :** | 550 | |
| | **Test Conductor Section($mm^2$)..... :** | 4 | |
| | **Ambient ($^oC$)..... :** | 85 | — |

| **Thermocouple Locations / Combination** | **Test current (A)** | **Max. temperature measured, ($^oC$)** | **Max. temperature limit, ($^oC$)** |
|---|---|---|---|
| **46010CM + HELIOS H4 female** | 32 | 104,5 | 105 |
| **46010CF + HELIOS H4 male** | 32 | 104,8 | 105 |
| **46010CM + MC4 female** | 33 | 104,3 | 105 |
| **46010CF + MC4 male** | 33 | 102,6 | 105 |
| **46010CM + PV-STICK female** | 30 | 104,6 | 105 |
| **46010CF + PV-STICK male** | 30 | 101,7 | 105 |
| Supplementary information: | | | |

| IEC 62852 | | | |
|---|---|---|---|
| Clause | Requirement + Test | Result - Remark | Verdict |

| | **TABLE D4: Final measurements (Contact resistance)** | | | | P |
|---|---|---|---|---|---|
| Test current .....: | | 1 A | | | — |
| Condition ..... : | | R2max ≤ 1,5R1 or **R2max ≤ 5 mΩ + R1** | | | — |
| | | Test sample | | | |
| **46010CM + HELIOS H4 female** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,13 | 5,13 | 5,15 | P |
| | ΔU2 [mV] | 0,17 | 0,15 | 0,20 | |
| | R2 [mΩ] | 0,17 | 0,15 | 0,20 | |
| **46010CF + HELIOS H4 male** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,12 | 5,12 | 5,13 | P |
| | ΔU2 [mV] | 0,19 | 0,15 | 0,15 | |
| | R2 [mΩ] | 0,19 | 0,15 | 0,15 | |
| **46010CM + MC4 female** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,13 | 5,16 | 5,14 | P |
| | ΔU2 [mV] | 0,16 | 0,16 | 0,18 | |
| | R2 [mΩ] | 0,16 | 0,16 | 0,18 | |
| **46010CF + MC4 male** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,13 | 5,13 | 5,11 | P |
| | ΔU2 [mV] | 0,14 | 0,14 | 0,13 | |
| | R2 [mΩ] | 0,14 | 0,14 | 0,13 | |
| **46010CM + PV-STICK female** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,24 | 5,27 | 5,25 | P |
| | ΔU2 [mV] | 0,31 | 0,29 | 0,26 | |
| | R2 [mΩ] | 0,31 | 0,29 | 0,26 | |
| **46010CF + PV-STICK male** | Contact | 1 | 2 | 3 | — |
| | R2max [mΩ] | 5,24 | 5,25 | 5,22 | P |
| | ΔU2 [mV] | 0,30 | 0,24 | 0,26 | |
| | R2 [mΩ] | 0,30 | 0,24 | 0,26 | |
| supplementary information: | | | | | |

Pictures of test samples





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