Maintenance of HV Measurement Technology – Calibration and Insulation Test

CSM web seminars

CSM Xplained
measurement technology

Innovative Measurement and Data Technology

Calibration

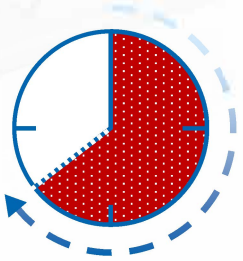
Expiring in
September 2022

DAkkS

Requested by the
customer

HV Insulation Test

Expiring in
September 2022

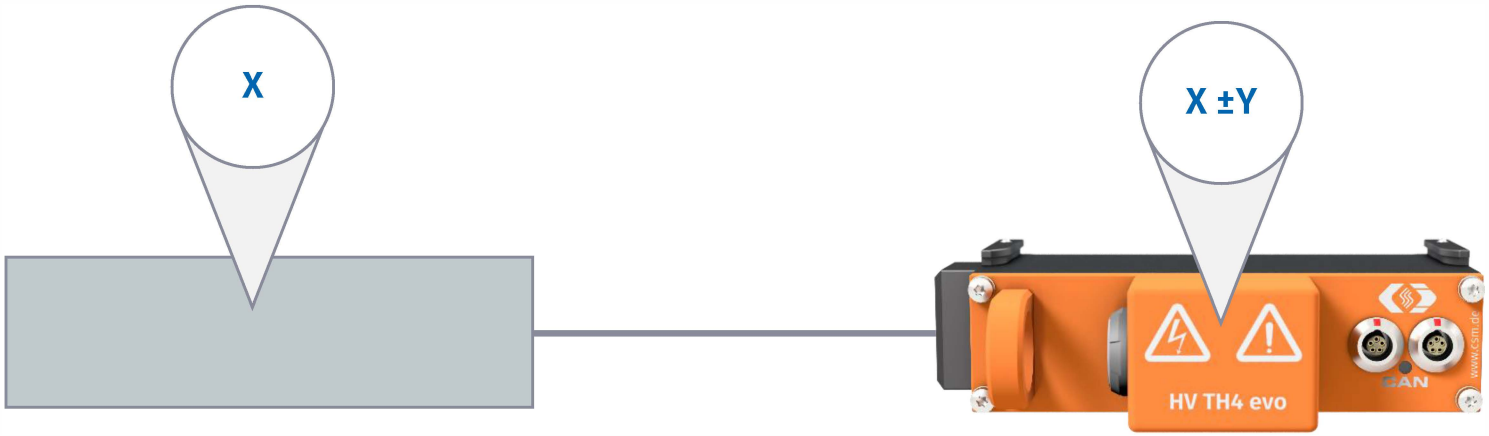


Time

How can the tests still
be carried out in time?

Calibration
Definition and procedure

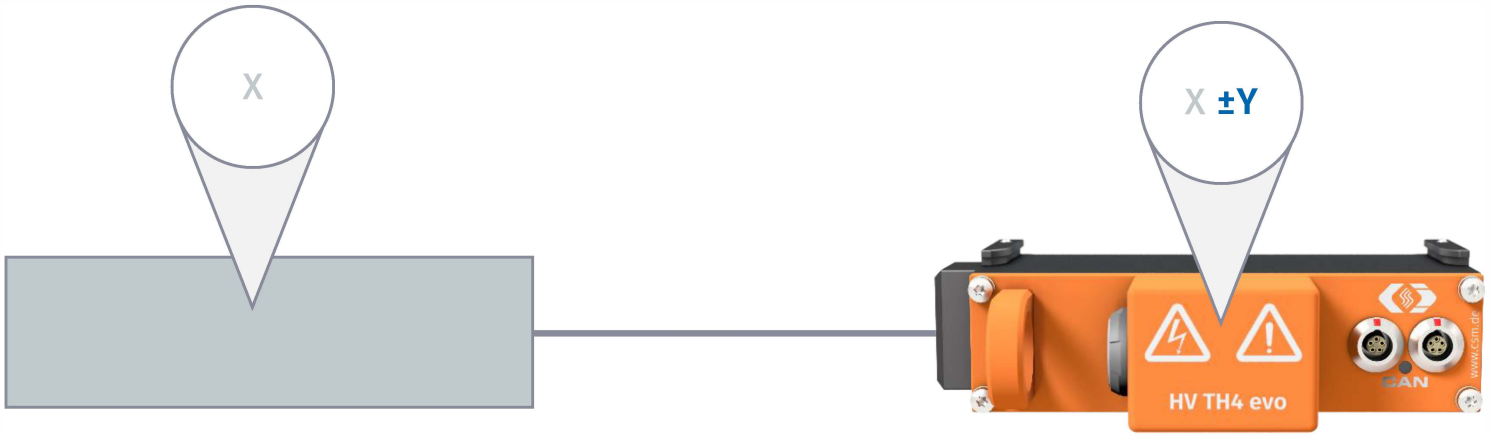
- **Comparison** of a measured value (display value) with a reference value



Calibrator DUT

Calibration
Definition and procedure

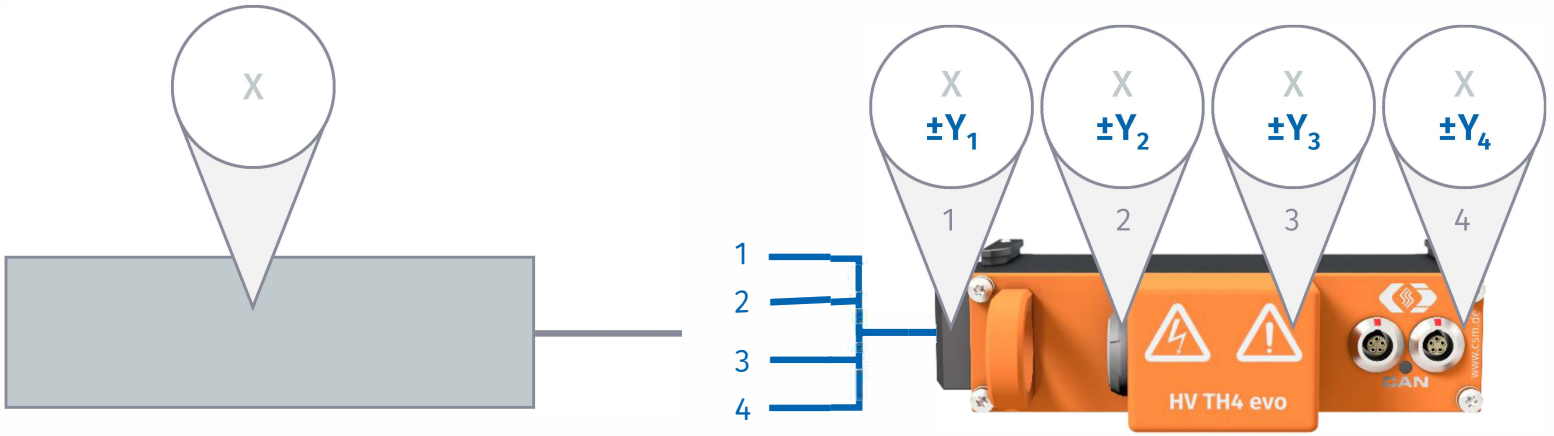
- Comparison of a measured value (display value) with a reference value
- Difference between nominal and actual value = **measurement deviation** of the calibration object



Calibrator DUT

Calibration
Definition and procedure

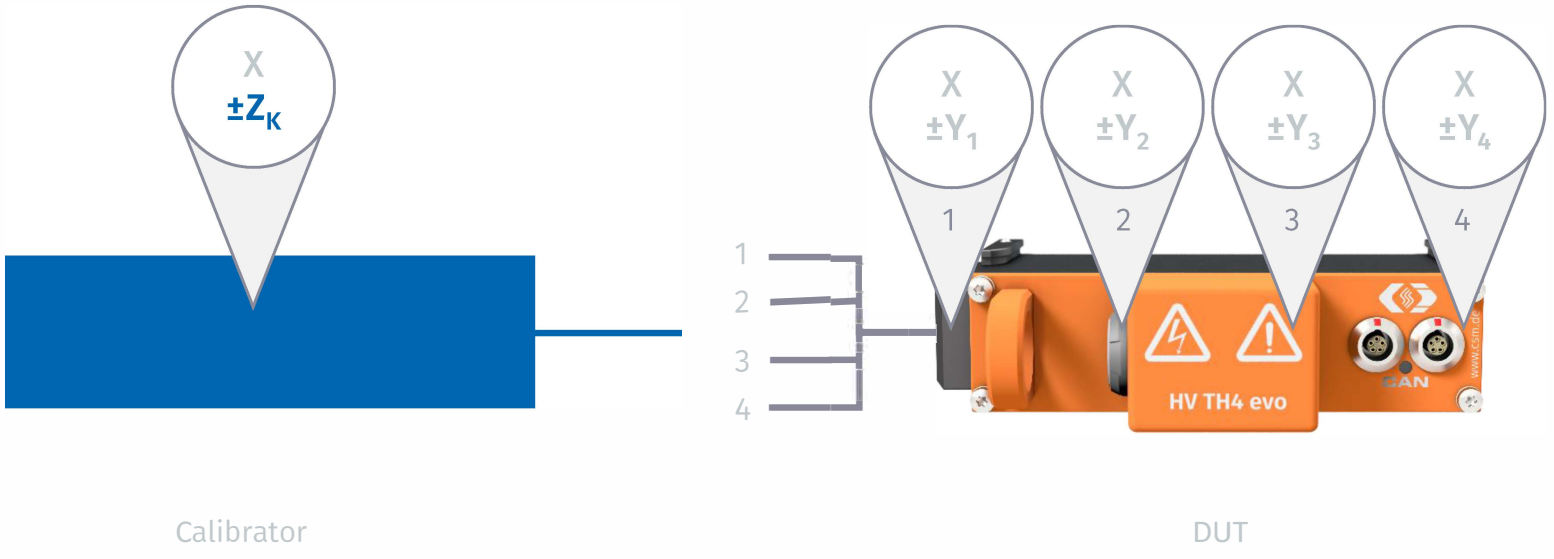
- Comparison of a measured value (display value) with a reference value
- Difference between nominal and actual value = measurement deviation of the calibration object
- **To be performed separately for all measurement channels / measurement ranges**



Calibrator DUT

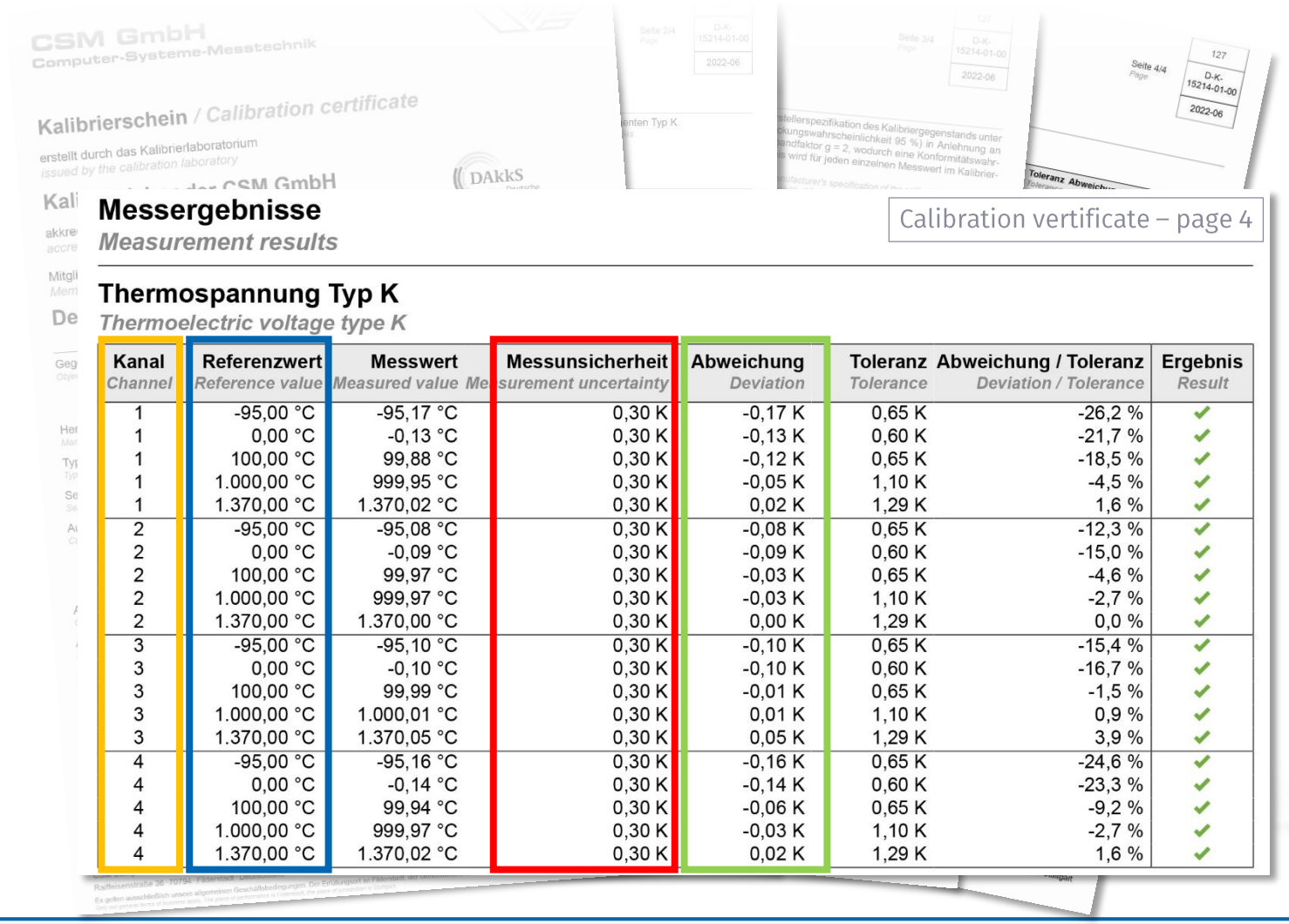
Calibration
Definition and procedure

- Comparison of a measured value (display value) with a reference value
- Difference between nominal and actual value = measurement deviation of the calibration object
- To be performed separately for all measurement channels / measurement ranges
- Observe **measurement uncertainty** due to calibration setup



Calibrator DUT

Calibration
Calibration certificate


CSM GmbH
Computer-Systeme-Messtechnik

Kalibrierschein / Calibration certificate

erstellt durch das Kalibrierlaboratorium
issued by the calibration laboratory

DAkkS

Seite 4/4 Page

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2022-06

Toleranz Abweichung

Messergebnisse
Measurement results

Calibration vertificate – page 4

Thermospannung Typ K
Thermoelectric voltage type K

Kanal *Channel*	Referenzwert *Reference value*	Messwert *Measured value*	Messunsicherheit *Measurement uncertainty*	Abweichung *Deviation*	Toleranz *Tolerance*	Abweichung / Toleranz *Deviation / Tolerance*	Ergebnis *Result*
1	-95,00 °C	-95,17 °C	0,30 K	-0,17 K	0,65 K	-26,2 %	✓
1	0,00 °C	-0,13 °C	0,30 K	-0,13 K	0,60 K	-21,7 %	✓
1	100,00 °C	99,88 °C	0,30 K	-0,12 K	0,65 K	-18,5 %	✓
1	1.000,00 °C	999,95 °C	0,30 K	-0,05 K	1,10 K	-4,5 %	✓
1	1.370,00 °C	1.370,02 °C	0,30 K	0,02 K	1,29 K	1,6 %	✓
2	-95,00 °C	-95,08 °C	0,30 K	-0,08 K	0,65 K	-12,3 %	✓
2	0,00 °C	-0,09 °C	0,30 K	-0,09 K	0,60 K	-15,0 %	✓
2	100,00 °C	99,97 °C	0,30 K	-0,03 K	0,65 K	-4,6 %	✓
2	1.000,00 °C	999,97 °C	0,30 K	-0,03 K	1,10 K	-2,7 %	✓
2	1.370,00 °C	1.370,00 °C	0,30 K	0,00 K	1,29 K	0,0 %	✓
3	-95,00 °C	-95,10 °C	0,30 K	-0,10 K	0,65 K	-15,4 %	✓
3	0,00 °C	-0,10 °C	0,30 K	-0,10 K	0,60 K	-16,7 %	✓
3	100,00 °C	99,99 °C	0,30 K	-0,01 K	0,65 K	-1,5 %	✓
3	1.000,00 °C	1.000,01 °C	0,30 K	0,01 K	1,10 K	0,9 %	✓
3	1.370,00 °C	1.370,05 °C	0,30 K	0,05 K	1,29 K	3,9 %	✓
4	-95,00 °C	-95,16 °C	0,30 K	-0,16 K	0,65 K	-24,6 %	✓
4	0,00 °C	-0,14 °C	0,30 K	-0,14 K	0,60 K	-23,3 %	✓
4	100,00 °C	99,94 °C	0,30 K	-0,06 K	0,65 K	-9,2 %	✓
4	1.000,00 °C	999,97 °C	0,30 K	-0,03 K	1,10 K	-2,7 %	✓
4	1.370,00 °C	1.370,02 °C	0,30 K	0,02 K	1,29 K	1,6 %	✓

- Reference value
- Measurement derivation
- Measurement channels / measurement ranges
- Measurement uncertainty

Calibration
Conformity Statement

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Computer-Systeme-Messtechnik

Kalibrierschein / *Calibration certificate*

erstellt durch das Kalibrierlaboratorium
issued by the calibration laboratory

DAkkS

Calibration vertificate – page 4

Messergebnisse
Measurement results

Thermospannung Typ K
Thermoelectric voltage type K

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4	-95,00 °C	-95,16 °C	0,30 K	-0,16 K	0,65 K	-24,6 %	✓
4	0,00 °C	-0,14 °C	0,30 K	-0,14 K	0,60 K	-23,3 %	✓
4	100,00 °C	99,94 °C	0,30 K	-0,06 K	0,65 K	-9,2 %	✓
4	1.000,00 °C	999,97 °C	0,30 K	-0,03 K	1,10 K	-2,7 %	✓
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- Reference value
- Measurement derivation
- Measurement channels / measurement ranges
- Mesaurement uncertainty
- **Conformity statement**

Comparison of the calibration values with limit values from specifications of the test specimen including the measurement uncertainty

Calibration
Conformity Statement

Calibration vertificate – page 3

Konformitätsaussage
Conformity statement

Die Messergebnisse der Kalibrierung werden auf Konformität mit der Herstellerspezifikation des Kalibriergegenstands unter Berücksichtigung der erweiterten Messunsicherheit (k = 2, mit Überdeckungswahrscheinlichkeit 95 %) in Anlehnung an DIN EN ISO 14253-1:2018-07 bewertet. Die Prüfung erfolgt mit Schutzbandfaktor g = 2, wodurch eine Konformitätswahrscheinlichkeit von 95 % und höher erreicht wird. Das Bewertungsergebnis wird für jeden einzelnen Messwert im Kalibrierschein wie folgt angezeigt:

The measurement results of the calibration are evaluated for conformity with the manufacturer's specification of the calibration object under consideration of the extended measurement uncertainty (k = 2, with coverage probability 95 %) referring to DIN EN ISO 14253-1:2018-07. The conformity assessment is carried out with guard band factor g = 2, which results in a conformance probability of 95 % and higher. The evaluation result for each individual measured value is given in the calibration certificate as follows:

Bewertungsergebnis *Evaluation result*	**Kennzeichnung** *Marking*	**Exemplarisches Messergebnis** *Measurement result example*
Innerhalb der Spezifikation *Within specification*	✔	
Keine Angabe möglich, Messwert im Unsicherheitsbereich *No statement possible, measured value in the uncertainty range*	–	
Messwert außerhalb des Toleranzbereichs und im Unsicherheitsbereich *Measured value outside the tolerance range and in the uncertainty range*	✖	
Außerhalb der Spezifikation *Out of specification*	✖	

Toleranzgrenzen / *Tolerance limits*
Referenzwert / *Reference value*
Messwert / *Measured value*
Messunsicherheit / *Measurement uncertainty*

Zusammenfassung je Kanal über alle Messwerte
Summary by channel over all measured values

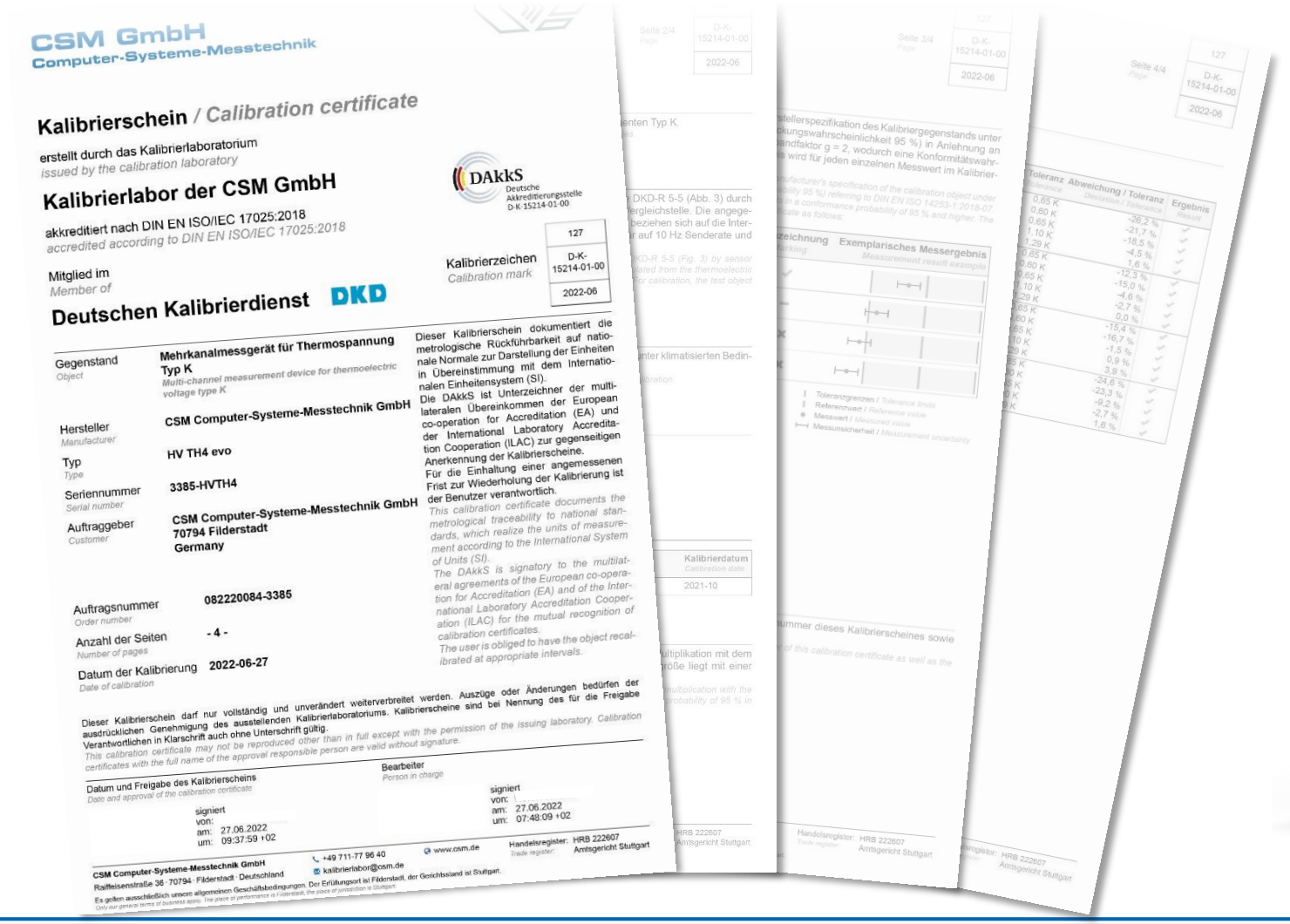
Messgröße *Measurand*	Thermospannung Typ K *Thermoelectric voltage type K*			
Kanal *Channel*	1	2	3	4
Ergebnis *Result*	✔	✔	✔	✔

- Reference value
- Measurement derivation
- Measurement channels / measurement ranges
- Mesaurement uncertainty
- **Conformity statement**

Comparison of the calibration values with limit values from specifications of the test specimen including the measurement uncertainty

Calibration

Factory calibration – DAkkS calibration



CSM GmbH
Computer-Systeme-Messtechnik

Kalibrierschein / *Calibration certificate*

erstellt durch das Kalibrierlaboratorium
issued by the calibration laboratory

Kalibrierlabor der CSM GmbH

akkreditiert nach DIN EN ISO/IEC 17025:2018
accredited according to DIN EN ISO/IEC 17025:2018

DAkkS Deutsche Akkreditierungsstelle D-K-15214-01-00

Mitglied im
Member of

Deutschen Kalibrierdienst DKD

Kalibrierzeichen
Calibration mark

127	
D-K-15214-01-00	
2022-06	

Gegenstand *Object*	**Mehrkanalmessgerät für Thermospannung Typ K** *Multi-channel measurement device for thermoelectric voltage type K*
Hersteller *Manufacturer*	**CSM Computer-Systeme-Messtechnik GmbH**
Typ *Type*	**HV TH4 evo**
Seriennummer *Serial number*	**3385-HVTH4**
Auftraggeber *Customer*	**CSM Computer-Systeme-Messtechnik GmbH 70794 Filderstadt Germany**
Auftragsnummer *Order number*	**082220084-3385**
Anzahl der Seiten *Number of pages*	**- 4 -**
Datum der Kalibrierung *Date of calibration*	**2022-06-27**

Dieser Kalibrierschein dokumentiert die metrologische Rückführbarkeit auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.
This calibration certificate documents the metrological traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DAkkS is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
The user is obliged to have the object recalibrated at appropriate intervals.

Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Auszüge oder Änderungen bedürfen der ausdrücklichen Genehmigung des ausstellenden Kalibrierlaboratoriums. Kalibrierscheine sind bei Nennung des für die Freigabe Verantwortlichen in Klarschrift auch ohne Unterschrift gültig.
This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. Calibration certificates with the full name of the approval responsible person are valid without signature.

Datum und Freigabe des Kalibrierscheins
Date and approval of the calibration certificate

signiert
von:
am: 27.06.2022
um: 09:37:59 +02

Bearbeiter
Person in charge

signiert
von:
am: 27.06.2022
um: 07:48:09 +02

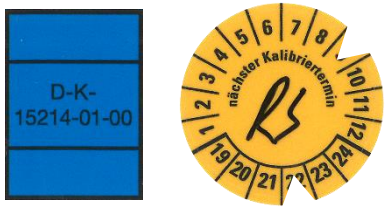
CSM Computer-Systeme-Messtechnik GmbH
Raiffeisenstraße 36 · 70794 · Filderstadt · Deutschland
+49 711-77 96 40
kalibrierlabor@csm.de
www.csm.de
Handelsregister: HRB 222607 Amtsgericht Stuttgart

Es gelten ausschließlich unsere allgemeinen Geschäftsbedingungen. Der Erfüllungsort ist Filderstadt, der Gerichtsstand ist Stuttgart.

- Reference value
- Measurement derivation
- Measurement channels / measurement ranges
- Mesaurement uncertainty
- Conformity statement
- **Factory calibration**

Manufacturer conducts calibration according to own specifications

Calibration
Factory calibration – DAkkS calibration



Calibration vertificate – page 1

CSM GmbH
Computer-Systeme-Messtechnik

Kalibrierschein / *Calibration certificate*

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akkreditiert nach DIN EN ISO/IEC 17025:2018
accredited according to DIN EN ISO/IEC 17025:2018

Mitglied im
Member of

Deutschen Kalibrierdienst DKD

DAkkS
Deutsche
Akkreditierungsstelle
D-K-15214-01-00

Kalibrierzeichen
Calibration mark

127
D-K-15214-01-00
2022-06

- Reference value
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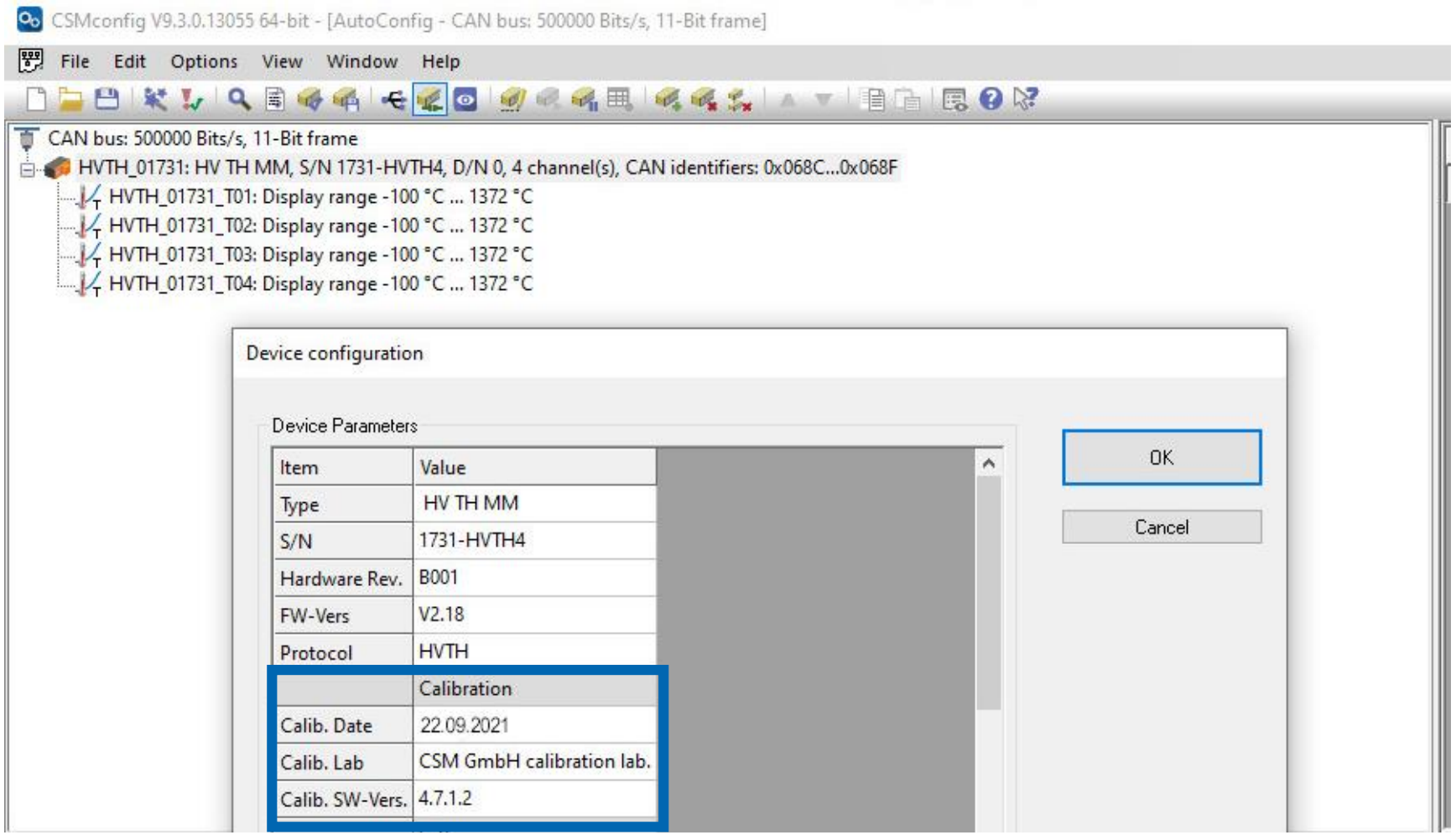
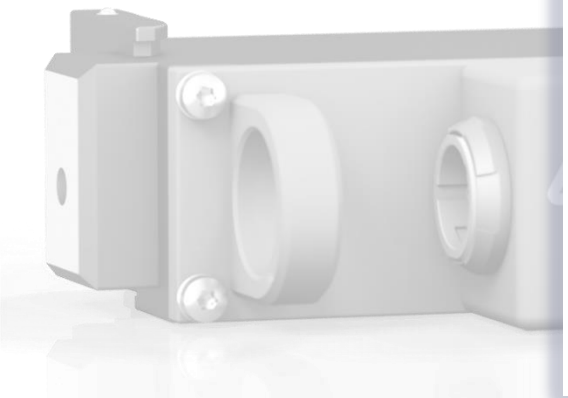
- Conformity statement
- Factory calibration
- **DAkkS calibration**

ISO 17025 accredited calibration laboratory. Internationally accepted

Date of last calibration / next calibration

- Configuration software CSMconfig (last calibration)





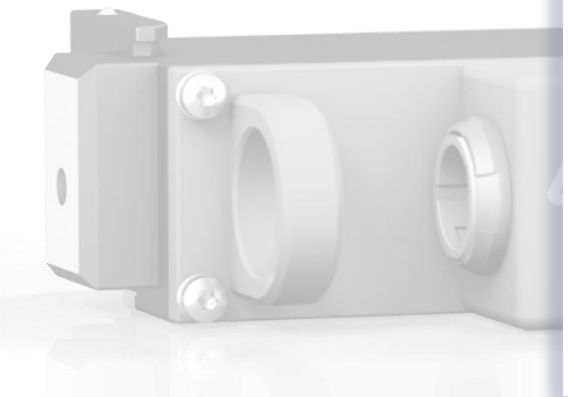
Date of last calibration / next calibration

- Configuration software CSMconfig (last calibration)

Program Settings

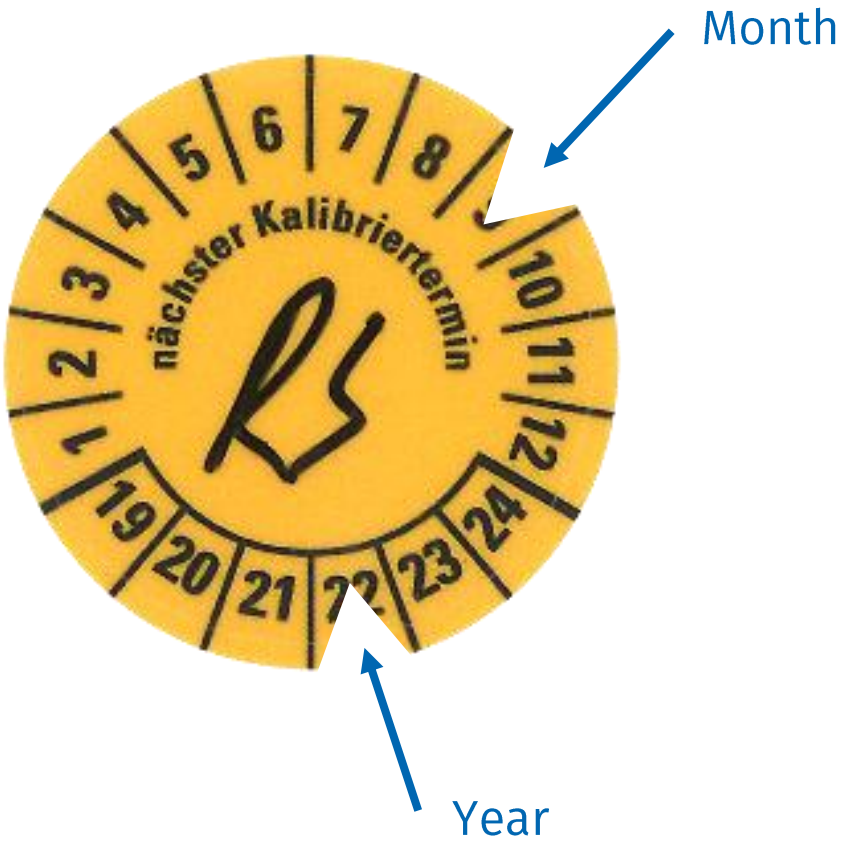
>	Measurement scheme import
Column Heading Definitions (XML)	MSP\MspColumns.xml
Assign S/N according to current devices	☑
>	ECM Related
Force ECM dashCANc compatibility	☐
Identifier base for ECM devices	0x0181
Enable ECM 16-bit mode	☑
Identifier base for ECM 16-bit values	0x0160
>	Calibration date monitoring
Monitoring type	on check
Calibration interval	365
Lead warn time	30
>	Misc.Settings
Display log file after bus scan.	☐
Force measurement to 0/3/6.. fractional digits	☑
Allow module internal adjustments	☑
Unit for temperature channels	deg Celsius
Temperature unit auto conversion	☑
Allows to adapt settings to the device limitations	☑
Max. number of columns in report tables	12

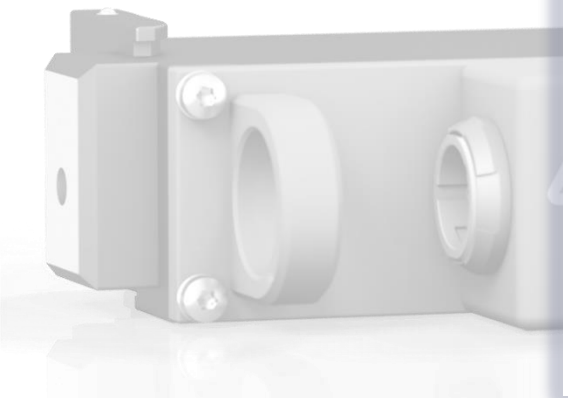
OK
Cancel
Vector Ethernet
Export to ...
Import



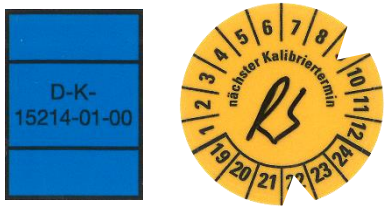
Date of last calibration / next calibration

- Configuration software CSMconfig (last calibration)
- Label (next calibration)



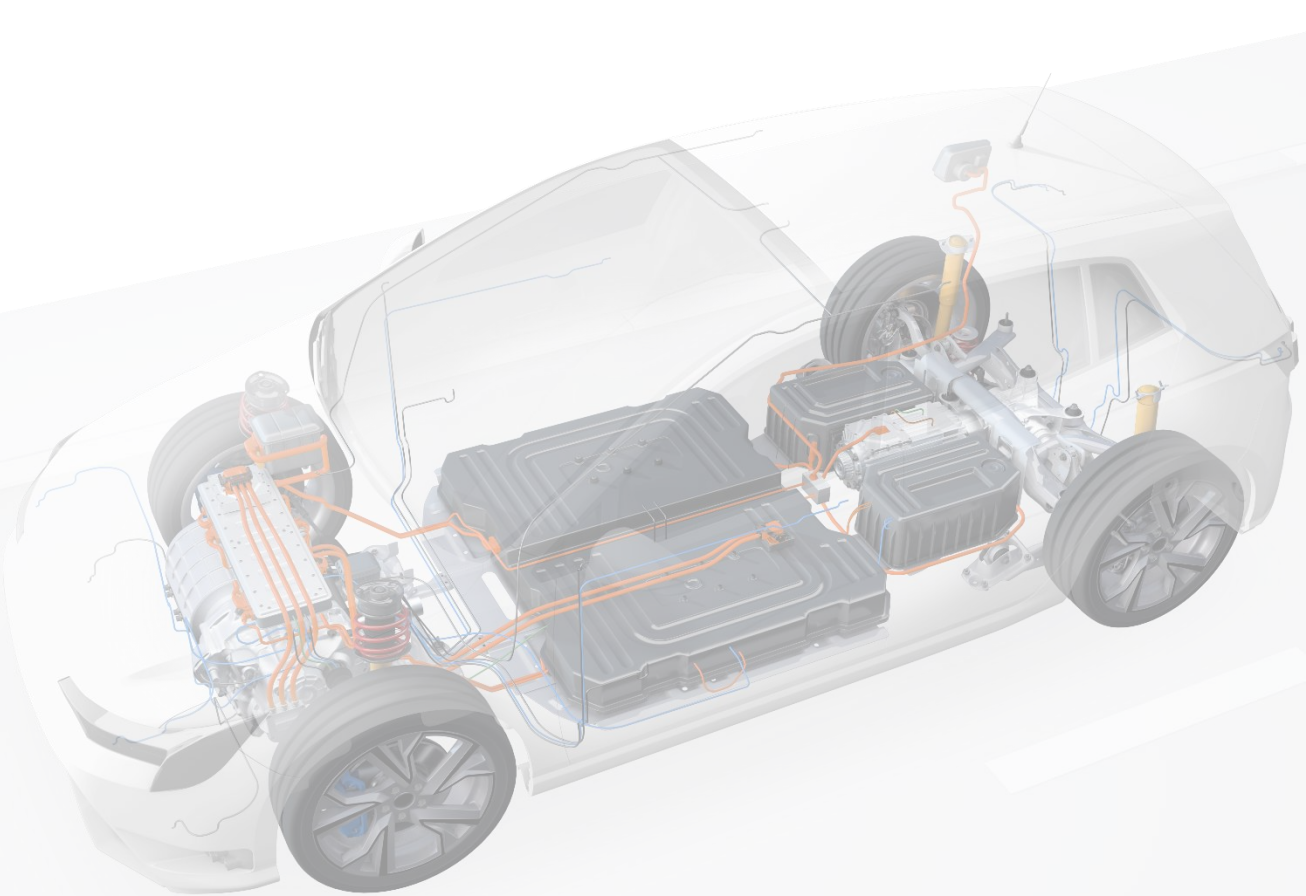


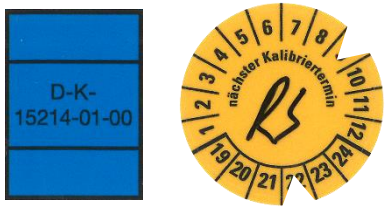
Calibration
Interval



- User determines calibration interval
  - Use case
  - Own quality requirements
  - Quality requirements by customer

- Manufacturer gives recommendation
  - CSM: Every **12 months**





CSM Maintenance Package

- Visual inspection
- Functional test
- Input calibration
- If necessary: Adjustment
- If necessary: Second calibration

Adjustment usually only by the manufacturer

Calibration

DAkkS

HV Insulation Test

Time

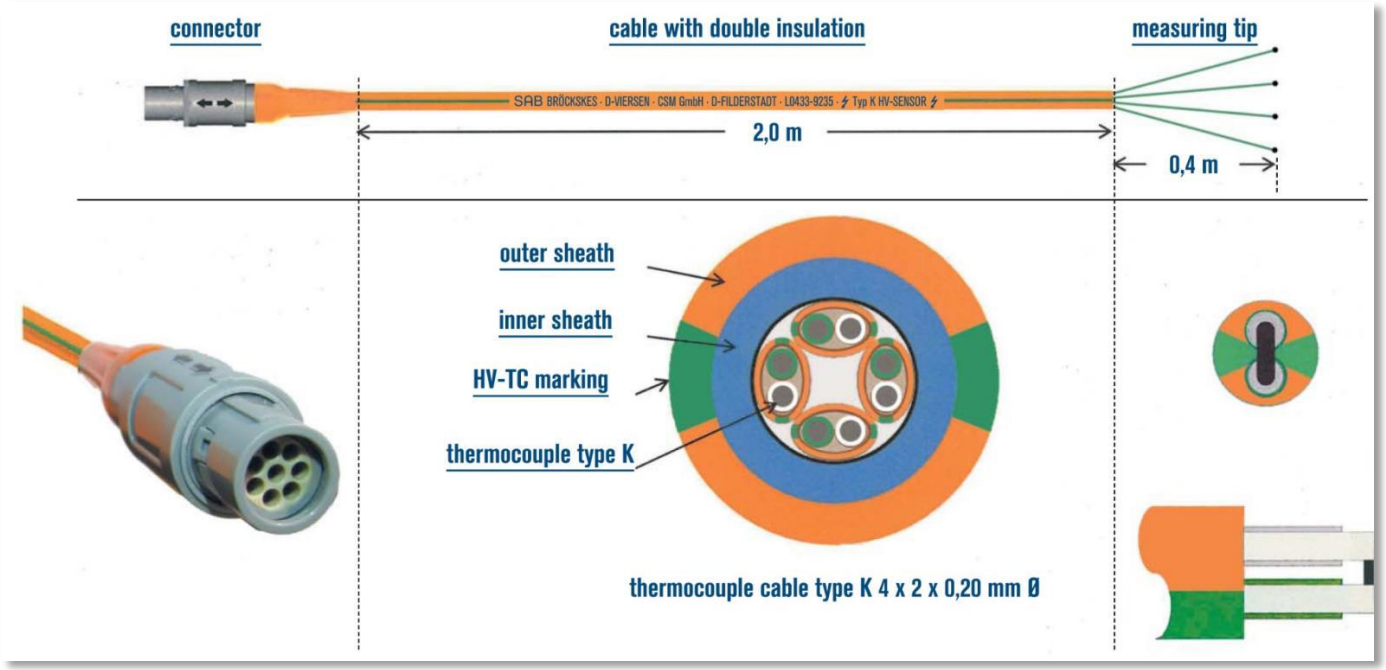
HV Insulation Test
Background

- Measurements in the HV environment (high voltages and currents) pose dangers for technology and users

HV Insulation Test
Background

- Measurements in the HV environment (high voltages and currents) pose dangers for technology and users

- **CSM safety concept**
  - **HV-safe cables**



HV Insulation Test
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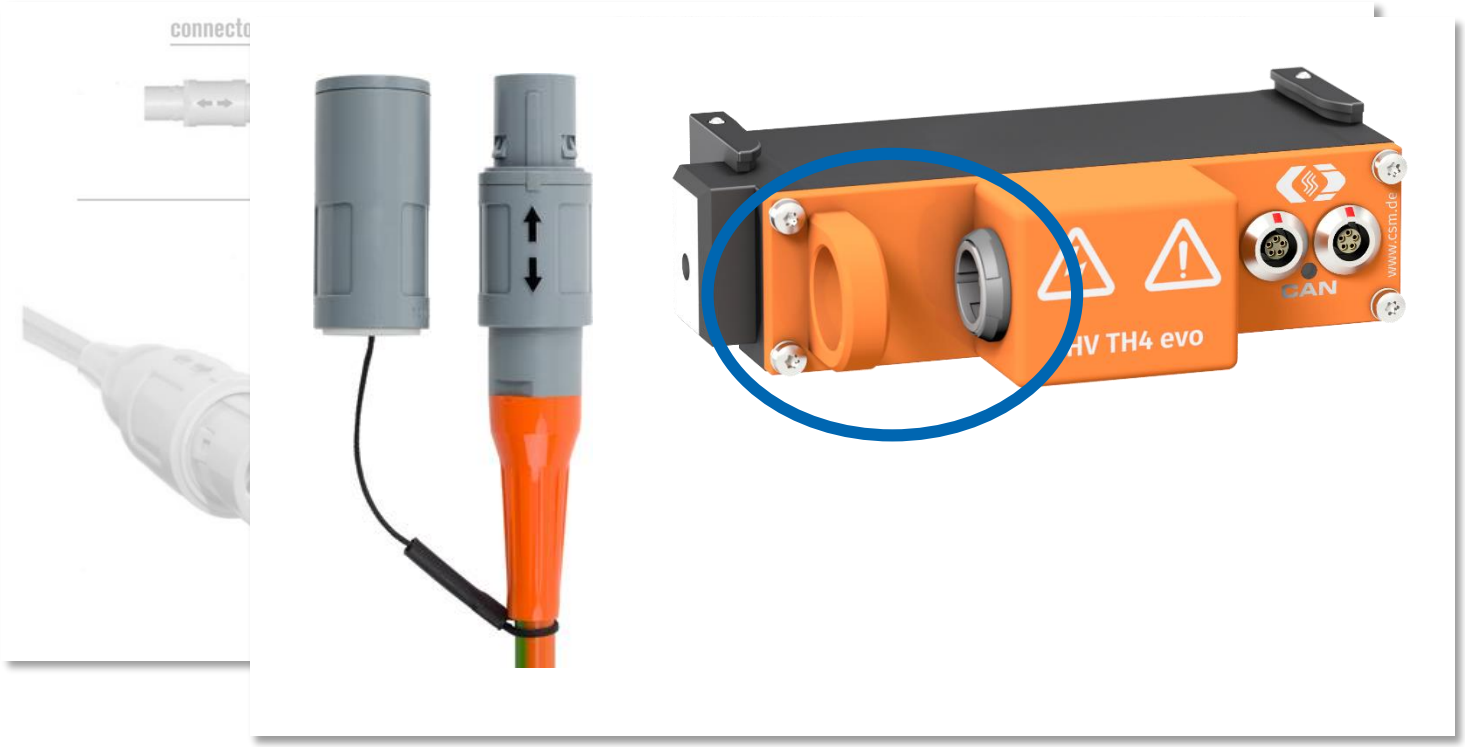
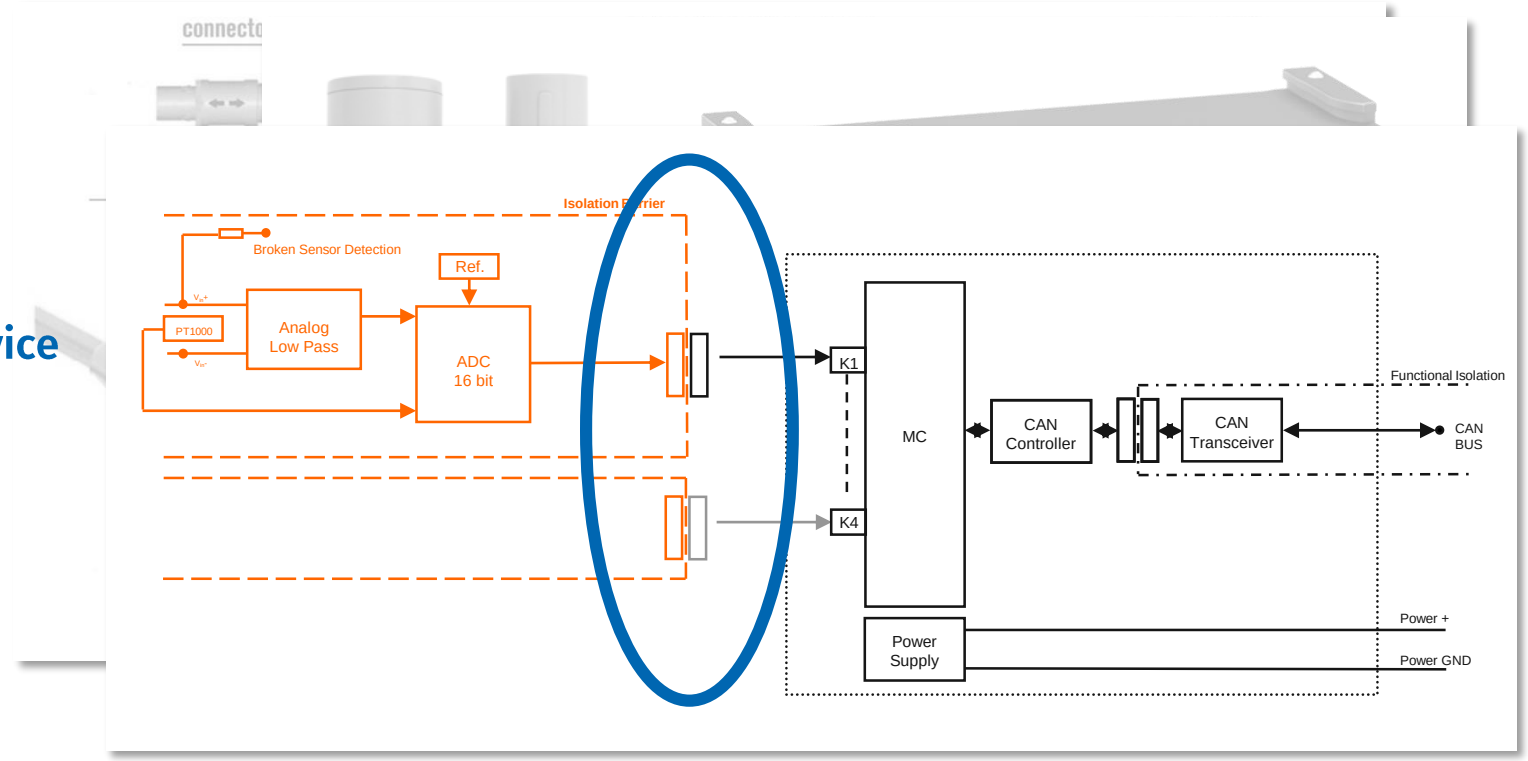
- **CSM safety concept**
  - HV-safe cables
  - **Protected connectors**



HV Insulation Test
Background

- Measurements in the HV environment (high voltages and currents) pose dangers for technology and users

- **CSM safety concept**
  - HV-safe cables
  - Protected connectors
  - **Isolation barrier in the measuring device**



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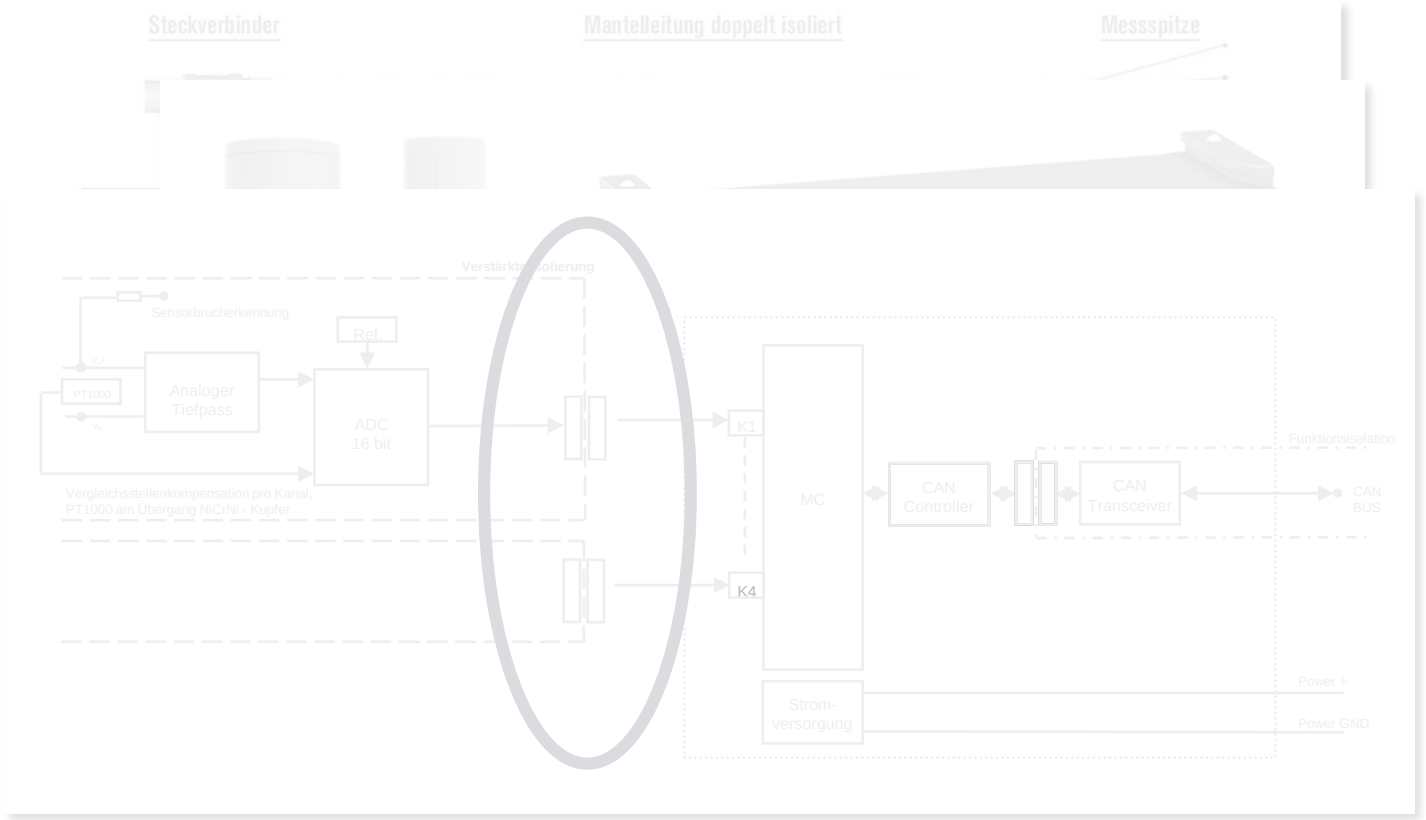


- Due to aging processes, **regular testing** of the HV insulation is necessary

HV Insulation Test
Procedure

- Norm EN 61010-1:2020

- Test of flashover strength between potentials on HV measuring device
  - All measuring channels against each other
  - All measuring channels against housing (SELV)

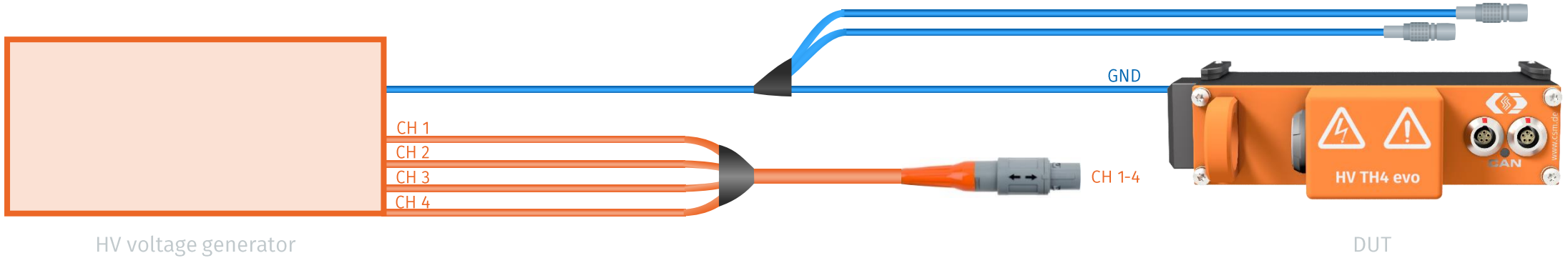
DUT

HV Insulation Test
Procedure

- Norm EN 61010-1:2020
- Test of flashover strength between potentials on HV measuring device
  - All measuring channels against each other
  - All measuring channels against housing (SELV)

Test specification:

- 3,100 V DC Test voltage
- 5 s Rise time
- 5 s holding time



HV Insulation Test
Test Report

- Norm EN 61010-1:2020
- Test of flashover strength between potentials on HV m
  - All measuring channels against each other
  - All measuring channels against housing (SELV)

Test specification:

- 3,100 V DC Test voltage
- 5 s Rise time
- 5 s holding time

Prüfbericht HV-Isolationstest
Test report High Voltage Isolation Test

Berichtsnummer *Report number* 5807 2022-09

Prüfgegenstand / *Device under test*

Typ *Type*	**HV THMM 4**
Seriennummer *Serial number*	**2871-HVTH4**
Hersteller *Manufacturer*	**CSM Computer-Systeme-Messtechnik GmbH**
Datum des Tests *Date of test*	**2022-09-07**
Anzahl Seiten *Number of pages*	**1**

Dieser Prüfbericht ist ohne Unterschrift nicht gültig. Es gilt immer die deutsche Textfassung.
This test report is not valid without signature. In case of doubt, the German text always applies.

Prüfverfahren / *Test procedure*

Die Prüfung wurde in Anlehnung an EN61010-1:2020-03, Anhang F durchgeführt.
The test has been carried out in accordance with EN61010-1:2020-03, Annex F.

Prüfspannung *Testing voltage*	A--B: 3100 V DC	Anstiegszeit *Rise time*	5 s	Haltezeit *Hold time*	5 s

Prüfergebnisse / *Test results*

Die oben angegebene Prüfspannung wurde jeweils zwischen den in folgender Tabelle mit A und B gekennzeichneten Bereichen des Prüflings angelegt. Die orangefarbige Hinterlegung markiert den Bereich bzw. Anschluss, an den das hohe elektrische Potential angelegt wurde. Der Bericht stellt den Zustand des Gegenstands zum Zeitpunkt des Tests dar.
The test voltage specified above was applied between the areas of the device under test indicated by A and B in the following table. The orange filling marks the area or connection to which the high electrical potential was applied. The report represents the state of the object at the time of test.

Test Nr. *Test No.*	Ergebnis *Result*	SELV	CH 1	CH 2	CH 3	CH 4
1	✓	A	B	B	B	B
2	✓	A	B	A	A	A
3	✓	A	A	B	A	A
4	✓	A	A	A	B	A
5	✓	A	A	A	A	B

Datum und Freigabe des Testzertifikats
Date and approval of the test certificate

Bearbeiter
Person in charge

HV Insulation Test
Test Report

- Norm EN 61010-1:2020
- Test of flashover strength between potentials on HV m
  - All measuring channels against each other
  - All measuring channels against housing (SELV)

Test specification:

- 3,100 V DC Test voltage
- 5 s Rise time
- 5 s holding time

HV-Spannungsgenerator

Prüfbericht HV-Isolationstest
Test report High Voltage Isolation Test

Berichtsnummer *Report number* 5807 2022-09

Prüfgegenstand / *Device under test*

Typ *Type*	**HV THMM 4**
Seriennummer *Serial number*	**2871-HVTH4**
Hersteller *Manufacturer*	**CSM Computer-Systeme-Messtechnik GmbH**
Datum des Tests *Date of test*	**2022-09-07**
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3	✔	A	A	B	A	A
4	✔	A	A	A	B	A
5	✔	A	A	A	A	B

Datum und Freigabe des Testzertifikats
Date and approval of the test certificate

Bearbeiter
Person in charge

HV Insulation Test
Interval

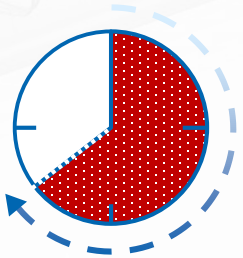
- Depending on the load of the device
- Manufacturer gives recommendation
  - CSM: Every **12 months**

Insulation test in combination with calibration in CSM maintenance package

Calibration ✓

DAkkS ✓

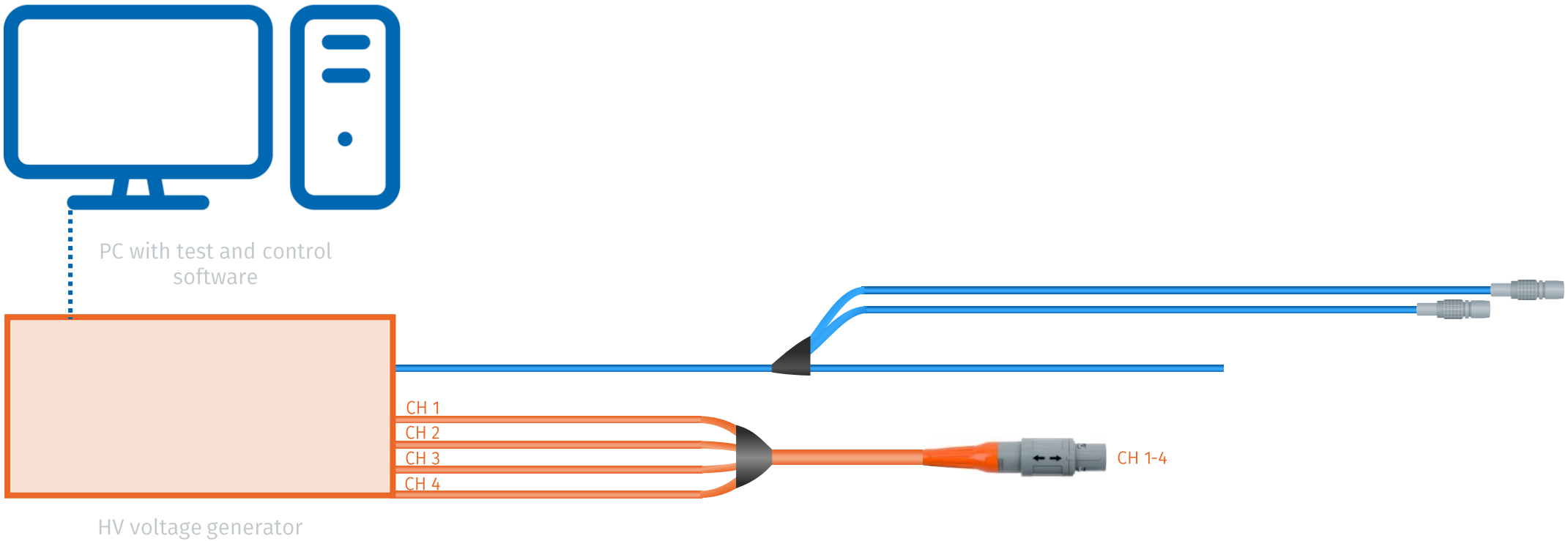
HV Insulation Test ✓



Time ?

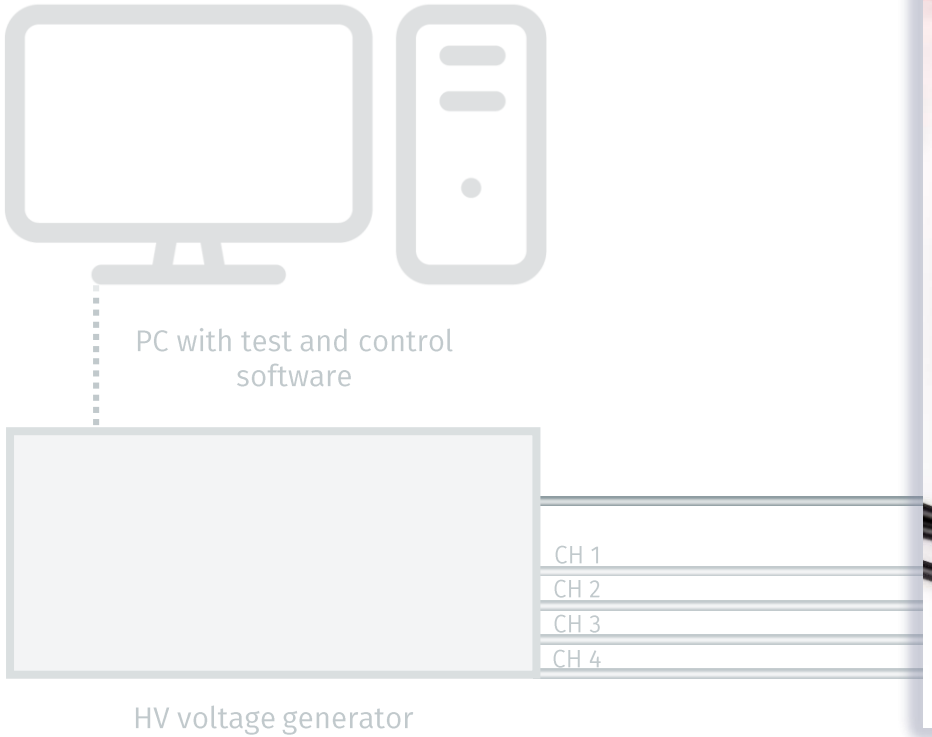
HV Insulation Test
Execution

- Manufacturer of the HV measuring device
- User with **HV Isolation Testing Station**



HV Insulation Test
Execution

- Manufacturer of the HV measuring devic
- User with **HV Isolation Testing Station**



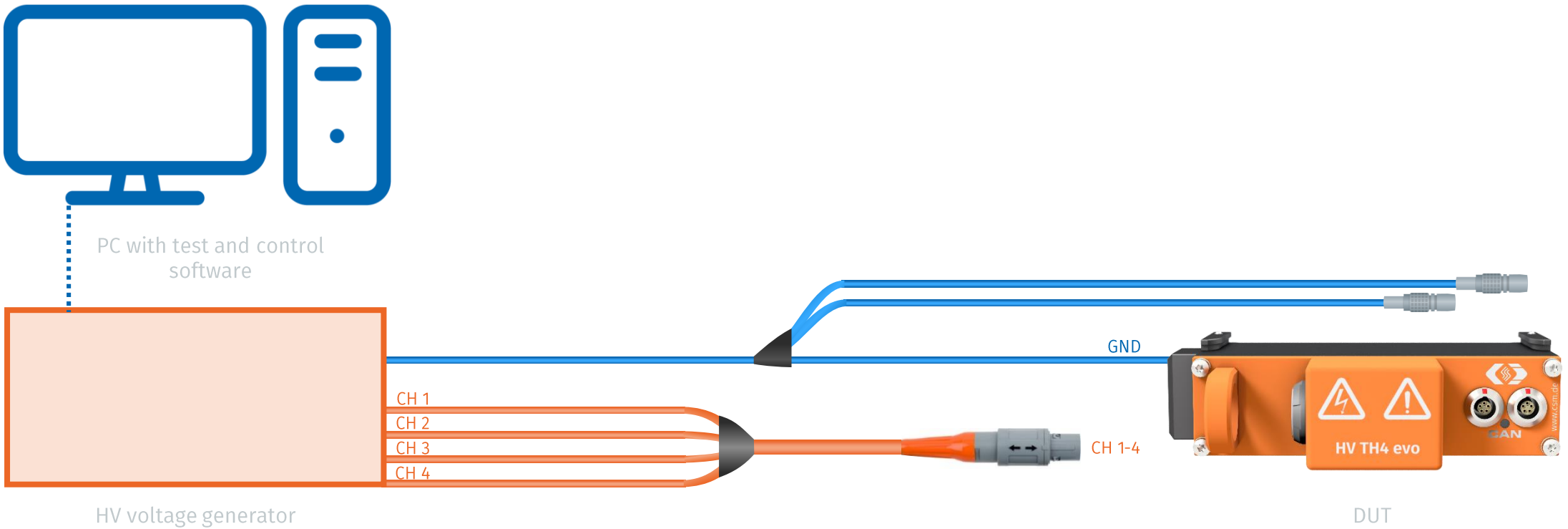
HV Isolation Testing Station
at www.csm.de

HV ISO Self-Test Adapter

- Self-testing of the entire test setup (cables and connectors)

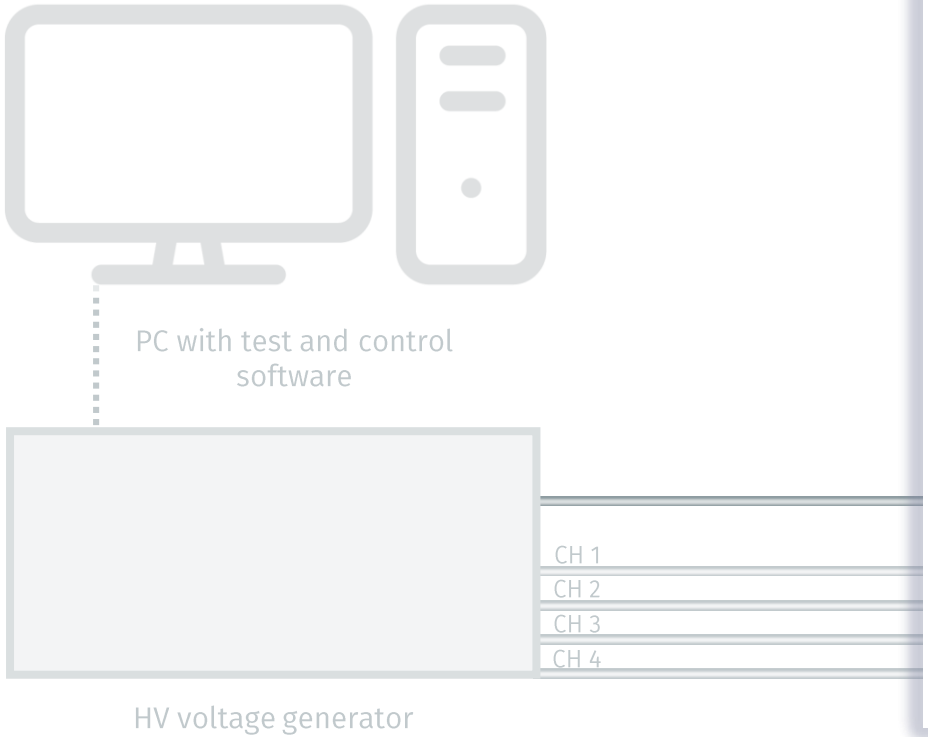
HV Insulation Test
Execution

- Manufacturer of the HV measuring device
- User with **HV Isolation Testing Station**



HV Insulation Test
Execution

- Manufacturer of the HV measuring devic
- User with **HV Isolation Testing Station**



Benefits with own testing

- Devices remain on site
- Shorter test intervals
- Testing of HV-safe cables
- Cost advantage with high number of measurement modules

Similar option for calibration by the user

Calibration

DAkkS

HV Insulation Test

Checklist maintenance HV measurement technology

- Keeping an eye on inspection intervals
  - Label on housing
  - Readout function in CSMconfig
- Timely notification of upcoming test to manufacturer or service provider
- Allow time for shipping
- Spare modules
- Backup of measurement configuration before shipment
- Benefit from price advantages when booking a package (calibration + HV iso test)
- In case of large number of measurement modules: own HV Isolation Testing Station

About CSM

CSM has been setting technological standards for decentralized measurement technology in vehicle development for over 35 years. Our CAN bus and EtherCAT® measurement devices support worldwide renowned vehicle manufacturers, suppliers and service providers in their developments.

Continuous innovation and long-term satisfied customers are our guarantee for success. Together with our partner Vector Informatik, we have developed an easily scalable and powerful E-Mobility Measurement System for hybrid and electric vehicles and are constantly expanding the areas of application. With our high-voltage safe measurement systems designed for fast and synchronous measurements and power analyses, we actively accompany the change to **E-Mobility.**

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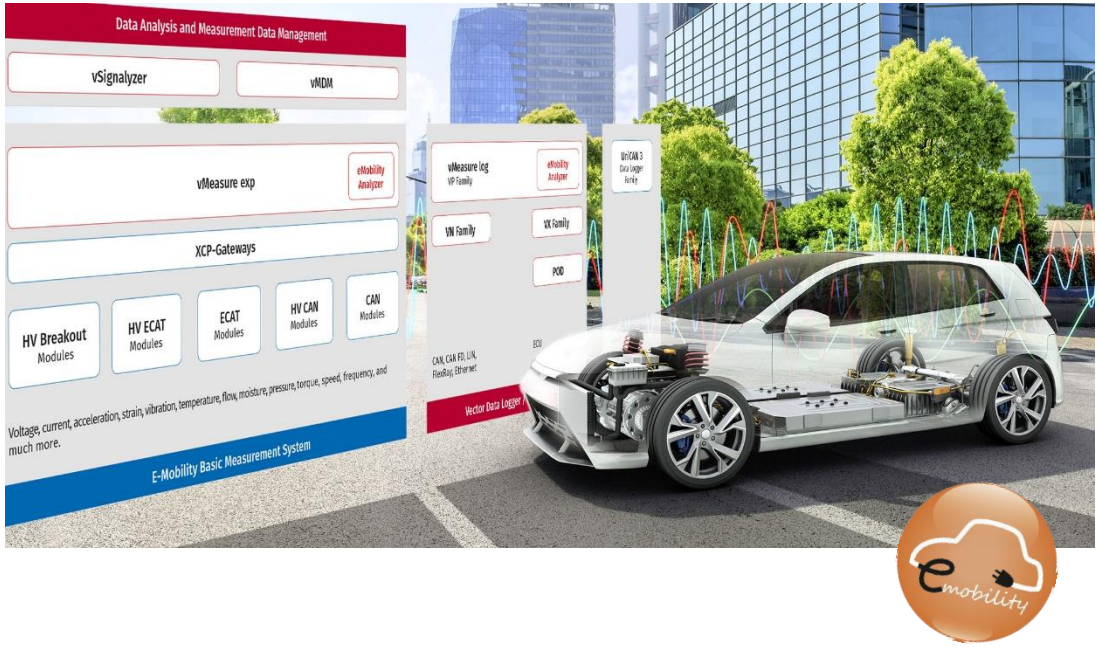

For more information and the current dates of CSM Xplained, please visit

www.csm.de/webseminars

CSM Xplained
measurement technology