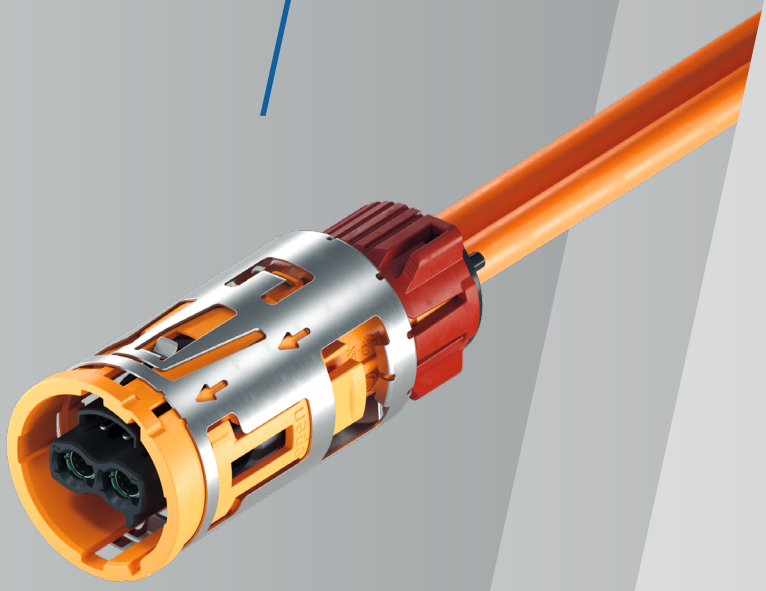


PRODUCT SPECIFICATION

HPS40-2 2+2
Female Connector SCC

EPS-100188

HIRSCHMANN
AUTOMOTIVE

TABLE

1 General

1.1 Introduction

This product specification is valid for the HPS40-2 2+2 female connector SCC, assembled according to the process specification listed below, and contains the product design and the condition upon delivery, the technical characteristics as well as the qualification inspections performed. In the case of improper application or deviation from specification that results in quality issues, the right of complaint is void.

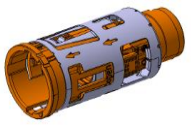
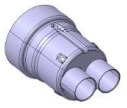
1.2 Other valid documents

A	Hirschmann product drawing	807-655-…00
B	Interface drawing	808-188-…00
C	Process specification	EVS-100096
D	Operating guideline	HPS40-2 female plug socket
E	Working committee directive LV214 (cf. TLF 0214)	Working committee test specification for motor vehicle plug-in connector – version March 2010
F	Working committee directive LV215 (cf. TLF 0214)	Electrics/ electronic requirements of HV-plug-in connectors – version May 2013
G	German norm DIN EN 60352-2	Solderless electric connections Part 2: crimp connections
H	DIN EN 60664-1	Insulation coordination for electronic equipment in low voltage systems. Part 1: principles, requirement, and tests
I	2000/53/EG	Directive of the European Parliament and of the council on end-of life vehicles incl. attachments; European Union
J	ISO 6469-3	Electric road vehicles – safety specifications Part 3: protection of persons against electric hazards
K	ISO 26053	Road vehicles; degrees of protection (IP-Code); protection against foreign objects, water, and access; electrical equipment;

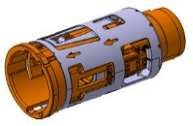
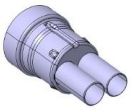
1.3 Product design

1.3.1 BOM, PN, description, weight, MOQ

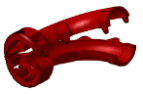
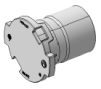
The HPS40-2 2+2 female connector SCC consists of following parts. (see BOM)

HPS40-2 2+2 female SCC 2x4.0 mm²		807-655-…00	Weight without wire:		52,11 g
Article picture	Article description	Article number	Needed parts per system	Packaging unit / MOQ	Weight per pcs.
	HPS40-2 locking sleeve	807-656-501	1	500 pcs.	22,90 g
	HPS40-2 female contact carrier (possible codings in the Article number list)	807-657-541 (A) 807-657-542 (B) 807-657-543 (C) 807-657-544 (D) 807-657-547 (Z)	1	1.200 pcs.	5,41 g
	HPS40-2 shielding sleeve 4.0 mm² SCC	710-161-504	1	1.100 pcs.	4,60 g
	HPS40-2 stress relief 4.0 mm² SCC	710-195-502	2	2.000 pcs.	0,75 g
	HPS40-2 cable seal 4.0 mm² SCC	709-972-502	1	5.000 pcs.	1,75 g
	HPS40-2 cover cap 4.0 mm² SCC	706-822-503	1	4.000 pcs.	2,37 g
	HCT4 terminal 4.0 mm²	709-427-504	2	2.600 pcs.	1,13 g

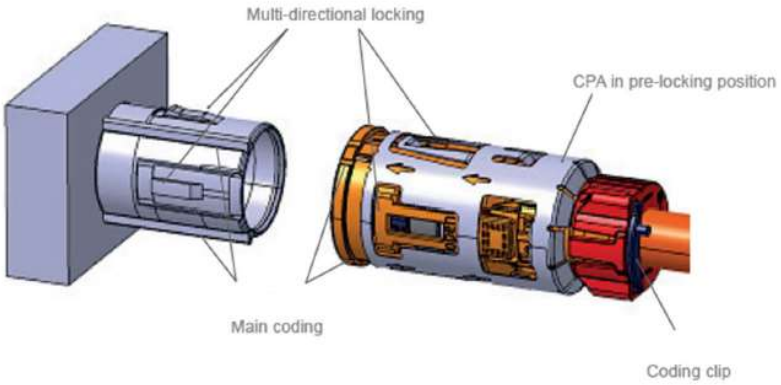
This document is not subject to change service!

HPS40-2 2+2 female SCC 2x6.0 mm²		807-655-…00	ht per system without wire:		53,71 g
	HPS40-2 locking sleeve	807-656-501	1	500 pcs.	22,90 g
	HPS40-2 female contact carrier (possible codings in the Article number list)	807-657-541 (A) 807-657-542 (B) 807-657-543 (C) 807-657-544 (D) 807-657-547 (Z)	1	1.200 pcs.	5,41 g
	HPS40-2 shielding sleeve 6.0 mm² SCC	710-161-506	1	1.100 pcs.	5,51 g
	HPS40-2 stress relief 6.0 mm² SCC	710-671-501	2	20.000 pcs.	0,54 g
	HPS40-2 X-Ring 6.0 mm² SCC	710-675-501	2	50.000 pcs.	0,10 g
	HPS40-2 cable seal 6.0 mm² SCC	709-972-504	1	5.000 pcs.	1,60 g
	HPS40-2 cover cap 6.0 mm² SCC	706-822-505	1	4.000 pcs.	2,33 g
	HCT4 terminal 6.0 mm²	709-427-505	2	2.600 pcs.	1,13 g

This document is not subject to change service!

HPS40-2 2+2 female SCC Optional parts		807-655-…00	Weight per system without wire:		14,16 g
	HPS40-2 coding clip (possible codings in the Article number list, same price for all codings)	706-505-501 (A) 706-505-502 (B) 706-505-503 (C) 706-505-504 (D) 706-505-507 (Z)	1	20.000 pcs.	0,15 g
	HPS40-2 90° angle cap	706-506-503	1	520 pcs.	9,21 g
	HPS40-2 protection cap	706-672-501	1	1.500 pcs.	4,80 g

1.3.2 Product features



- Multi-directional locking
- Main coding/ polarisation
- HPS40-2 locking sleeve is always with CPA
- HPS40-2 female contact carrier has always integrated an HVIL bridge
- HPS40-2 female contact carrier has 5 coding options (A, B, C, D, Z)

2 Technical product information

The connector can be placed in the entire vehicle if the specified characteristics will not be exceeded. The characteristics are determined by tests (see verification plan) and material datasheets.

2.1 Current class

The connector system fulfills the class 1 and 2.

2.2 Operating condition

Nominal voltage	1,000 VDC	
Maximum altitude	acc. to OEM specification or the device manufacturer	
Insulating material group:	1 (CTI >=600) – for components with direct contact to HV	
Degree of contamination:	acc. to OEM specification or the device manufacturer	
Overvoltage category:	1	
Rated impulse voltage:	acc. to OEM specification or the device manufacturer	
Test voltage for electric strength:	acc. to OEM specification or the device manufacturer	
Real min. distance in mated condition:	The clearance and creepage distances at the transition of the connector to the unit interface is not considered and must be considered additional – e.g. when using bade versions.	
Min. clearance distance:	HV-HV:	3.9 mm
	HV-HVIL:	13.5 mm
	HV-Shield:	6.0 mm
Min. creepage distance:	HV-HV:	5.0 mm
	HV-HVIL:	> 13.5 mm
	HV-Shield:	6.5 mm
	Shield outside housing:	> 10.0 mm

2.2.1 Calculation Example

Clearance and creepage distance based on the exemplary following requirements according to DIN EN 60664-1.

Max. operating voltage:	1,000 VDC
Insulating material group:	1
Degree contamination:	2
Altitude:	5,600 m
Rated impulse voltage:	2,500 VDC
Test voltage for electric strength:	2,150 VDC/ 1,500 VAC (basic insulation)
	4,300 VDC/ 3,000 VAC (reinforced-, double insulation)
Normative min. clearance distance:	2.45 mm basic insulation
	4.90 reinforced insulation
Normative min. creepage distance:	5.00 mm basic insulation
	10.0 reinforced insulation

2.3 Voltage class

Class B according to ISO 6469-3
60 VDC < U ≤ 1,000 VDC
25 VAC < Ueff ≤ 707 VAC (15-150 Hz)

2.4 Ambient condition

Permissible temperature range for the plastic used:
-40° C to +140° C according to “temperature collective 4” for 8,000 h
The details of the changes in the properties of the plastics can be found in the plastics data sheets.

“Temperature collective 4” of MBN 10306, 2020-06 or GS 95024-3-1, 2013-07

Temperature in ° C	Distribution in %
-40	6
23	20
85	65
135	8
140	1

2.5 EMC performance

Delta transfer impedance of the HV connector system.

2.5 mm²	**4.0 mm²**	**6.0 mm²**
Until 2 MHz: < 2.5 mΩ/ m Until 30 MHz: < 5 mΩ/ m	Until 30 MHz: < 1 mΩ	Until 30 MHz: < 1 mΩ
Shielding attenuation:		
2.5 mm²	**4.0 mm²**	**6.0 mm²**
> 70 dB (10 kHz to 100 MHz) > 65 dB (100 MHz to 1,000 MHz)	> 70 dB (10 kHz to 1,000 MHz)	> 75 dB (10 kHz to 500 MHz) > 65 dB (500 MHz to 1,000 MHz)

2.6 Shield area

Shield transfer: 360° circumferential
Shield contact resistance R < 2 mΩ (Total from sheathed cable until the device.)

2.7 IP-Degree of protection

IPxxD (plugged female connector)
IPxxB+ (unplugged female connector)
min. air distance HV contacts to shock-proof protection finger female connector interface at IPxxB: 0.9 mm
min. air distance HV contacts to shock-proof protection finger male connector interface at IPxxB: 0.8 mm

2.8 HVIL system

Min. 1.0 mm leading HV Interlock contacts to HV load contact at unmating (nominal 2.00 mm).

2.9 Technical cleanliness

Inside the connector and on the connector, there are no metallic particles *> 1,000 µm allowed*
For metallic particles at each connector: CCC = *N (J4/ K0) acc. to VDA Band 19*
For all other particles at each connector: CCC = *N (J10/ K0) acc. to VDA Band 19*

2.10 Ampacity SCC (derating)

The derating in the housing shows exemplary values. Requirement related to the current capability of the connector has also to be considered with the derating.

2.10.1 Calculation

Calculation for t- / I-curve determination

$$I(t,T_u)_{x\,mm^2\,Material} = \sqrt{\frac{(T_{grenz}-T_u)}{k_1 * \left(1-e^{\frac{-t}{\tau}}\right)}} + \sqrt{\frac{(T_{grenz}-T_u) * \left(1-e^{\frac{-t}{\tau}}\right)}{k_2}}$$

T= time [s]
Tu = ambient temperature [° C]
T_{grenz} = limit temperature connector system [° C]
k1 = constant heat capacity (dynamic time domain) [K/A²]
k2 = constant heat conduction (quasi-statical time domain) [K/A²]
t = time constant [s]
x mm² Material = used cross section incl. Material (for example: 35 mm² Cu)

Leitung Cu wire Cu	1x6mm²	1x4mm²	
Kontaktsystem contact system	HCT4	HCT4	
T_{grenz}	200	200	°C
K_1	0,10099	0,04267	K/A²
K_2	0,23968	2,1168	K/A²
t	185,582	127,009	s
log10 Abweichung log10 deviation	+1 / -3		%

1x 6.0 mm² incl. HCT4 female contact and HCT4short male contact (Automotive, tested with male header)

Time for calculation (s)	23° calculated	60° calculated	65° calculated	70° calculated	75° calculated	80° calculated	85° calculated	90° calculated	95° calculated	100° calculated	105° calculated	110° calculated	115° calculated	120° calculated
100000	76,67	68,19	66,96	65,7	64,43	63,13	61,8	60,44	59,05	57,63	56,17	54,67	53,13	51,54
3600	76,67	68,19	66,96	65,7	64,43	63,13	61,8	60,44	59,05	57,63	56,17	54,67	53,13	51,54
456	78,3	69,64	68,38	67,1	65,8	64,47	63,11	61,73	60,31	58,85	57,36	55,83	54,26	52,64
160	88,1	78,35	76,94	75,5	74,04	72,54	71,02	69,45	67,86	66,22	64,55	62,82	61,05	59,23
37	135,59	120,59	118,41	116,2	113,94	111,64	109,29	106,89	104,43	101,91	99,33	96,68	93,96	91,15
14,4	201,92	179,58	176,34	173,05	169,69	166,26	162,76	159,18	155,52	151,77	147,93	143,98	139,93	135,75
7,8	268,11	238,44	234,15	229,77	225,31	220,76	216,11	211,36	206,5	201,52	196,42	191,18	185,79	180,25
0,1	2302,85	2048,07	2011,16	1973,57	1935,24	1896,14	1856,22	1815,42	1773,68	1730,93	1687,1	1642,11	1595,84	1548,19

1x 4.0 mm² incl. HCT4 female contact and HCT4short male contact (Automotive, tested with male header)

Time for calculation (s)	60° calculated	65° calculated	70° calculated	75° calculated	80° calculated	85° calculated	90° calculated	95° calculated	100° calculated	105° calculated	110° calculated	115° calculated	120° calculated
100000	58,42	57,37	56,3	55,2	54,09	52,95	51,79	50,6	49,38	48,13	46,84	45,52	44,16
3600	58,42	57,37	56,3	55,2	54,09	52,95	51,79	50,6	49,38	48,13	46,84	45,52	44,16
899	58,62	57,56	56,49	55,39	54,27	53,13	51,96	50,77	149,54	48,29	47	45,68	44,31
182	66,44	65,24	64,02	62,78	61,51	60,222	58,89	57,54	56,15	54,73	53,27	51,77	50,22
37	106,24	104,33	102,38	100,39	98,36	96,29	94,17	92,01	89,79	87,52	85,18	82,78	80,31
15,9	151,98	149,24	146,45	143,61	140,71	137,75	134,72	131,62	128,45	125,2	121,86	118,42	114,89
9,9	188,91	185,5	182,04	178,5	174,89	171,21	167,45	163,6	159,66	155,61	151,46	147,2	142,8
0,1	1818,85	1786,08	1752,69	1718,65	1683,93	1648,48	1612,24	1575,17	1537,21	1498,29	1458,33	1417,24	1374,92

3 Performed delta tests SCC

Tests acc. to LV214 / LV215 (cf. TLF 0214)
Details see DVP-Plan HPS40-2 2+2 female connector serial validation

1.1	PG 0 – Receiving inspection and testing (contacts + shield)	Shield contact resistance: < 2 mΩ Insulation resistance: R > 200 mΩ at 1,000 VDC Withstand voltage 3,000 VAC for 1 min. (acc. to DIN EN 1987-3 and LV215) min. air distance 3.9 mm + min. creepage distance 5.0 mm
1.2	PG 1 – Dimension	
1.3	PG 2 – Material and surface test (contacts)	All metal parts
1.4	PG 3 – Material and surface test (housing)	All plastic parts and seals
1.5	PG 10 – Contacts: Conductor pull-out strength	Shielding > 150 N
1.12	PG 13 – Housing influence on the derating	Tmax. 180° C see Drawing
1.13	PG 14 – Termal time constant	Up to 5 times nominal current and i/t curve
1.14	PG 15 – Electrical stress test	
1.16	PG 17 – Dynamic stress	Shield contact > 2 mΩ - Vibration SG2 Temp. SG4 (HV contact + shield) - Vibration SG3 Temp. SG4 (HV contact + shield) - Vibration SG3 Temp. SG4+ 45A load (HV c. + sh.) - Vibration SG4 Temp. SG4 (HV contact + shield)
1.17	Corrosion test	720 h salt spray test with salt mixture of severity level 3 and following PG23
1.18	PG 19 – Environmental simulation	Max. test temperatur: 140° C
1.22	PG 23 – Water leak tightness	All wire cross section and wire type (2.5mm²/ 4.0 mm²/ 6.0 mm² Coroplast, Kroschu, Leoni)
1.24	PG 50 – EMC test	Acc. to IEC 62153-4-3 At frequence area of 10 kHz to 1,000 MHz

4 Result of performed tests

4.1 Ampacity SCC (I/t) measurement results

1x 6.0 mm² incl. HCT4 female contact and HCT4short male contact (Automotive, tested with male header)

Ambient temperature	49.71	74.56	119.82	151.64	172.58
Current (A)	72.56	64.29	48.22	32.00	16.00

1x 4.0 mm² incl. HCT4 female contact and HCT4short male contact (Automotive, tested with male header

Ambient temperature	36.80	-	97.70	142.50	170.40
Current (A)	64.09	-	48.08	32.00	16.00

4.2 Insulation resistance

Over complete lifetime: >200 MΩ

Lowering during humidity load: >25 MΩ

In plugged condition between HV contacts, HV contacts and shield.

4.3 Contact resistance HV and HVIL

Acc. to LV215-1: 2013-02 (cf. TLF 0214)

wire cross section mm²	contact resistance (total resistance incl. Crimp)	
	new condition mΩ	after aging mΩ
2,5	1,17	2,34
4	0,72	1,44
6	0,68	1,36
acc. to LV215		

	group 1					
wire cross section mm²/ contact sice mm	0,13	0,22	0,35	0,5	0,75	1
0,63	30	30	15	15	15	-
1,2	20	20	15	15	15	15
1,5	-	15	15	15	15	15
2,8	-	15	15	15	15	10
4,8-6,3	-	10	10	8	8	8
8	-	-	-	-	-	-
9,5-12	-	-	-	-	-	-
acc. to LV214						

4.4 Watertightness

IP6K9K and IPx8

PG23 acc. to working group inspection guideline LV214 and LV215 (cf. TLF 0214)

4.5 Vibration load

Vibration stability: PG17 acc. to working group inspection guideline LV214 and LV215 (cf. TLF 0214)
Fixing length: Free cable length between connector and first cable fixing point, where the cable is fixed with the same oscillation as the connector. The cable fixing must be designed for every operation mode.

4.5.1 SCC:

Vibration class severity level 2:	no fixation point needed
Vibration class severity level 3:	no fixation point needed
Vibration class severity level 4:	first fixation point max. 200 mm, second fixation point max. 250 mm from the first fixation point

4.6 Amount of mating cycles

Max. 50 cycles (Ag)

4.7 Polarization/ Koshiri-safety

Failed insertion force min. 200 N (3 times assembly force)
Koshiri-safety is given

4.8 Retention force of the contact in the housing

HV contacts:	Primary locking/ secondary locking min. 120 N
IL Bridge (stamped part):	F > 50 N

4.9 Secondary locking

Activation force < 40 N
No unintentional opening possible.

4.10 Mating/ Unmating force

Assembly force of the female plug into the plug/ plug socket:	< 65 N
Disassembly force from the female plug out of the plug/ plug socket:	< 65 N
Retention force of the female plug in the plug/ plug socket:	> 400 N
Retention force of the female plug in the plug/ plug socket incl. CPA:	> 500 N
Operating force of the CPA:	< 30 N
Max. pull-off force of the angled cap:	< 60 N

5 Table of change

Version	Change description	Change date	Editor
1	First version	02.07.2016	-
2	English version added	04.11.2016	-
3	Update to serial design	16.05.2017	-
4	Update deratings	07.07.2017	-
5	Update serial SVP and characteristics	05.09.2017	-
6	Revision of layout, angled cap and transportation cap added	07.03.2018	-
7	Update vibration load	23.07.2019	-
8	Added SCC version	02.12.2020	-
9	Updated ampacity of SCC version	15.09.2021	-
10	Added SCC 4mm² derating and ampacity	16.11.2021	-
11	Updated SCC 6mm² ampacity	25.05.2022	-
12	Update design specification	14.06.2023	Jussel E-M.
13	Adjusting data of the bottom line	08/ 2023	Jussel E-M.
14	Update BOM weight of the parts	08/ 2023	Jussel E-M.
15	Adjusting data “Ambient Condition”	10/ 2023	Jussel E-M.
16	Update Topic 2.9 – wording VDA	04/ 2024	Jussel E-M.