SCAPE
POWERING E-MOBILITY

D2.3 – Test cases

SWITCHING-CELL-ARRAY-BASED POWER ELECTRONICS CONVERSION FOR FUTURE ELECTRIC VEHICLES

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Project: SCAPE | www.scapepower.eu
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Dissemination level: Public
Work package: WP2
Description: Report defining the test cases what will serve as an acceptance criterion of system requirements with supporting documents (L3 DCDC Test Case Document, L3 IIOBC Test Case Document)

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Executive summary

This deliverable introduces the test case documents for verification of DC-DC and IIOBC functionality of SCAPE. It summarizes the information contained in the test case documents and how to interpret them according to requirement engineering process tailored for SCAPE. Test cases are used to validate the functional requirements by using their acceptance criteria as a precursor. Detailed test cases with their evaluation criteria, test flow and test conditions will be executed later by the responsible partners. Furthermore, L4 and L5 test cases will be created after defining L4 and L5 requirements. Necessary traceability will be done between L4 and L5 requirements and test cases according to that. Any discrepancies between requirements and test cases in the further stages of the development can always be rectified with dap analysis and change management process, as defined in the collaboration methodology.

Following documents are supplements to this document and makes the information conveyed complete.

- D2.1. Collaboration Method Report
- D2.2 Use cases and requirements

Test cases of SCAPE can be found in the appendix of this document.

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List of abbreviations

RQ	: Requirement
WP	: Work Packages
L3	: Level 3
L4	: Level 4
L5	: Level 5
SC	: Switching Cell
IIOBC	: Integrated Inverter On-Board Charger
DC	: Direct Current

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CONTENTS

1. L3 Test Cases for SCAPE

Test cases are created for each requirement since they must be verified through tests and reviews. Each requirement should have a corresponding test case that clearly defines pass/fail criteria. Test cases are required to confirm each level's functional requirements. System reviews at each level must certify the non-functional requirements. Each technical partner that develops the requirements will oversee the test case definition of their pertinent needs throughout the elicitation and specification of the requirements.

In SCAPE, there are two certain formats as test suite and test case. The test suite format is the first format, and other sheets of the test document specify each test case in the test suite. Second format named "Test Case" contains the specific status of each test. In other words, a test suite represents test cases, and it can been on the main page of the test case documents.

L3 test cases of SCAPE are documented as following:

- D2.3_SCAPE_L3_Testcase_IIOBC_V2.0
- D2.3_SCAPE_L3_Testcase_DCDC_V2.0

L3 DC-DC test cases are described as the test cases for SCAPE DCDC functionality, and L3 IIOBC test cases are described as the test cases for SCAPE IIOBC functionality.

These documents can be found in the appendix of this document and in project repository along with supplemental documents.

Table 1 shows the main attributes and definitions of the test suite.

Table 1: Main attributes and definitions of the test suite

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ATTRIBUTE	DEFINITION
Test Case ID	Unique ID of the test case. Should be selected from ID_list of the RQ document during RQ development. Used to link the test cases with requirements in field "Validated By"
Test Case #	Indicates the number of the test case (TC_1, TC_2....)
Test Title	Title of the test case
Test Summary	Provides a summary of the test case
Requirement	Requirement ID that the test case validates
Notes	Any notes or comments on the test case

Test Cases are written for validating the functional requirements. Attributes given in Table 2 define the test case.

Table 2: Main attributes and definitions of a specific test case sheet

ATTRIBUTE	DEFINITION
Summary	Summary of the test step
Test Flow	Specific directions to carry out the test
Evaluation Criteria	Evaluation criteria of the outcomes of each step
Test Comments	Comments about test method

A test case is written in the context of the requirement and available test environment. Directions is precise, the state of the system is tried to be clear and evaluation criteria is tried to be easily understandable and objective. Each functional requirement is associated to a test case and every requirement is validated for the project to be delivered successfully.

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2. Appendix

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SCAPE POWERING E-MOBILITY			Test Document History			Title:	Test Specifications for IIOBC	Legend:	
								Content Update	
								Interim Release	
								Document Frozen	
Test Suite			Test Cases						
Date	V1.1	Partner	Date	Version	Partner				
16/10/2022	V1.0	Initial Release (AVL)	16/10/2022	V1.0	Initial Release (AVL)				
29/5/2023	V1.1	Test suite was updated.	29/5/2023	V1.1	All test cases were written for the testable requirements in L3 IIOBC document except the requirements in work (ID:357 358,359,360). They will be written after they are ready,too. (AVL)				
6/1/2023	V1.2	Test suite is ready for the release.	6/1/2023	V1.2	All test cases were written for the testable requirements in L3 IIOBC document. Document is ready for the release.				
6/2/2023	V1.3	Test suite was released to the partners for the first review (AVL)	6/2/2023	V1.3	Test Cases were released to the partners for the first review (AVL)				

	Project Name:	SCAPE	Test Designed by:	Hakan Yeniay, Berk Ascioglu
	Module Name:	IIOBC Test Suite	Test Designed date:	tbd
	Release Version:	v1.3	Test Executed by:	tbd
	Test Version	v1.0	Test Execution date:	tbd
Remark	This test suite is an example for SCAPE Multi-level SC array IIOBC functionality			
Test Environment	HV-Lab			

Test Case ID	Test Case #	Test Title	Test Summary	Test Data	Status	Requirement1	Requirement2	Requirement3	Requirement4	Requirement5	Requirement6	Notes
5001	TC_01	Continuous Power Test for Passenger Car App.	To verify if the inverter is capable of providing of full rated power.		Not Executed	308	321					
5002	TC_02	Continuous Power Test for e-Bike App.	To verify if the inverter is capable of providing of full rated power.		Not Executed	320						
5003	TC_03	Continuous Power Test for Truck App.	To verify if the inverter is capable of providing of full rated power.		Not Executed	97	322					
5004	TC_04	Inverter Efficiency Test	To verify if the inverter is met the efficiency requirements.		Not Executed	87						17/06/23 SeBU: The calculation of the efficiency is not correct. The formula stated in the test corresponds to the efficieny of inverter+motor. It should be the efficiency of only the inverter. Please see the proposed formula in the figure to the right.
5005	TC_05	Performance Test	To verify if the inverter is met the performance criterias for ambient temperature range.		Not Executed	214						
5006	TC_06	Inverter Leg Fault Tolerance Test	To verify inverter fault tolerance for the failure of the inverter legs.		Not Executed	338						
5007	TC_07	Zero Torque Ensurance for Charging Mode	To verify EM does not create torque during charging		Not Executed	341						
5008	TC_08	Charging Test 1	To verify charging at AC input voltage of 230 Vrms 50/60 Hz for single phase		Not Executed	219	222	220	221			
5009	TC_09	Charging Test 2	To verify charging at AC input voltage of 230 Vrms 50/60 Hz for three phase		Not Executed	91	222					
5010	TC_10	Charging Test 3	To verify unity displacement factor for charging mode operation		Not Executed	223						
5011	TC_11	Battery Voltage Scalability Test	To verify the battery voltage scalability		Not Executed							20/06/23 SeBu: This test is not clear. It is not clear what the intention of the test is. On the other hand, is you keep removing battery modules, you should reduce the requested speed (you cannot keep nominal speed). 23/06/23 BeAs: Cancelled, link removed.
5012	TC_12	Temperature Interface Test	To verify the temperature sensor interface.		Not Executed	355						20/06/23 SeBu: What is the inverter temperature sensor? Is it a sensor in the heat sink?
5013	TC_13	Rotor Position Interface Test	To verify the rotor position sensor interface.		Not Executed	229	356					
5014	TC_14	DC Overvoltage Detection Test	To monitor DC Overvoltage		Not Executed	265						
5015	TC_15	Phase overcurrent detection test	To monitor Phase Current		Not Executed	324						20/06/23 SeBu: Shouldn't it be "Phase overcurrent detection test"? 23/06/23 BeAs: Yes, changed it.
5016	TC_16	Overtemperature detection for switching cells	To monitor Switching cell temperature		Not Executed	272						
5017	TC_17	SoH test	To verify SoH function for switching cell, EM and HV Battery		Not Executed	276	277	278				
5018	TC_18	Configurable EM Winding Test	To verify if the inverter capable to control different EM winding configuration		Not Executed	336	225	218	350	351	352	
5019	TC_19	Phase to Ground EM Fault Tolerance test	To verify if the inverter capable to control in case EM phase to ground fault		Not Executed	358	357					
5020	TC_20	Phase to Phase EM Fault Tolerance test	To verify if the inverter capable to control in case EM phase to phase fault		Not Executed	359	357					
5021	TC_21	Inter-turn EM Fault Tolerance test	To verify if the inverter capable to control in case EM inter-turn fault		Not Executed	360	357					
5022	TC_22	Switching-cell failure tolerance Test	To verify if the inverter fault tolerance for the failure of multiple switching-cells.		Not Executed	362						

In a general n-level p-phase inverter operating in traction mode, the efficiency should be calculated according to:

$$\eta = \frac{\langle \sum_j v_{jX} \cdot i_j \rangle}{\langle \sum_k v_{Bk} \cdot i_{Bk} \rangle}$$

where v_{jX} is the phase j voltage with reference to node X, i_j is the phase j current, v_{Bk} is the battery k voltage, i_{Bk} is the battery k current, and < > indicates average value over a full fundamental cycle. Node X can be any desired reference point.

In regenerative mode, the efficiency should be calculated with the inverse of the previous expression:

$$\eta = \frac{\langle \sum_k v_{Bk} \cdot i_{Bk} \rangle}{\langle \sum_j v_{jX} \cdot i_j \rangle}$$

For example, in a three-level six-phase inverter operating in traction mode, the efficiency could be calculated as:

$$\eta = \frac{\langle v_{aO} \cdot i_a + v_{bO} \cdot i_b + v_{cO} \cdot i_c + v_{dO} \cdot i_d + v_{eO} \cdot i_e + v_{fO} \cdot i_f \rangle}{\langle v_{B1} \cdot i_{B1} + v_{B2} \cdot i_{B2} \rangle}$$

where O is the midpoint of the dc bus or battery bank.

Test Case ID	TC_01		**Test Case Objective**	Continuous Power Test for Passenger Car App.		
Created By	Berk Ascioglu, Hakan Yeniay		**Reviewed By**		**Version**	1,0

History	1.0 - First version of the test case

Tester's Name			**Date Tested**		**Overall Test Case Re**	**Not Executed**

Sl.No	Measurement Files
1	https://irecedu.sharepoint.com/:x:/r/sites/SCAPE/DUMMY_FILES
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify torque control operation.	#cond1 -Set inverter to torque control mode through communication bus.	#crit1 - Inverter operation mode = Torque Control			**Not Executed**
2	Test condition to verify positive torque range with 0 speed (motoric operation).	#cond2 - Set the torque request from 0 to the maximum (tbd) torque with gradiant 20 Nm/s.	#crit2 - Machine torque is changing from 0 to max.			**Not Executed**
3	Test condition to verify positive torque range for whole positive speed range (motoric operation).	# cond3 - Set the torque request to maximum specified torque. - Set the EM speed from 0 to maximum (rpm) (tbd) with gradiant of 50 rpm/s.	#crit3 - EM torque behaves according to torque speed curve.			**Not Executed**

4	Test condition to verify negative torque range with 0 speed (motoric operation).	#cond4 - Set the torque request from 0 to the negative value of maximum (tbd) torque with gradiant -20 Nm/s.	#crit4 - Machine torque is changing from 0 to -max.			**Not Executed**
5	Test condition to verify negative torque range for whole negative speed range (reverse motoric operation).	#cond5 - Set the torque request to negative value of the maximum specified torque. - Set the EM speed from 0 to the negative value of maximum (rpm) (tbd) with gradiant of -50 rpm/s.	#crit5 - EM torque behaves according to torque speed curve.			**Not Executed**
6	Test condition to verify positive torque range for whole negative speed range (reverse regenarative operation).	#cond6 - Set the torque request to maximum specified torque. - Set the EM speed from 0 to minimum (rpm) (tbd) with gradiant of -50 rpm/s.	#crit6 - EM torque behaves according to torque speed curve.			**Not Executed**
7	Test condition to verify negative torque range for whole positive speed range (regenarative operation).	#cond7 - Set the torque request to the negative value of the maximum specified torque. - Set the EM speed from 0 to maximum (rpm) (tbd) with gradiant of 50 rpm/s.	#crit7 - EM torque behaves according to torque speed curve.			**Not Executed**

Observations :

Test Case ID	TC_02		Test Case Objective	Continuous Power Test for e-Bike App.		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify torque control operation.	#cond1 -Set inverter to torque control mode through communication bus.	#crit1 - Inverter operation mode = Torque Control			Not Executed
2	Test condition to verify positive torque range with 0 speed (motoric operation).	#cond2 - Set the torque request from 0 to the maximum (tbd) torque with gradiant 20 Nm/s.	#crit2 - Machine torque is changing from 0 to max.			Not Executed
3	Test condition to verify positive torque range for whole positive speed range (motoric operation).	# cond3 - Set the torque request to maximum specified torque. - Set the EM speed from 0 to maximum (rpm) (tbd) with gradiant of 50 rpm/s.	#crit3 - EM torque behaves according to torque speed curve.			Not Executed

4	Test condition to verify negative torque range with 0 speed (motoric operation).	#cond4 - Set the torque request from 0 to the negative value of maximum (tbd) torque with gradiant -20 Nm/s.	#crit4 - Machine torque is changing from 0 to -max.			**Not Executed**
5	Test condition to verify negative torque range for whole negative speed range (reverse motoric operation).	#cond5 - Set the torque request to negative value of the maximum specified torque. - Set the EM speed from 0 to the negative value of maximum (rpm) (tbd) with gradiant of -50 rpm/s.	#crit5 - EM torque behaves according to torque speed curve.			**Not Executed**
6	Test condition to verify positive torque range for whole negative speed range (reverse regenarative operation).	#cond6 - Set the torque request to maximum specified torque. - Set the EM speed from 0 to minimum (rpm) (tbd) with gradiant of -50 rpm/s.	#crit6 - EM torque behaves according to torque speed curve.			**Not Executed**
7	Test condition to verify negative torque range for whole positive speed range (regenarative operation).	#cond7 - Set the torque request to the negative value of the maximum specified torque. - Set the EM speed from 0 to maximum (rpm) (tbd) with gradiant of 50 rpm/s.	#crit7 - EM torque behaves according to torque speed curve.			**Not Executed**

Observations :

Test Case ID	TC_03		Test Case Objective	Continuous Power Test for Truck App.		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify torque control operation.	#cond1 -Set inverter to torque control mode through communication bus.	#crit1 - Inverter operation mode = Torque Control			**Not Executed**
2	Test condition to verify positive torque range with 0 speed (motoric operation).	#cond2 - Set the torque request from 0 to the maximum (tbd) torque with gradiant 20 Nm/s.	#crit2 - Machine torque is changing from 0 to max.			**Not Executed**
3	Test condition to verify positive torque range for whole positive speed range (motoric operation).	# cond3 - Set the torque request to maximum specified torque. - Set the EM speed from 0 to maximum (rpm) (tbd) with gradiant of 50 rpm/s.	#crit3 - EM torque behaves according to torque speed curve.			**Not Executed**

4	Test condition to verify negative torque range with 0 speed (motoric operation).	#cond4 - Set the torque request from 0 to the negative value of maximum (tbd) torque with gradiant -20 Nm/s.	#crit4 - Machine torque is changing from 0 to -max.			**Not Executed**
5	Test condition to verify negative torque range for whole negative speed range (reverse motoric operation).	#cond5 - Set the torque request to negative value of the maximum specified torque. - Set the EM speed from 0 to the negative value of maximum (rpm) (tbd) with gradiant of -50 rpm/s.	#crit5 - EM torque behaves according to torque speed curve.			**Not Executed**
6	Test condition to verify positive torque range for whole negative speed range (reverse regenarative operation).	#cond6 - Set the torque request to maximum specified torque. - Set the EM speed from 0 to minimum (rpm) (tbd) with gradiant of -50 rpm/s.	#crit6 - EM torque behaves according to torque speed curve.			**Not Executed**
7	Test condition to verify negative torque range for whole positive speed range (regenarative operation).	#cond7 - Set the torque request to the negative value of the maximum specified torque. - Set the EM speed from 0 to maximum (rpm) (tbd) with gradiant of 50 rpm/s.	#crit7 - EM torque behaves according to torque speed curve.			**Not Executed**

Observations :	

Test Case ID	TC_04		Test Case Objective	Inverter Efficiency Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Efficiency for nominal operating point.	#cond1 - Set the EM torque and speed to the nominal values.	#crit1 - DC link to AC bus efficiency is at least &&&%. $\eta = (\Sigma P_{AC} / \Sigma P_{DC})x100$ Where ΣP_{AC} is the average power delivered to load from all inverter phase outputs, ΣP_{DC} is the averaged input power from HV battery and η is the percent efficiency.			**Not Executed**
2	Efficiency for typical operating point.	#cond2 - Set the EM torque and speed to the typical values. - Set the current to 20% of its nominal value. *Typical Values: At nominal speed with 0.2 p.u. output current. Rest are TBD.*	#crit2 - DC link to AC bus efficiency is at least 97.5%. $\eta = (\Sigma P_{AC} / \Sigma P_{DC})x100$ Where ΣPAC is the average power delivered to load from all inverter phase outputs, ΣPDC is the averaged input power from HV battery and η is the percent efficiency.			**Not Executed**
3						**Not Executed**

4						**Not Executed**
5						**Not Executed**

Observations :	

Test Case ID	TC_05		Test Case Objective	Performance Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Inverter performance for room temperature condition.	#cond1 - Set the EM torque and speed to the nominal values. - Set the ambient temperature to 20 °C.	#crit1 - The inverter provides the requested torque without derating. - All derating flags are 0.			Not Executed
2	Inverter performance for minimum ambient temperature condition.	#cond2 - Set the EM torque and speed to the nominal values. - Set the ambient temperature to -40 °C.	#crit2 - The inverter provides the requested torque without derating. - All derating flags are 0.			Not Executed
3	Inverter performance for maximum ambient temperature condition.	#cond3 - Set the EM torque and speed to the nominal values. - Set the ambient temperature to 35 °C.	#crit3 - The inverter provides the requested torque without derating. - All derating flags are 0.			Not Executed

4						**Not Executed**
5						**Not Executed**

Observations :	

Test Case ID	TC_06		Test Case Objective	Inverter Leg Fault Tolerance Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify inverter fault tolerance for the failure of the inverter legs.	#cond1 - Force at least one of the converter leg in order to make it or them to have an error situation (manipulation by SW or HW solution on the test bench etc.) - Set the EM torque and speed to the nominal values.	#crit1 - Inverter is operated in torque control mode even at least one of the converter leg is failed. - Power output of the inverter is reduced according to the number of failed legs.			Not Executed
2						Not Executed
3						Not Executed

4						**Not Executed**
5						**Not Executed**

Observations :	

Test Case ID	TC_07		Test Case Objective	Zero Torque Ensurance for Charging Mode		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify EM does not create torque during charging	#cond1 - Request charging operation via communication bus. - Set charging power to nominal charge power.	#crit1 - Charging mode is entered and charge power is equal to requested power. - EM torque is 0.			Not Executed
2						Not Executed
3						Not Executed

4						**Not Executed**
5						**Not Executed**

Observations :	

Test Case ID	TC_08		Test Case Objective	Charging Test 1		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition for charging via single phase AC grid	#cond1 -Set power condition to the nominal power. -Set AC grid supply to 230 Vrms at 50/60 Hz - Activate charging mode via communication bus	#crit1 - Charging output is equal to nominal value.			**Not Executed**
2						**Not Executed**
3						**Not Executed**

4						**Not Executed**
5						**Not Executed**

Observations :	

Test Case ID	TC_09		**Test Case Objective**	Charging Test 2		
Created By	Berk Ascioglu, Hakan Yeniay		**Reviewed By**		**Version**	1,0

History	1.0 - First version of the test case

Tester's Name			**Date Tested**		**Overall Test Case Re**	**Not Executed**

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition for charging via three phase AC grid	#cond1 -Set power condition to the nominal power. -Use three-phase AC grid -Set AC grid supply to 230 Vrms at 50/60 Hz - Activate charging mode via communication bus	#crit1 - Charging output is equal to nominal value.			**Not Executed**
2						**Not Executed**
3						**Not Executed**

4						**Not Executed**
5						**Not Executed**

Observations :	

Test Case ID	TC_10		Test Case Objective	Charging Test 3		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition for unity displacement factor for charging mode operation	#cond1 -Use three-phase AC grid -Set AC grid supply to 230 Vrms at 50 Hz - Activate charging mode via communication bus	#crit1 - Charging output power is equal to nominal value.			Not Executed
2	Test condition for unity displacement factor for charging mode operation	#cond2 -Calculate displacement factor.	#crit2 - Unity displacement factor is achieved.			Not Executed
3	Test condition for unity displacement factor for charging mode operation	#cond3 - Set allowed charging power to (0.25*Nominal charging rated power). Use three-phase AC grid -Set AC grid supply to 230 Vrms at 50 Hz - Activate charging mode via communication bus	#crit3 - Charging output power is equal to (0.25*nominal value).			Not Executed

4	Test condition for unity displacement factor for charging mode operation	#cond4 -Calculate displacement factor.	#crit4 - Unity displacement factor is achieved.			**Not Executed**
5	Test condition for unity displacement factor for charging mode operation	#cond5 - Set allowed charging power to (0.5*Nominal charging rated power). Use three-phase AC grid -Set AC grid supply to 230 Vrms at 50 Hz - Activate charging mode via communication bus	#crit5 - Charging output power is equal to (0.5*nominal value).			**Not Executed**
6	Test condition for unity displacement factor for charging mode operation	#cond6 -Calculate displacement factor.	#crit6 - Unity displacement factor is achieved.			
6	Test condition for unity displacement factor for charging mode operation	#cond7 -Repeat the flow for single phase.	#crit7 - Unity displacement factor is achieved.			**Not Executed**

Observations :

Test Case ID	TC_11		Test Case Objective	Battery Voltage Scalability Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Result	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition for the scalability of the battery voltage	#cond1 - Set available voltage value to a maximum value - Request the maximum torque at the rated voltage. - Set EM speed to the nominal value.	#crit1 - Actual torque = Requested torque ± relative tolerance (tbd).			Not Executed
2	Test condition for the scalability of the battery voltage	#cond2 - Switch off one of the battery connectors. - Set available voltage value to a maximum value - Request the maximum torque at the rated voltage. - Set EM speed to the nominal value.	#crit2 - Actual torque = Requested torque ± relative tolerance (tbd).			Not Executed
3	Test condition for the scalability of the battery voltage	#cond3 - Switch off one of the battery connectors. - Set available voltage value to a maximum value - Request the maximum torque at the rated voltage. - Set EM speed to the nominal value. - Repeat the previous conditions until the last battery component remained.	#crit3 - Actual torque = Requested torque ± relative tolerance (tbd).			Not Executed

4						**Not Executed**
5						**Not Executed**
6						**Not Executed**

Observations :	

Test Case ID	TC_12		**Test Case Objective**	Temperature Interface Test		
Created By	Berk Ascioglu, Hakan Yeniay		**Reviewed By**		**Version**	1,0

History	1.0 - First version of the test case

Tester's Name			**Date Tested**		**Overall Test Case Re**	**Not Executed**

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition for the temp. sensor interface	#cond1 - Set operation mode to Standby.	#crit1 - The inverter temp. is read.			**Not Executed**
2	Test condition for the temp. sensor interface	#cond2 - Set the inverter to torque control. - Drive it under different loads.	#crit2 - The inverter temp. changed according to the load profile.			**Not Executed**
3						**Not Executed**

4						**Not Executed**
5						**Not Executed**
6						**Not Executed**

Observations :	

Test Case ID	TC_13		**Test Case Objective**	Rotor Position Interface Test		
Created By	Berk Ascioglu, Hakan Yeniay		**Reviewed By**		**Version**	1,0

History	1.0 - First version of the test case

Tester's Name			**Date Tested**		**Overall Test Case Re**	**Not Executed**

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition for the rotor position sensor interface	#cond1 - Set operation mode to Torque control. - Rotate the machine or stimulate resolver interface at 5 rpm (± absolute tolerance).	#crit1 - Mechanical speed signal = 5 rpm (± absolute tolerance). - Electrical angle signal shall be at the sawtooth waveform with rising slope and time period of (5/(60*pole pair (s))). (± absolute tolerance).			**Not Executed**
2	Test condition for the rotor position sensor interface	#cond2 - Set operation mode to Torque control. - Rotate the machine or stimulate resolver interface at maximum speed (± relative tolerance).	#crit2 - Mechanical speed signal = maximum speed (± relative tolerance). - Electrical angle signal shall be at the sawtooth waveform with rising slope and time period of (maximum speed/(60*pole pair (s))). (± relative tolerance).			**Not Executed**
3	Test condition for the rotor position sensor interface	#cond3 - Set operation mode to Torque control. - Rotate the machine or stimulate resolver interface at minimum speed (± relative tolerance).	#crit3 - Mechanical speed signal = minimum speed (± relative tolerance). - Electrical angle signal shall be at the sawtooth waveform with rising slope and time period of (minimum speed/(60*pole pair (s))). (± relative tolerance).			**Not Executed**

4	Test condition for the rotor position sensor interface	#cond4 - Repeat test flow 2 and 3 for the different speed (setpoint) values between maximum and minimum.	#crit4 - Mechanical speed signal = setpoint speed (± relative tolerance). - Electrical angle signal shall be at the sawtooth waveform with rising slope and time period of (setpoint speed/(60*pole pair (s))). (± relative tolerance).			**Not Executed**
5						**Not Executed**
6						**Not Executed**

Observations :

Test Case ID	TC_14		Test Case Objective	DC Overvoltage Detection Test	
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition for the detection of the DC overvoltage	#cond1 - Increase the DC voltage above the overvoltage threshold (tbd).	#crit1 - Error signal for DC link overvoltage is set. - Defined error reaction for overvoltage case is fulfilled (freewheel or ASC).			Not Executed
2						Not Executed
3						Not Executed
4						Not Executed
5						Not Executed
6						Not Executed

Observations :	

Test Case ID	TC_15		Test Case Objective	Phase overcurrent detection test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition for the detection of the phase current.	#cond1 - Set Inverter to the torque control. - Request maximum power. - Set a phase overcurrent threshold to a lower value compared to maximum available current.	#crit1 - Error signal for phase overcurrent is set. - Defined error reaction for overcurrent case is fulfilled (freewheel or ASC).			Not Executed
2						Not Executed
3						Not Executed
4						Not Executed
5						Not Executed
6						Not Executed

Observations :	

Test Case ID	TC_16		Test Case Objective	Overvtemperature detection for switching cells	
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition for the detection of the overtemperature of switching cells.	#cond1 - Set Inverter to the torque control. - Request maximum power. - Deactivate derating functions. - Wait until at least one switching cell temperature is higher than defined overtemperature threshold.	#crit1 - Error signal for switching cell temperature is set when overtemperature threshold is reached. - Defined error reaction for switching cell overtemperature case is fulfilled (freewheel or ASC).			Not Executed
2						Not Executed
3						Not Executed
4						Not Executed
5						Not Executed
6						Not Executed

Observations :	

Test Case ID	TC_17		Test Case Objective	SoH test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify the adaptability of inverter to minimize the stress and degredation and maximize the operating life.	#cond1 * Connect a voltage source to the inverter input and output. * Set the output voltage to VLV,nom. * Set the input voltage to VHV,nom * Set inverter operation mode to HV2LV. * Set the transferred power to 100% of the nominal value. * Manipulate the inverter related state-of-health variables.	"#crit1 - The manipulated SoH variables return to its normal value (±Tolerance) and the rest of SoH are not gratly affected.			Not Executed
2	Test condition to verify the adaptability of inverter to minimize the stress and degredation and maximize the operating life.	#cond2 * Connect a voltage source to the inverter input and output. * Set the output voltage to VLV,nom. * Set the input voltage to VHV,nom * Set inverter operation mode to LV2HV. * Set the transferred power to 100% of the nominal value. * Manipulate inverter related state-of-health variables.	"#crit2 - The manipulated SoH variables return to its normal value (±Tolerance) and the rest of SoH are not gratly affected.			Not Executed
3						Not Executed
4						Not Executed
5						Not Executed
6						Not Executed

Observations :	

Test Case ID	TC_18		Test Case Objective	Configurable EM Winding Test	
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version 1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test Condition to verify if the inverter capable to control different EM winding configuration	#cond1 - Configure the EM for single three phase operation - Set the torque request to maximum specified torque. - Set the EM speed from 0 to maximum (rpm) (tbd) with gradiant of 50 rpm/s.	#crit1 - EM torque behaves according to torque speed curve.	Single 3phase		Not Executed
2	Test Condition to verify if the inverter capable to control different EM winding configuration	#cond2 - Configure the EM for double three phase operation - Set the torque request to maximum specified torque. - Set the EM speed from 0 to maximum (rpm) (tbd) with gradiant of 50 rpm/s.	#crit2 - EM torque behaves according to torque speed curve.	Double 3phase		Not Executed
3	Test Condition to verify if the inverter capable to control different EM winding configuration	#cond2 - Configure the EM for six phase operation - Set the torque request to maximum specified torque. - Set the EM speed from 0 to maximum (rpm) (tbd) with gradiant of 50 rpm/s.	#crit3 - EM torque behaves according to torque speed curve.	Single 6phase		Not Executed
4						Not Executed
5						Not Executed
6						Not Executed

Observations :	

Test Case ID	TC_19		Test Case Objective	Phase to Ground EM Fault Tolerance test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify if the inverter capable to control in case EM phase to ground fault.	#cond1 - Set operation mode to torque control. - Drive with nominal torque and speed. - Trigger EM phase to ground fault.	#crit1 - Inverter torque output is equal to the requested torque until phase to ground fault is occured. - Inverter is able to stabilize EM and provide (reduced/at least 50%) torque in case of a phase to ground.			Not Executed
2						Not Executed
3						Not Executed
4						Not Executed
5						Not Executed
6						Not Executed

Observations :	

Test Case ID	TC_20		Test Case Objective	Phase to Phase EM Fault Tolerance test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify if the inverter capable to control in case EM phase to phase fault.	#cond1 - Set operation mode to torque control. - Drive with nominal torque and speed. - Trigger EM phase to phase fault.	#crit1 - Inverter torque output is equal to the requested torque until phase to phase fault is occured. - Inverter is able to stabilize EM and provide (reduced/at least 50%) torque in case of a phase to phase.			Not Executed
2						Not Executed
3						Not Executed
4						Not Executed
5						Not Executed
6						Not Executed

Observations :	

Test Case ID	TC_21		Test Case Objective	Inter-turn EM Fault Tolerance test	
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify if the inverter capable to control in case EM inter-turn fault.	#cond1 - Set operation mode to torque control. - Drive with nominal torque and speed. - Trigger EM inter-turn fault.	#crit1 - Inverter torque output is equal to the requested torque until inter-turn fault is occured. - Inverter is able to stabilize EM and provide (reduced/at least 50%) torque in case of an inter-turn.			Not Executed
2						Not Executed
3						Not Executed
4						Not Executed
5						Not Executed
6						Not Executed

Observations :	

Test Case ID	TC_22		Test Case Objective	Switching-cell failure tolerance Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	To verify if the inverter fault tolerance for the failure of multiple switching-cells.	#cond1 * Connect a voltage source to the inverter input and output. * Set the output voltage to VLV,nom. * Set the input voltage to VHV,nom. * Set inverter operation mode to HV2LV. * Set the transferred power to 100% of the nominal value. * Disable non-critical switching cells from the LV and HV side one after the another	#crit1 - The inverter is able to operate even after all non-critical switching cells are disabled.			Not Executed
2	To verify if the inverter fault tolerance for the failure of multiple switching-cells.	#cond2 * Connect a voltage source to the inverter input and output. * Set the output voltage to VLV,nom. * Set the input voltage to VHV,nom. * Set inverter operation mode toLV2HV. * Set the transferred power to 100% of the nominal value. * Disable non-critical switching cells from the LV and HV side one after the another	#crit2 - The inverter is able to operate even after all non-critical switching cells are disabled.			Not Executed
3						Not Executed
4						Not Executed
5						Not Executed
6						Not Executed

Observations :	

List of Open Points

Sl No	Date	Issue	Description	Solution	Status (Open, Closed, Ongoing, Cancelled)
1	10/4/2023	Requirement ID:218	Multiple motor/inverter configuration shall be discussed.	Shall be discussed in the next WP meeting. Linked to TC18.	Closed
2	5/5/2023	Requirement ID: 336	Under which condition and how can we change winding connections ? How will they be connected ?	Shall be discussed in the next WP meeting. 3-phase, double 3-phase and 6-phase configurations will be used.	Closed
3	5/5/2023	Requirement ID: 225	Under which condition and how can we change winding connections ? How will they be connected ?	Shall be discussed in the next WP meeting. 3-phase, double 3-phase and 6-phase configurations will be used.	Closed
4	5/5/2023	Requirement ID: 226	Under which condition and how can we change winding connections ? How will they be connected ?	Shall be discussed in the next WP meeting. 3-phase, double 3-phase and 6-phase configurations will be used.	Closed
5	9/5/2023	Requirement ID: 276,277,278	To extend the test cases of these requirements, it shall be discussed how the SoH values can be manipulated and verified	Test cases were written but it shall be discussed in the next WP meeting. See TC17.	Closed
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Test Document History

Title:	

Legend:	
Content Update	
Interim Release	
Document Frozen	

Test Suite			Test Cases				
Date	Version	Partner	Date	Version	Partner		
16/10/2022	V1.0	Initial Release (AVL)	16/10/2022	V1.0	Initial Release (AVL)		
29/5/2023	V1.1	Test suite is updated.	29/5/2023	V1.1	All test cases were written for the testable requirements in L3 DCDC document except the requirements in work (ID:10018, 10028) and the marked ones with red. They will be written after they are ready,too. ID: 10025 will be updated(AVL).		
7/6/2023	V1.2	Test suite is ready for the release.	7/6/2023	V1.2	Remaining test cases were completed.		
7/6/2023	V1.3	Test suite was released to the partners for the first review (AVL)	7/6/2023	V1.3	Test Cases were released to the partners for the first review (AVL)		
22/6/2023	V1.3	Deleted TC_10 and renamed TC_11 and TC_12 to TC_10 and TC_11 (IREC)	22/6/2023	V1.3	Deleted TC_10 and renamed TC_11 and TC_12 to TC_10 and TC_11 (IREC)		
23/6/2023	V2.0	Deliverable release (AVL)	23/6/2023	V2.0	Deliverable released(AVL)		

Project Name:	SCAPE	Test Designed by:	Berk Ascioglu, Hakan Yeniay
Module Name:	DCDC Test Suite	Test Designed date:	tbd
Release Version:	v2.0	Test Executed by:	tbd
Test Version	v1.3	Test Execution date:	tbd
Remark	This test suite is for SCAPE Multi-level SC array DCDC functionality		
Test Environment	HV-Lab		

Test Case ID	Test Case #	Test Title	Test Summary	Test Data	Status	Requirement1	Requirement2	Requirement3	Requirement4	Requirement5	Notes
5001	TC_01	Continuous Power Test	To verify if the DC-DC Converter is capable of providing of continuous power.		Not Executed	10007					
5002	TC_02	Input Voltage Test	To verify if the DC-DC Converter is capable of the change of the input voltage.		Not Executed	10008	10026				
5003	TC_03	Efficiency Test	To verify if the DC-DC Converter is met the efficiency requirements.		Not Executed	10013					
5004	TC_04	State of charge equalize function Test	To verify the equalization for each Service battery module		Not Executed	10020					
5005	TC_05	Switching-cell failure tolerance Test	To verify DC-DC fault tolerance for the failure of multiple switching-cells.		Not Executed	10025					
5006	TC_06	Stress and Degredation Minimization Test	To verify the adaptability of DC-DC Converter to minimize the stress and degredation and maximize the operating life.		Not Executed	10024					
5007	TC_07	Output Voltage Test	To verify if the DC-DC Converter is capable of the regulation between 18 and 25 V.		Not Executed	10021					
5008	TC_08	Output Current Test	To verify if the DC-DC Converter is capable of supplying/sinking a continuous current		Not Executed	10028					
5009	TC_09	Bidirectional Power Transfer Test	To verify if the DC-DC Converter is capable of providing bidirectional power transfer HV and Service batteries.		Not Executed	10018					12/06/23 BeAs: This test should be performed before TC_07, TC_08, TC_10, TC_11.
5010	TC_10	Nominal Output Voltage Test	To verify if the DC-DC Converter is capable of the nominal voltage of 24V.		Not Executed	10010					
5011	TC_11	Continuous Power at whole Ambient Temperature Range Test	To verify if the DC-DC Converter is capable of operation without derating in the stated range.		Not Executed	10029					
5012	TC_12	Limp Home Mode Test	To verify if the DC-DC Converter is capable of the transfer power from the LV-side to the HV-side to enable (limited) vehicle motion when the traction battery fails.		Not Executed	10042					
5013	TC_13				Not Executed						
5014	TC_14				Not Executed						
5015	TC_15				Not Executed						
5016	TC_16				Not Executed						
5017	TC_17				Not Executed						

Test Case ID	TC_01		**Test Case Objective**	Continuous Power Test		
Created By	Berk Ascioglu, Hakan Yeniay		**Reviewed By**		**Version**	1,0

History	1.0 - First version of the test case

Tester's Name			**Date Tested**		**Overall Test Case Re**	**Not Executed**

Sl.No	Measurement Files
1	https://irecedu.sharepoint.com/:x:/r/sites/SCAPE/DUMMY_FILES
2	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify if the DCDC Converter is capable of providing the nominal powre.	#cond1 - Connect voltage sources to the input and output. - Set the input voltage to VHV,nom, and the output voltage to VLV,nom. - Set DC DC Converter operation mode to HV2LV. - Request 100% of the nominal power.	#crit1 - The DCDC converter is able to transfer the requested power within the SOA.			**Not Executed**

Observations :	

Test Case ID	TC_02		Test Case Objective	Input Voltage Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify if the DC-DC Converter is able to operate within the defined input voltage range.	#cond1 - Connect a voltage source to the input and output of the DCDC converter. - Set the output voltage to VLV,nom. - Set DC DC Converter operation mode to HV2LV. - Increase the input voltage from VHV,min to VLV,out with gradient of VHV,nom/100 V/s. - Perform the test for 10% of the nominal power transfer.	#crit1 - The DCDC converter is able to transfer the requested power within the SOA.			Not Executed
2	Test condition to verify if the DC-DC Converter is able to operate within the defined input voltage range.	#cond2 - Connect a voltage source to the input and output of the DCDC converter. - Set the output voltage to VLV,nom. - Set DC DC Converter operation mode to HV2LV. - Increase the input voltage from VHV,min to VLV,out with gradient of VHV,nom/100 V/s. - Perform the test for 50% of the nominal power transfer.	#crit2 - The DCDC converter is able to transfer the requested power within the SOA.			Not Executed
3	Test condition to verify if the DC-DC Converter is able to operate within the defined input voltage range.	#cond3 - Connect a voltage source to the input and output of the DCDC converter. - Set the output voltage to VLV,nom. - Set DC DC Converter operation mode to HV2LV. - Increase the input voltage from VHV,min to VLV,out with gradient of VHV,nom/100 V/s. - Perform the test for 100% of the nominal power transfer.	#crit3 - The DCDC converter is able to transfer the requested power within the SOA.			Not Executed

4	Test condition to verify if the DC-DC Converter is able to operate within the defined input voltage range.	#cond4 - Connect a voltage source to the input and output of the DCDC converter. - Set the output voltage to VLV,nom. - Set DC DC Converter operation mode to LV2HV. - Increase the input voltage from VHV,min to VLV,out with gradient of VHV,nom/100 V/s. - Perform the test for 10% of the nominal power transfer.	#crit4 - The DCDC converter is able to transfer the requested power within the SOA.			**Not Executed**
5	Test condition to verify if the DC-DC Converter is able to operate within the defined input voltage range.	#cond5 - Connect a voltage source to the input and output of the DCDC converter. - Set the output voltage to VLV,nom. - Set DC DC Converter operation mode to LV2HV. - Increase the input voltage from VHV,min to VLV,out with gradient of VHV,nom/100 V/s. - Perform the test for 50% of the nominal power transfer.	#crit5 - The DCDC converter is able to transfer the requested power within the SOA.			**Not Executed**
6	Test condition to verify if the DC-DC Converter is able to operate within the defined input voltage range.	#cond6 - Connect a voltage source to the input and output of the DCDC converter. - Set the output voltage to VLV,nom. - Set DC DC Converter operation mode to LV2HV. - Increase the input voltage from VHV,min to VLV,out with gradient of VHV,nom/100 V/s. - Perform the test for 100% of the nominal power transfer.	#crit6 - The DCDC converter is able to transfer the requested power within the SOA.			**Not Executed**
7						**Not Executed**

Observations :

Test Case ID	TC_03		Test Case Objective	Efficiency Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Efficiency at nominal operating point.	#cond1 - Connect a voltage source to the DCDC converter input and output. - Set the output voltage to VLV,nom. - Set the input voltage to VHV,nom. - Set DC DC Converter operation mode to HV2LV. - Set the transferred power to 100% of the nominal value.	"#crit1 - Input-to-output power-transfer efficiency is at least 95%. Efficiency = ((Vo*Io))/(Vi*Ii))x100"			Not Executed
2						Not Executed
3						Not Executed
4						Not Executed

5						Not Executed
6						Not Executed
7						Not Executed

Observations :	

Test Case ID	TC_04		**Test Case Objective**	State of charge equalize function Test		
Created By	Berk Ascioglu, Hakan Yeniay		**Reviewed By**		**Version**	1,0

History	1.0 - First version of the test case

Tester's Name			**Date Tested**		**Overall Test Case R**	**Not Executed**

Sl.No	Measurement Files
1	
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify the equalization for each Service battery module.	#cond1 * Connect in series two 12 V battery modules to the DC DC Converter output side, connecting the output side mid point to the battery mid point. The batteries should have a SoC between 30-70 %. The batteries can be substituted by voltage supplies with battery-emulation mode. * Connect a voltage source to the input. * Connect one programmable load to the 12 V port and another one to the 24 V port. * Set the input voltage to 400 V. * Set DC DC converter operation mode to HV2LV. * Set output 24-V-load power setpoint to 91 % of the converter nominal power. * Set output 12-V-load power setpoint to 9 % of the converter nominal power. * Operate the converter for 30 min. * Check the state of charges of each service battery module.	"#crit1 - By the end of both tests, SOCs of each service battery module are equal (±Tolerance).			**Not Executed**
2	Test condition to verify the equalization for each Service battery module.	#cond2 * Connect in series two 12 V battery modules to the DC DC Converter output side, connecting the output side mid point to the battery mid point. The batteries should have a SoC between 30-70 %. The batteries can be substituted by voltage supplies with battery-emulation mode. * Connect a voltage source to the input. * Connect one programmable load to the 12 V port and another one to the 24 V port. * Set the input voltage to 400 V. * Set DC DC converter operation mode to LV2HV. * Set output 24-V-load power setpoint to 91 % of the converter nominal power. * Set output 12-V-load power setpoint to 9 % of the converter nominal power. * Operate the converter for 30 min. * Check the state of charges of each service battery module.	"#crit2 - By the end of both tests, SOCs of each service battery module are equal (±Tolerance).			**Not Executed**
3						**Not Executed**

4						**Not Executed**
5						**Not Executed**

Observations :	

Test Case ID	TC_05		**Test Case Objective**	Switching-cell failure tolerance Test		
Created By	Berk Ascioglu, Hakan Yeniay		**Reviewed By**		**Version**	1,0

History	1.0 - First version of the test case

Tester's Name			**Date Tested**		**Overall Test Case Re**	**Not Executed**

Sl.No	**Measurement Files**
1	
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Step #	**Summary**	**Test Flow**	**Evaluation Criteria**	**Test Comments**	**Suggestion for Failure**	**Status**
1	Test condition for verifying DC DC fault tolerance for the failure of multiple switching-cells.	#cond1 * Connect a voltage source to the DCDC converter input and output. * Set the output voltage to VLV,nom. * Set the input voltage to VHV,nom. * Set DC DC Converter operation mode to HV2LV. * Set the transferred power to 100% of the nominal value. * Disable non-critical switching cells from the LV and HV side one after the another	#crit1 - The DCDC converter is able to operate even after all non-critical switching cells are disabled.			**Not Executed**
2	Test condition for verifying DC DC fault tolerance for the failure of multiple switching-cells.	#cond2 * Connect a voltage source to the DCDC converter input and output. * Set the output voltage to VLV,nom. * Set the input voltage to VHV,nom. * Set DC DC Converter operation mode toLV2HV. * Set the transferred power to 100% of the nominal value. * Disable non-critical switching cells from the LV and HV side one after the another	#crit2 - The DCDC converter is able to operate even after all non-critical switching cells are disabled.			**Not Executed**
3						**Not Executed**
4						**Not Executed**

5						**Not Executed**

Observations :	

Test Case ID	TC_06		Test Case Objective	Stress and Degredation Minimization Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
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Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify the adaptability of DC-DC Converter to minimize the stress and degredation and maximize the operating life.	#cond1 * Connect a voltage source to the DCDC converter input and output. * Set the output voltage to VLV,nom. * Set the input voltage to VHV,nom * Set DC DC Converter operation mode to HV2LV. * Set the transferred power to 100% of the nominal value. * Manipulate the DC-DC related state-of-health variables.	"#crit1 - The manipulated SoH variables return to its normal value (±Tolerance) and the rest of SoH are not gratly affected.			**Not Executed**
2	Test condition to verify the adaptability of DC-DC Converter to minimize the stress and degredation and maximize the operating life.	#cond2 * Connect a voltage source to the DCDC converter input and output. * Set the output voltage to VLV,nom. * Set the input voltage to VHV,nom * Set DC DC Converter operation mode to LV2HV. * Set the transferred power to 100% of the nominal value. * Manipulate the DC-DC related state-of-health variables.	"#crit2 - The manipulated SoH variables return to its normal value (±Tolerance) and the rest of SoH are not gratly affected.			**Not Executed**
3						**Not Executed**

4						**Not Executed**
5						**Not Executed**

Observations :	

Test Case ID	TC_07		Test Case Objective	Output Voltage Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify if the DC-DC Converter is able to operate within the defined output voltage range.	#cond1 - Connect a voltage source to the input and a programmable load to the output of the DCDC converter. - Set the input voltage to VHV,nom. - Set DC DC Converter operation mode to HV2LV. - Increase the ouput voltage from VLV,min to VLV,max with a gradient of VLV,nom/100 V/s. - Perform the test for 10% of the nominal power transfer.	#crit1 The output voltage is equal to the requested value ± tolerance.			Not Executed
2	Test condition to verify if the DC-DC Converter is able to operate within the defined output voltage range.	#cond2 - Connect a voltage source to the input and a programmable load to the output of the DCDC converter. - Set the input voltage to VHV,nom. - Set DC DC Converter operation mode to HV2LV. - Increase the ouput voltage from VLV,min to VLV,max with a gradient of VLV,nom/100 V/s. - Perform the test for 50% of the nominal power transfer.	#crit2 The output voltage is equal to the requested value ± tolerance.			Not Executed
3	Test condition to verify if the DC-DC Converter is able to operate within the defined output voltage range.	#cond3 - Connect a voltage source to the input and a programmable load to the output of the DCDC converter. - Set the input voltage to VHV,nom. - Set DC DC Converter operation mode to HV2LV. - Increase the ouput voltage from VLV,min to VLV,max with a gradient of VLV,nom/100 V/s. - Perform the test for 100% of the nominal power transfer.	#crit3 The output voltage is equal to the requested value ± tolerance.			Not Executed

4	Test condition to verify if the DC-DC Converter is able to operate within the defined output voltage range.	#cond4 - Connect a voltage source to the input and a programmable load to the output of the DCDC converter. - Set the input voltage to VHV,nom. - Set DC DC Converter operation mode to LV2HV. - Increase the ouput voltage from VLV,min to VLV,max with a gradient of VLV,nom/100 V/s. - Perform the test for 10% of the nominal power transfer.	#crit4 The output voltage is equal to the requested value ± tolerance.			**Not Executed**
5	Test condition to verify if the DC-DC Converter is able to operate within the defined output voltage range.	#cond5 - Connect a voltage source to the input and a programmable load to the output of the DCDC converter. - Set the input voltage to VHV,nom. - Set DC DC Converter operation mode to LV2HV. - Increase the ouput voltage from VLV,min to VLV,max with a gradient of VLV,nom/100 V/s. - Perform the test for 50% of the nominal power transfer.	#crit5 The output voltage is equal to the requested value ± tolerance.			**Not Executed**
6	Test condition to verify if the DC-DC Converter is able to operate within the defined output voltage range.	#cond6 - Connect a voltage source to the input and a programmable load to the output of the DCDC converter. - Set the input voltage to VHV,nom. - Set DC DC Converter operation mode to LV2HV. - Increase the ouput voltage from VLV,min to VLV,max with a gradient of VLV,nom/100 V/s. - Perform the test for 100% of the nominal power transfer.	#crit6 The output voltage is equal to the requested value ± tolerance.			**Not Executed**

Observations :	

Test Case ID	TC_08		Test Case Objective	Output Current Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify if the DC-DC Converter is capable of supplying/sinking continuously the nominal current.	#cond1 * Connect a voltage source to the DCDC converter input and output. * Set the input voltage to VHV,nom. * Set the output voltage to VLV,nom. * Set DC DC Converter operation mode to HV2LV * Set output current setpoint to Iout,nom.	#crit1 - DC DC output current is equal to Iout,nom ± tolerance.			Not Executed
2	Test condition to verify if the DC-DC Converter is capable of supplying/sinking continuously the nominal current.	#cond2 * Connect a voltage source to the DCDC converter input and output. * Set the input voltage to VHV,nom. * Set the output voltage to VLV,nom. * Set DC DC Converter operation mode to HV2LV * Set output current setpoint to -Iout,nom.	#crit2 - DC DC output current is equal to -Iout,nom ± tolerance.			Not Executed
3						Not Executed

4						**Not Executed**
5						**Not Executed**

Observations :	

Test Case ID	TC_09		Test Case Objective	Bidirectional Power Transfer Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond1 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 10% of the nominal value. - Set the input source voltage to VHV,min. - Sweep the output source voltage from VLV,min to VLV,max.	#crit1 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			Not Executed
2	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond2 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 10% of the nominal value. - Set the input source voltage to VHV,nom. - Sweep the output source voltage from VLV,min to VLV,max.	#crit2 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			Not Executed
3	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond3 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 10% of the nominal value. - Set the input source voltage to VHV,max. - Sweep the output source voltage from VLV,min to VLV,max.	#crit3 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			Not Executed
4	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond4 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 50% of the nominal value. - Set the input source voltage to VHV,min. - Sweep the output source voltage from VLV,min to VLV,max.	#crit4 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			Not Executed

5	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond5 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 50% of the nominal value. - Set the input source voltage to VHV,nom. - Sweep the output source voltage from VLV,min to VLV,max.	#crit5 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
6	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond6 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 50% of the nominal value. - Set the input source voltage to VHV,max. - Sweep the output source voltage from VLV,min to VLV,max.	#crit6 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
7	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond7 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 100% of the nominal value. - Set the input source voltage to VHV,min. - Sweep the output source voltage from VLV,min to VLV,max.	#crit7 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
8	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond8 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 100% of the nominal value. - Set the input source voltage to VHV,nom. - Sweep the output source voltage from VLV,min to VLV,max.	#crit8 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
9	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond9 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 100% of the nominal value. - Set the input source voltage to VHV,max. - Sweep the output source voltage from VLV,min to VLV,max.	#crit9 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
10	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond10 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 10% of the nominal value. - Set the input source voltage to VHV,min. - Sweep the output source voltage from VLV,min to VLV,max.	#crit10 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**

11	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond11 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 10% of the nominal value. - Set the input source voltage to VHV,nom. - Sweep the output source voltage from VLV,min to VLV,max.	#crit11 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
12	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond12 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 10% of the nominal value. - Set the input source voltage to VHV,max. - Sweep the output source voltage from VLV,min to VLV,max.	#crit12 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
13	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond13 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 50% of the nominal value. - Set the input source voltage to VHV,min. - Sweep the output source voltage from VLV,min to VLV,max.	#crit13 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
14	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond14 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 50% of the nominal value. - Set the input source voltage to VHV,nom. - Sweep the output source voltage from VLV,min to VLV,max.	#crit14 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
15	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond15 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 50% of the nominal value. - Set the input source voltage to VHV,max. - Sweep the output source voltage from VLV,min to VLV,max.	#crit15 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
16	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond16 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 100% of the nominal value. - Set the input source voltage to VHV,min. - Sweep the output source voltage from VLV,min to VLV,max.	#crit16 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**

17	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond17 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 100% of the nominal value. - Set the input source voltage to VHV,nom. - Sweep the output source voltage from VLV,min to VLV,max.	#crit17 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
18	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond18 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 100% of the nominal value. - Set the input source voltage to VHV,max. - Sweep the output source voltage from VLV,min to VLV,max.	#crit18 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
19	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond19 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 10% of the nominal value. - Set the output source voltage to VLV,min. - Sweep the input source voltage from VHV,min to VHV,max.	#crit19 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
20	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond20 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 10% of the nominal value. - Set the output source voltage to VLV,nom. - Sweep the input source voltage from VHV,min to VHV,max.	#crit20 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
21	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond21 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 10% of the nominal value. - Set the output source voltage to VLV,max. - Sweep the input source voltage from VHV,min to VHV,max.	#crit21 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
22	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond22 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 50% of the nominal value. - Set the output source voltage to VLV,min. - Sweep the input source voltage from VHV,min to VHV,max.	#crit22 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**

23	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond23 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 50% of the nominal value. - Set the output source voltage to VLV,nom. - Sweep the input source voltage from VHV,min to VHV,max.	#crit23 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
24	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond24 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 50% of the nominal value. - Set the output source voltage to VLV,max. - Sweep the input source voltage from VHV,min to VHV,max.	#crit24 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
25	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond25 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 100% of the nominal value. - Set the output source voltage to VLV,min. - Sweep the input source voltage from VHV,min to VHV,max.	#crit25 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
26	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond26 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 100% of the nominal value. - Set the output source voltage to VLV,nom. - Sweep the input source voltage from VHV,min to VHV,max.	#crit26 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
27	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond27 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in HV2LV mode. - Set the transferred power to 100% of the nominal value. - Set the output source voltage to VLV,max. - Sweep the input source voltage from VHV,min to VHV,max.	#crit27 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
28	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond28 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 10% of the nominal value. - Set the output source voltage to VLV,min. - Sweep the input source voltage from VHV,min to VHV,max.	#crit28 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**

29	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond29 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 10% of the nominal value. - Set the output source voltage to VLV,nom. - Sweep the input source voltage from VHV,min to VHV,max.	#crit29 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
30	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond30 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 10% of the nominal value. - Set the output source voltage to VLV,max. - Sweep the input source voltage from VHV,min to VHV,max.	#crit30 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
31	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond31 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 50% of the nominal value. - Set the output source voltage to VLV,min. - Sweep the input source voltage from VHV,min to VHV,max.	#crit31 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
32	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond32 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 50% of the nominal value. - Set the output source voltage to VLV,nom. - Sweep the input source voltage from VHV,min to VHV,max.	#crit32 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
33	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond33 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 50% of the nominal value. - Set the output source voltage to VLV,max. - Sweep the input source voltage from VHV,min to VHV,max.	#crit33 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
34	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond34 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 100% of the nominal value. - Set the output source voltage to VLV,min. - Sweep the input source voltage from VHV,min to VHV,max.	#crit34 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**

35	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond35 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 100% of the nominal value. - Set the output source voltage to VLV,nom. - Sweep the input source voltage from VHV,min to VHV,max.	#crit35 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**
36	Test condition to verify if the DC-DC Converter is capable of providing bidirectional power transfer between the traction battery module and the service battery.	#cond36 - Connect a voltage source to the DCDC converter input and output. - Set DCDC converter in LV2HV mode. - Set the transferred power to 100% of the nominal value. - Set the output source voltage to VLV,max. - Sweep the input source voltage from VHV,min to VHV,max.	#crit36 - The DCDC converter is able to transfer the requested power within the SOA. Note: SOA: Safe operating area			**Not Executed**

Observations :	

Test Case ID	TC_11		Test Case Objective	Continuous Power at whole Ambient Temperature Range Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify if the DC-DC Converter is capable of operation without derating at the specified ambient temperature range. *(Note: Here the ambient temperature is surrounding air temperature, independently whether the converter is air cooled or liquid cooled.)*	#cond1 * Connect a voltage source to the DCDC converter input and output. * Set the output voltage to VLV,nom. * Set the input voltage to VHV,nom. * Set DC DC Converter operation mode to HV2LV. * Set the transferred power to 100% of the nominal value. * Increase the ambient temperature from 0 ºC to 40 ºC with a gradient of 1 ºC/min.	#crit1 - The DC DC converter is able to operate in the SOA on all the tested operating points. Note: SOA: Safe operating area			Not Executed
2	Test condition to verify if the DC-DC Converter is capable of operation without derating at the specified ambient temperature range. *(Note: Here the ambient temperature is surrounding air temperature, independently whether the converter is air cooled or liquid cooled.)*	#cond2 * Connect a voltage source to the DCDC converter input and output. * Set the output voltage to VLV,nom. * Set the input voltage to VHV,nom. * Set DC DC Converter operation mode to LV2HV. * Set the transferred power to 100% of the nominal value. * Increase the ambient temperature from 0 ºC to 40 ºC with a gradient of 1 ºC/min.	#crit2 - The DC DC converter is able to operate in the SOA on all the tested operating points. Note: SOA: Safe operating area			Not Executed
3						Not Executed
4						Not Executed

5						**Not Executed**
6						**Not Executed**

Observations :	

Test Case ID	TC_12		Test Case Objective	Limp Home Mode Test		
Created By	Berk Ascioglu, Hakan Yeniay		Reviewed By		Version	1,0

History	1.0 - First version of the test case

Tester's Name			Date Tested		Overall Test Case Re	Not Executed

Sl.No	Measurement Files
1	
2	
3	
4	

Step #	Summary	Test Flow	Evaluation Criteria	Test Comments	Suggestion for Failure	Status
1	Test condition to verify if the DC-DC Converter is capable of the transfer power from the LV-side to the HV-side and regulate the HV voltage since no battery is present. This test vliates the limp home mode.	#cond1 * Connect a programmable load to the converter input and a voltage source to the output. * Set the output voltage to VLV,nom. * Set the input voltage setpoint to VHV,nom. * Set DC DC Converter operation mode to LV2HV. * Set the transferred power to 100% of the nominal value.	#crit1 - The input voltage is equal to VHV,nom ± tolerance.			Not Executed
2						Not Executed
3						Not Executed
4						Not Executed

5						**Not Executed**
6						**Not Executed**

Observations :	

List of Open Points

Sl No	Date	Issue	Description	Solution	Status (Open, Close, Ongoing, Cancelled)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
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26					
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29					
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31					
32					

33					

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