

# Low-voltage DC applications up to 100 A with MC4, MC4-Evo 2 & MC4-Evo stor

## Stäubli Description Report

EN



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## Products

<p><b>MC4</b> Connector</p>  <p>PV-KBT4... PV-KST4...</p>	<p><b>Panel receptacle</b></p>  <p>PV-ADBP4-S2... PV-ADSP4-S2...</p>	<p><b>MC4-Evo 2</b> Connector</p>  <p>PV-KBT4-EVO 2A/...-UR PV-KST4-EVO 2A/...-UR</p>	<p><b>Panel receptacle</b></p>  <p>PV-ADB4-EVO 2A PV-ADS4-EVO 2A</p>
<p><b>MC4-Evo stor</b> Connector</p>  <p>PV-KBT4-EVO ST/... PV-KST4-EVO ST/...</p>	<p><b>Panel receptacle</b></p>  <p>PV-ADB4-EVO ST/... PV-ADS4-EVO ST/...</p>		

## 1. Information on standards and certifications

MC4 & MC4-Evo 2 connectors and panel receptacles offer a cost-effective, high-quality solution for low voltage DC applications up to 1500 V, 100 A with leads with conductors up to 10 mm<sup>2</sup>/8 AWG.

This description report offers technical information for non-PV application of:

Connectors:	Assembly instructions:
PV-KBT4/....	MA231
PV-KBT4-EVO 2A/...	MA298
PV-KBT4-EVO ST/...	MA297



Panel receptacles:



PV-ADBP4-S2/...	MA273
PV-ADB4-EVO 2A/...	MA299



PV-ADB4-EVO ST/...	MA702
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**For general low-voltage DC applications the products fulfill the requirements of IEC 61984:2008 (Connectors – Safety requirements and tests).**

Further, the technical performance of the connectors is TÜV certified according to IEC 62852:2014 + A1:2020 (Connectors for DC-application in photovoltaic systems - Safety requirements and tests). At UL, the connectors are certified according to UL 6703:2014 (Standard for Connectors for Use in Photovoltaic Systems). This high-level PV certification outperforms the general industry level requirements of IEC 61984:2008, UL 1977 and is beyond most known general industry level standards (UL 2237, UL 2238, UL 486A/B, etc.). **These TÜV and UL certifications, however, are only valid when the respective PV leads are mounted.** Also the UR sign on the connectors is only valid for certified PV leads attached as described in the assembly instructions (MA231, MA275, MA297, MA298, MA299, MA702, MA710).

### Summary:

- The connectors are suitable for use with other lead types in lieu of PV leads
- For the use in systems outside of photovoltaics, no PV-specific certification is applicable
- In this case connectors perform according to IEC 61984:2008 (Connectors - Safety requirements and tests).

## 2. Cable stranding possible to connect

Leads in the range of 2.5 mm<sup>2</sup>-10 mm<sup>2</sup> (12 AWG-8 AWG) can be applied for such application.

Lead stranding must be Class 5 according to IEC 60228.

The following information describes possible lead types on which the connectors might be used in low-voltage DC applications regarding cable stranding, diameter range and limiting

temperatures. Further, current ratings with respect to ambient temperature (derating diagrams) are given. The products' assembly instructions (as listed above) are valid for non PV leads as well and have to be followed.

		MC4 open crimp contact	MC4 barrel crimp contacts	MC4-Evo 2	MC4-Evo stor
Stranding range	2.5 mm <sup>2</sup> 4 mm <sup>2</sup> 6 mm <sup>2</sup> 10 mm <sup>2</sup>	Lead stranding must be Class 5 according to IEC 60228.			
Stranding range	14 AWG 12 AWG 10 AWG 8 AWG	19 – 49 19 – 65 19 – 78 –	7 – 49 7 – 65 7 – 78 7 – 168	19 – 49 19 – 65 19 – 105 19 – 168	19 – 49 19 – 65 19 – 105 19 – 168

## 3. Untinned copper leads

Tinned copper strands can be connected with all metal parts.

Untinned copper strands:

For untinned copper strands of 10 mm<sup>2</sup>/8 AWG, the round crimp MC4 PV-KXT4/8II-UR shall be used (leads of other diameters need to have tinned copper strands in order to be connected to the respective metal parts).

In case of blanc, i.e. untinned, copper strands, it has to be assured that the crimping area on the lead strands is free of oxides and dirt when crimping.

To ensure long-term stable crimping, please submit the lead specification to the Stäubli Electrical Connectors Engineering team for evaluation. We offer support in qualifying leads for customer applications.

## 4. Cable insulation-outer diameter ranges

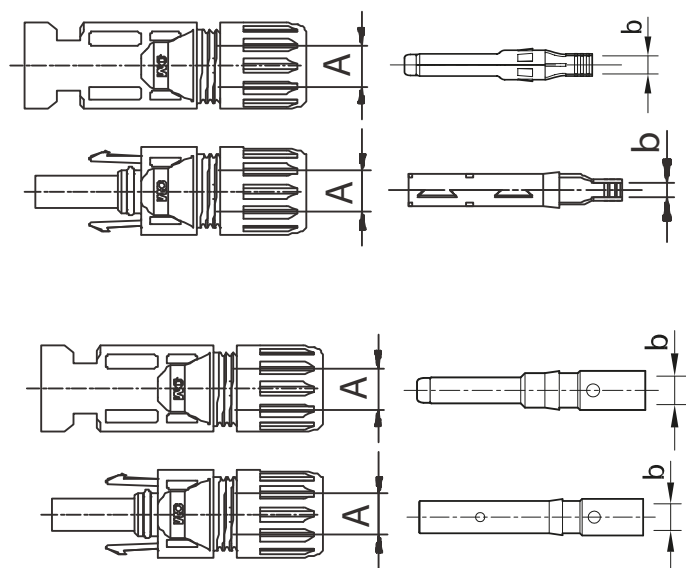
The following table shows the outer diameter ranges for connectable leads as well as the respective sealing element of the connector.

	MC4	MC4-Evo 2	MC4-Evo stor
Lead outer diameter range	DZER6: 4.7 mm-6.2 mm DZER7: 5.7 mm-7.4 mm DZER9: 6.0 mm-8.8 mm	Seal DI: 4.7 mm-6.4 mm Seal X: 5.76mm-7.45mm Seal DII: 6.4 mm-8.4 mm	Seal DI: 4.7 mm-6.4 mm Seal X: 5.76mm-7.45mm Seal DII: 6.4 mm-8.4 mm

### 4.1 MC4

#### Selection of connector configuration

A: $\phi$ range of the cable [mm]	Conductor cross section			
	2.5 mm <sup>2</sup>	4 mm <sup>2</sup>	6 mm <sup>2</sup>	10 mm <sup>2</sup>
5.0 – 6.0	PV-KxT4/2,5I-UR	PV-KxT4/6I-UR	PV-KxT4/6I-UR	PV-KxT4/10I
5.5 – 7.4	PV-KxT4/2,5X-UR	PV-KxT4/6X-UR	PV-KxT4/6X-UR	PV-KxT4/10X
7.0 – 8.8	PV-KxT4/2,5II-UR	PV-KxT4/6II-UR	PV-KxT4/6II-UR	PV-KxT4/10II
b: Control dimension	4 mm	~5.8 mm		~6.5 mm

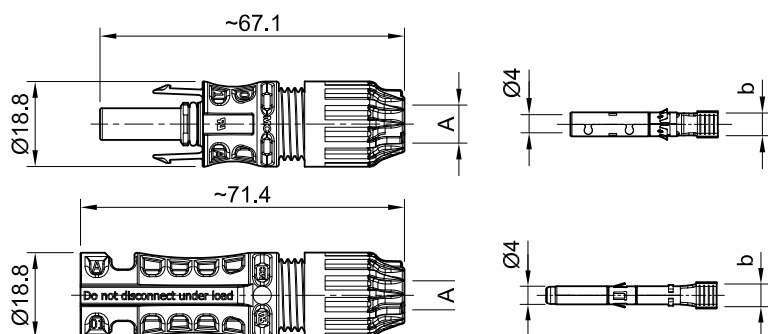


## 4.2 MC4-Evo 2

### Selection of the connector type

Choose the isolation and connector type that is suitable for your application.

Conductor cross section		b: Control measure	Type		
mm <sup>2</sup>	AWG	mm			
1.5 – 2.5	14	~ 4	PV-K...T4-EVO 2A/2,5I	PV-K...T4-EVO 2A/2,5X	PV-K...T4-EVO 2A/2,5II
4 – 6	12/10	~ 5.8	PV-K...T4-EVO 2A/6I	PV-K...T4-EVO 2A/6X	PV-K...T4-EVO 2A/6II
10	8	~ 6.5	-	PV-K...T4-EVO 2A/10X	PV-K...T4-EVO 2A/10II
ø range of the lead (mm)			4.7 – 6.4	5.9 – 7.3	6.4 – 8.4
Usable seals			DI maroon	DX yellow	DII grey



## 5. PVC lead applications

For safety reasons Stäubli prohibits the use of PVC leads. Leads made from PVC can be connected to MC4-Evo 2 since the insulation material of the connector (Polyamide) is suitable to

be connected to PVC. PVC leads usually have an upper limiting temperature of 70 °C, in fixed installations sometimes 80 °C.



PV-KBT4-EVO2A/...



PV-KST4-EVO2A/...

### Example PVC lead:

H07VK according to EN 50525-2-31:2011, Part 2-31:

Power cables for general applications - Conductor and wiring lines with thermoplastic PVC insulation.

### Exemplary application areas of PVC leads:

- Control devices, e. g. machine tools
- Flow and assembly lines, conveyor systems, production lines
- Plant engineering, switchgear cabinet construction, control engineering
- Communication technology equipment, data processing
- Electrical engineering, installation and packaging technology
- Iron and steel production industry, chemical industry, textile
- Automotive industry, automation technology, press and mold construction
- Printing and paper machine construction
- Household appliances

## 6. Rubber lead applications

Rubber lead (usual upper limiting temperature: 90 °C) can be connected to MC4 or MC4-Evo 2.  
For example: NSGAFÖU lead according to VDE 0250 T 602 with

nominal voltage of at least U0/U: 1.8/3 kV (short circuit safe and grounded wiring up to 1000 V according to VDE 0100 T520 and VDE 0298 T 3).

### 6.1. Conductor cross section 10 mm<sup>2</sup>/8 AWG

The round crimp metal part of the MC4 named PV-KST/KBT4/8II-UR is suitable for 8 AWG or 10 mm<sup>2</sup> Rubber lead. The max. outer diameter of the cable insulation is limited by the sealing to 8.8 mm.

(A H07RNF 10mm<sup>2</sup> according to DIN EN 50525-2-21 /VDE 0285-525-2-21:2012-01 is 9.5 mm to 11.9 mm outer diameter, so H07RNF can only be used up to 6 mm<sup>2</sup>)



PV-KBT4/8II-UR



PV-KST4/8II-UR

### 6.2. Conductor cross section 2.5 mm<sup>2</sup>, 4mm<sup>2</sup>, 6 mm<sup>2</sup>/10-14 AWG

2.5/4/6 mm<sup>2</sup> (10-14 AWG) rubber leads (usual upper limiting temperature: 90 °C) can be connected to MC4 or MC4-Evo 2.  
e. g. NSGAFÖU leads according to VDE 0250 T 602 with nominal voltage of at least U0/U: 1.8/3 kV (short circuit safe and earthing

safe wiring up to 1000 V according to VDE 0100 T520 and VDE 0298 T 3) or H07RNF according to DIN EN 50525-2-21 /VDE 0285-525-2-21:2012-01).



PV-KBT4-EVO 2A/...



PV-KST4-EVO 2A/...

or



PV-KBT4/2,5.../PV-KBT4/6...



PV-KST4/2,5.../PV-KST4/6...



## 7. Maximum currents and temperatures – the derating diagram

The derating diagram is valid for the

connectors: assembly instructions

PV-KBT4/.... MA231

PV-KBT4-EVO 2A/... MA298

PV-KBT4-EVO ST/... MA297

panel receptacles:

PV-ADBP4-S2/... MA273

PV-ADB4-EVO 2A/... MA299

PV-ADB4-EVO ST/... MA702

The current capacity has been evaluated according to IEC 60512-5-2:2002 (with a derating factor of 0.9) and IEC 60364-5-52:2009.

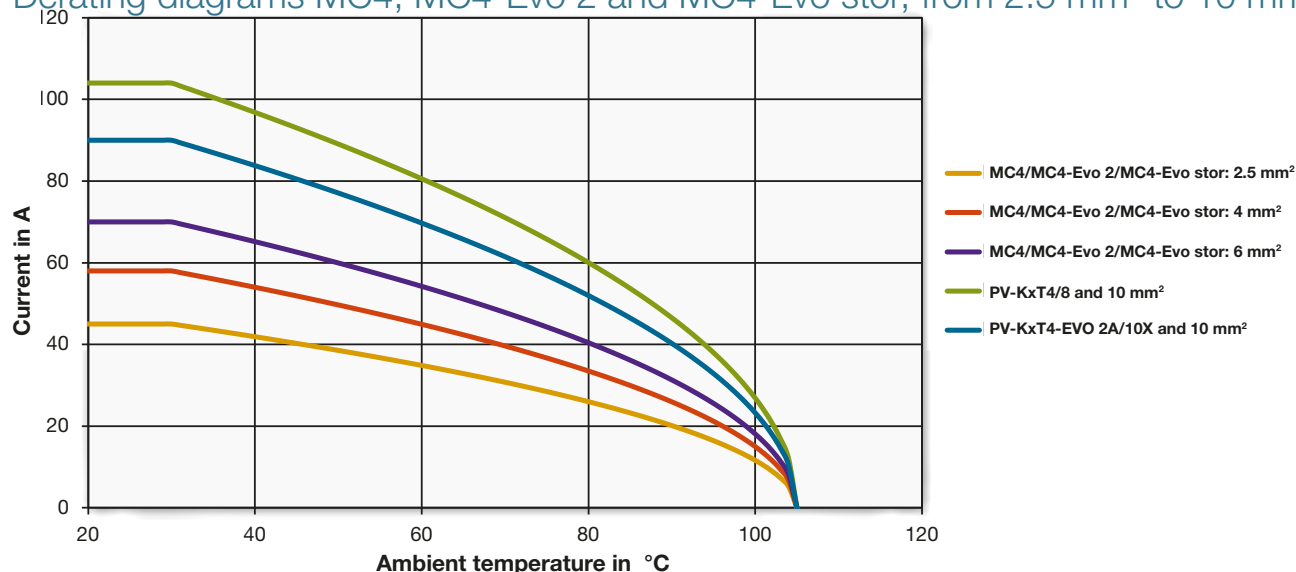
The derating diagram specifies the maximum current at respective ambient temperatures. Operation of the connector is limited by a maximum component temperature (ambient temperature plus

heating from current flow). This maximum admissible temperature is 105 °C inside of the connector. Typical ambient temperatures in industrial applications are between 30 °C and 50 °C.

**Beware:**

Hot surfaces of the connector and attached leads are possible (> 65 °C maximum temperature of touchable surfaces). Please note that in some switchgear applications the maximum temperature of touchable surfaces is limited to 65 °C (touchable/susceptible to manipulation) according to IEC 60947-1 (Low-voltage switchgear and control gear - Part 1: General rules). Depending on the application, it has to be checked whether this requirement applies.

Derating diagrams MC4, MC4-Evo 2 and MC4-Evo stor, from 2.5 mm<sup>2</sup> to 10 mm<sup>2</sup>



The derating diagram is valid for connected leads with a maximum conductor temperature of 90 °C or higher. If leads with a maximum conductor temperature rating < 90 °C is used, the derating of the lead has to be considered.

**Possible examples of cables with their respective maximum conductor temperature**

- PVC leads: H07V-K 10 mm<sup>2</sup>: 70 °C
- Rubber leads: NSGAFÖU 1.8 / 3 kV 10 mm<sup>2</sup>: 90 °C
- PV leads: FLEX-SOL-EVO-DX 10 mm<sup>2</sup>: 120 °C. The PV leads have a continuous maximum conductor temperature of 90 °C. The 120 °C is an exceptional maximum conductor temperature, limited to 20,000h.

The current values of the diagram for 2.5 mm<sup>2</sup>, 4mm<sup>2</sup> und 6mm<sup>2</sup> are shown in the following table:

Rated currents at respective ambient temperatures for MC4 and MC4-EVO 2			
Ambient temperature	lead cross section		
	2.5 mm <sup>2</sup>	4 mm <sup>2</sup>	6 mm <sup>2</sup>
30 °C	42	55	70
40 °C	39	51	65
50 °C	36	47	60
60 °C	32	43	54
70 °C	28	38	48
80 °C	24	32	40
90 °C	19	25	31

The following table shows rated currents with respect to cross sections and lead types:

Maximum admissible current in Ampere for T <sub>AMB</sub> = 30 °C for 2.5 mm <sup>2</sup> to 10 mm <sup>2</sup>				
Max admissible temperature of attached lead	70 °C lead		90 °C lead or higher	
	MC4	MC4-Evo 2	MC4	MC4-Evo 2
2.5 mm <sup>2</sup> / 14 AWG	32 A		42 A	
4.0 mm <sup>2</sup> / 12 AWG	42 A		55 A	
6.0 mm <sup>2</sup> / 10 AWG	54 A		70 A	
10 mm <sup>2</sup> / 8 AWG	85 A*	80 A	104 A*	90 A

\* 8II-UR version for 10 mm<sup>2</sup>/8 AWG: measured derating, smaller diameters calculated according to IEC 60364-5-52:2009

The following tables display the rated currents for MC4 and for MC4-Evo 2 for the largest possible lead -10 mm<sup>2</sup>/8 AWG- at different temperatures with respect to lead temperature rating 70 °C or > 90 °C, and for keeping touchable surfaces cooler than

65 °C. Note: Maximum ambient temperature for the connectors is specified to 85 °C.

MC4 PV-KXT4/8	Maximum admissible current in Ampere for		
	Ambient temperature	Touchable surface < 65 °C	70 °C lead
30 °C	80	85	104
40 °C	65	74	95
50 °C	41	58	88
60 °C	14	30	81
65 °C	0	15	77
70 °C		0	72
80 °C			61
90 °C			41

MC4-Evo 2	Maximum admissible current in Ampere for			
	Ambient temperature	Touchable surface < 65 °C	70 °C lead	90 °C lead
30 °C	86	80	90	90
40 °C	72	68	83	83
50 °C	53	58	76	77
60 °C	18	30	67	70
65 °C	0	15	63	67
70 °C		0	59	63
80 °C			47	51
90 °C			27	31

## 8. Technical characteristics

MC4 (PV-KxT4/... and PV-ADxP4-S2/...)

Rated voltage	1000 V DC
Rated current (30 °C)	2.5 mm <sup>2</sup> /14 AWG: 39 A 4.0 mm <sup>2</sup> /12 AWG: 51 A 6.0 mm <sup>2</sup> /10 AWG: 65 A 10.0 mm <sup>2</sup> /8 AWG: 104 A
Rated surge voltage	12 kV
Ambient temperature range	-40 °C...+85 °C
Upper limiting temperature	105 °C
Mating cycles	100
Schutzart, gesteckt	Leitungsgebunden (PVKxT4/...) Aufbaudosen (PV-ADxP4-S2/...)
Degree of protection, unmated	IP65/IP68 (1 m, 168 h) IP65/IP66/IP68 (1 m, 1 h)
Overvoltage category/Pollution degree	III/3
Contact resistance of plug connectors	≤ 0.25 mΩ
Locking system	snap-in/locking type
Safety class	II
Contact system	MULTILAM
Type of termination	Crimping
Contact material	Tin-plated copper
Warning	Do not disconnect under load
Insulation material	PC
Flame class	UL94-V0

MC4-Evo 2 (PV-KxT4-EVO 2A/... and PV-ADx4-EVO 2A/...)

MC4-Evo stor (PV-KxT4-EVO ST/... and PV-ADx4-EVO ST/...)

Rated voltage	1500 V DC
Rated current (30 °C)	2.5 mm <sup>2</sup> /14 AWG: 39 A 4.0 mm <sup>2</sup> /12 AWG: 51 A 6.0 mm <sup>2</sup> /10 AWG: 65 A 10.0 mm <sup>2</sup> /8 AWG: 90 A
Rated surge voltage	16 kV
Ambient temperature range	-40 °C...+ 85 °C
Upper limiting temperature	115 °C
Mating cycles	100
Degree of protection, mated	IP65
Degree of protection, unmated	IP2X
Overvoltage category/Pollution degree	III/3
Contact resistance of plug connectors	≤ 0.2 mΩ
Locking system	Snap-in/locking type
Safety class	II
Contact system	MULTILAM
Type of termination	Crimping
Contact material	Tin-plated copper
Warning	Do not disconnect under load
Insulation material	PC/PA
Flame class	UL94-V0

## 9. Norms and standards

IEC 61984: Connectors – Safety requirements and tests

IEC 62852:+A1: Connectors for DC-application in photovoltaic systems. Safety requirements and tests

IEC 60664: Insulation coordination for equipment within low-voltage systems

IEC 60512-5-2: Connectors for electronic equipment – Tests and measurements – Part 5-2: Current-carrying capacity tests – Test 5b: Current-temperature derating

IEC 60364-5-52: Low-voltage electrical installations – Part 5-52: Selection and erection of electrical equipment – Wiring systems

IEC 60947-1: (Low-voltage switchgear and control gear – Part 1: General rules).

UL 6703: Standard for Connectors for Use in Photovoltaic Systems

UL 1977: Standard for Component Connectors for Use in Data, Signal, Control and Power Applications

UL 2237: Outline of Investigation for Multi-Point Interconnection Power Cable Assemblies For Industrial Machinery

UL 2238: Standard for Cable Assemblies and Fittings for Industrial Control and Signal Distribution

UL 486A,B: wire connectors

EN 50525-2-31:, Part 2-31: Power cables for general applications – conductor and wiring lines with thermoplastic PVC insulation

DIN VDE 0100-520:-06+A1: Errichten von Niederspannungsanlagen – Teil 5-52: Auswahl und Errichtung elektrischer Betriebsmittel – Kabel- und Leitungsanlagen (IEC 60364-5-52:, modifiziert + Corrigendum Feb. 2011); German implementatio HD 60364-5-52:

DIN VDE 0298-3:-06: Verwendung von Kabeln und isolierten Leitungen für Starkstromanlagen – Teil 3: Leitfadern für die Verwendung nicht harmonisierter Starkstromleitungen Application of cables and cords in power installations- Part 3: Guide to use of non-harmonized cables

EN 50525-2-21: Kabel und Leitungen – Starkstromleitungen mit Nennspannungen bis 450/750 V ( $U_0/U$ ) – Teil 2-21: Starkstromleitungen für allgemeine Anwendungen – Flexible Leitungen mit vernetzter Elastomer-Isolierung; Electric cables-Low voltage energy cables of rated voltages up to and including 450/750 V ( $U_0/U$ )-Part 2-21: Cables for general applications-Flexible cables with crosslinked elastomeric insulation;

DIN VDE 0250-602:1985-03 Cables, wires and flexible cords for power installation; special rubber-insulated single-core cables