



PRODUCT SPECIFICATION

HPS40-2 2+2

Female Connector NAFTA SCC

EPS-100187



HIRSCHMANN
AUTOMOTIVE



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1 General

1.1 Introduction

This product specification is valid for the HPS40-2 2+2 female connector NAFTA 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	809-886-...106
B	Interface drawing	808-188-...106
C	Process specification	EVS-100101
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;




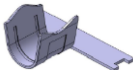



1.3 Product design

1.3.1 BOM, PN, description, weight, MOQ

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


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HPS40-2 Female NAFTA SCC 2x 4.0 mm ²		809-886-...106	Weight without wire:		51,70 g
Article picture	Article description	Article number	Needed parts per system	Packaging unit / MOQ	Weight per pcs.
	HPS40-2 locking sleeve NAFTA	807-656-503	1	500 pcs.	22,90 g
	HPS40-2 female contact carrier (possible codings in the Article number list)	807-657-551 (A) 807-657-552 (B) 807-657-553 (C) 807-657-554 (D) 807-657-557 (Z)	1	600 pcs.	5,00 g
	HPS40-2 shielding sleeve SCC	710-161-504	1	1100 pcs.	4,60 g
	HPS40-2 stress relief 4.0 mm ² SCC	710-195-502	2	2000 pcs.	0,75 g
	HPS40-2 cable seal 4.0 mm ² SCC	709-972-502	1	5000 pcs.	1,75 g
	HPS40-2 cover cap 4.0 mm ² SCC	706-822-503	1	4000 pcs.	2,37 g
	HCT4 terminal 4.0 mm ²	709-427-504	2	2600 pcs.	1,13 g

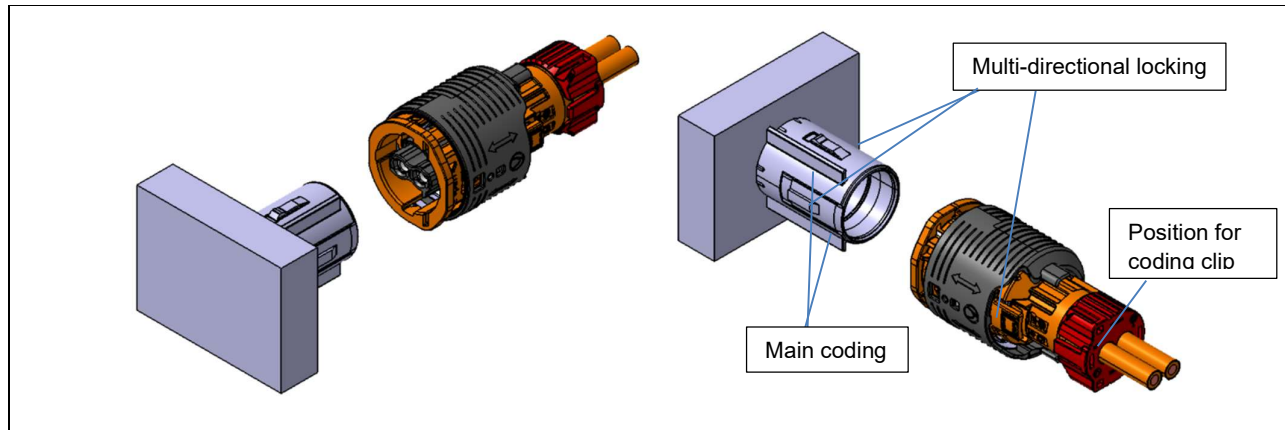
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HPS40-2 Female NAFTA SCC 2x 6.0 mm ²		809-886-...106	Weight without wire:		53,46 g
	HPS40-2 locking sleeve NAFTA	807-656-503	1	500 pcs.	22,90 g
	HPS40-2 female contact carrier (possible codings in the Article number list)	807-657-551 (A) 807-657-552 (B) 807-657-553 (C) 807-657-554 (D) 807-657-557 (Z)	1	1161,1 pcs.	5,00 g
	HPS40-2 shielding sleeve 6.0 mm ² SCC	710-161-506	1	1100 pcs.	5,51 g
	HPS40-2 stress relief 6.0 mm ² SCC	710-671-501	2	20000 pcs.	0,54 g
	HPS40-2 X-Ring 6.0 mm ² SCC	710-675-501	2	50000 pcs.	0,10 g
	HPS40-2 cable seal 6.0 mm ² SCC	709-972-504	1	5000 pcs.	1,75 g
	HPS40-2 cover cap 6.0 mm ² SCC	706-822-505	1	4000 pcs.	2,37 g
	HCT4 terminal 6.0 mm ²	709-427-505	2	2600 pcs.	1,13 g

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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:	I acc. to OVE EN IEC 60664-1 (CTI \geq 600) for components with direct contact to HV
Degree of contamination:	acc. to OEM specification or the device manufacturer
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
Min. creepage distance:	HV-Shield: 6.0 mm HV-HV: 5.0 mm HV-HVIL: > 13.5 mm HV-Shield: 6.5 mm

2.2.1 Calculation Example

Clearance and creepage distance based on the exemplary following requirements according to OVE EN IEC 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)

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2.3 Voltage class

Class B according to ISO 6469-3

60 VDC < U ≤ 1,000 VDC

25 VAC < U_{eff} ≤ 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 mm ²	4.0 mm ²	6.0 mm ²
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 mm ²	4.0 mm ²	6.0 mm ²
> 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.)

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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 2.0 mm).

2.9 Technical cleanliness

Inside the connector and on the connector, there are no metallic particles $> 1,000 \mu\text{m}$ 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.

- 1x 6.0 mm² incl. HCT4 female contact and HCT4short male contact (Automotive, tested with male header).
- 1x 4.0 mm² incl. HCT4 female contact and HCT4short male contact (Automotive, tested with male header)



2.10.1 Calculation

Calculation for t- / I-curve determination

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

T= time [s]

T_u = 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	1x6mm ²	1x4mm ²	
Kontaktsystem contact system	HCT4	HCT4	
T _{grenz}	200	200	°C
K ₁	0,10099	0,04267	K/A ²
K ₂	0,23968	2,1168	K/A ²
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	49,54	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

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3 Performed tests SCC

Tests acc. to SAE/USCAR-2 and SAE/USCAR-37

1	D – Term-Connector Insertion Retention	Insertion force max. 19N Forward stop min. 62N Retention force min. 250N
2	E – Misc. Component Engage/ Disengage Force	Pre-set to lock CPA 13-21N Lock to Pre-set CPA 20-27N Pre-set to lock unmated min. 69N Complete removal min. 260N
3	F – Audible Click	min. 88dB
4	G – Conn. Mating/ Unmating	mating (180° header) max. 55N unmating (180° header) max. 44N retention (180° header) min. 310N lock deflection (180° header) 29-38N mating (90° header) max. 70N unmating (90° header) max. 74N retention (90° header) min. 320N lock deflection (90° header) 44-48N
5	H – Polarization Effectiveness	Polarization >180N Keying >100N
6	I – Drop	performed
7	J – Cavity Damage	Reached with 9.1.2.3 (1018857 PSA)
8	M- Vibration/ Mechanical Shock	T3, V3 (180° header) T3, V2 (90° header)
9	Q – Fluid Resistance	Tested according to LV214 (cf. TLF 0214) PG22b
10	RSAA – Combined R+S+AA	High-pressure spray distance 145mm
11	TUAB – Combined T+U+AB	High-pressure spray distance 145mm

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

4.3.1 HV wire

acc. to ISO20076:2019

Permitted connection resistance according to conductor cross-sectional area.

cable area mm ²	Initial resistance mV/A	Final resistance mV/A
2,5	1,07	2,14
4.0	0,79	1,58
6.0	0,61	1,22

4.3.2 HVIL wire

acc. to SAE/USCAR-2

Nominal male terminal size	max. total connection resistance (mΩ)		
	terminals with tin plating	terminals with precious metal plating (1)	Voltage drop (mV) (2)
1,2 mm	15.0	10.0	50

Notes:

- (1) Silver or gold top plating
- (2) For reference: 1 mΩ = 1 mV/A

4.4 Watertightness

IPx9K and IPx8 acc. to SAE/USCAR-2.

4.5 Vibration load

“M” – vibration/ mechanical shock

Fixing length acc SAE/USCAR-2 100 mm: 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: for 90° header version - no fixation point needed
Vibration class severity level 3: for 180° header version - no fixation point needed

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

	180°	90°
Assembly force of the female plug into the plug/ plug socket:	max. 55N	max. 70N
Disassembly force from the female plug out of the plug/ plug socket:	max. 44N	max. 74N
Retention force of the female plug in the plug/ plug socket:	min. 310N	min. 320N
Lock deflection:	29N - 38N	44N - 48N

5 Table of change

Version	Change description	Change date	Editor
1	First version	08/ 2023	Jussel E-M.
2	Adjusting data "Ambient Condition"	10/ 2023	Jussel E-M.
3	Topic 4.2) updated the description from mΩ to MΩ	11/ 2023	Jussel E-M.
4	Topic 2.9 – update wording VDA	04/ 2024	Jussel E-M.