HARMONIZED DOCUMENT

800V 300KW Generator PIM Technical Specifications
Statement of Requirements (SOR)

Change level	Date	Description of change
0.1	2022/Dec/14	Initial draft
0.2	2023/Jun/22	Added AC & DC Junction Boxes. See Change Summary for details.

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1 INTRODUCTION

1.1 Purpose

This Performance Standard establishes the “Power Inverter Module” (PIM) requirements for the Global Stellantis “800V 300kW Generator PIM” Electrified Vehicle (EV) applications. The functional, performance, design constraints, environmental, physical, electrical, mechanical, regulatory, validation, reliability and durability requirements needed for this component are defined in this document.

1.2 Component/Commodity Description

The Generator PIM as called out within the document is a power electronics device that is an inverter in function. The primary functions of the Generator PIM as used within this document are relevant to regen within an electrified powertrain within a vehicle. The PIM shall be capable of smoothly controlling the Electric Motor/Generator in its motoring mode and capable to generate DC energy from the Generator AC energy. Bi-directional functionality is required wherein the PIM operates the generator motor to crank the Engine and generates Electrical Energy from the generator motor while engine is running. The PIM shall be capable of performing these tasks efficiently and without causing perceivable disturbances in the form of NVH, BSR or EMC radiation.

The Generator PIM module is electrically connected to the Generator motor which is coupled to an Engine. The PIM with its Application Software developed within Stellantis shall ensure smooth delivery of torque and generates electrical energy.

There will be two PIM Junction Boxes (JBs), one for AC and one for DC. Both JBs will contain fastening strategy to mount the box to PIM housing, sealing strategy to ensure box is sealed, sealed interface for HV DC cable attached and high voltage interlock loop (HVIL). The HVIL solution should have a plastic “guard plate” under the access cover, which blocks access to the HV connections for >5 seconds after HVIL is triggered. The “guard plate” is secured by a bolt that is only accessible after the HVIL connection is broken. The PIM junction box enclosure is aluminium that guarantees the protection from water, dust, crash, vibrations, temperature, corrosion, etc.

The Supplier shall quote the following part numbers based on the requirements in this document for 300kW operational in an 800V system.

GPIM
05185314AA 800V 300kW HD Generator PIM

Junction Boxes
05185386AA DC Cover Kit
05185388AA DC Box Kit
05185385AA AC Cover Kit
05185387AA AC Box Kit

The Junction Boxes must be compatible with these Yazaki connector part numbers:

- AC: X42185-AA97
- DC: X42185-AP63
- DC: X42185-AA94

Space Claim:

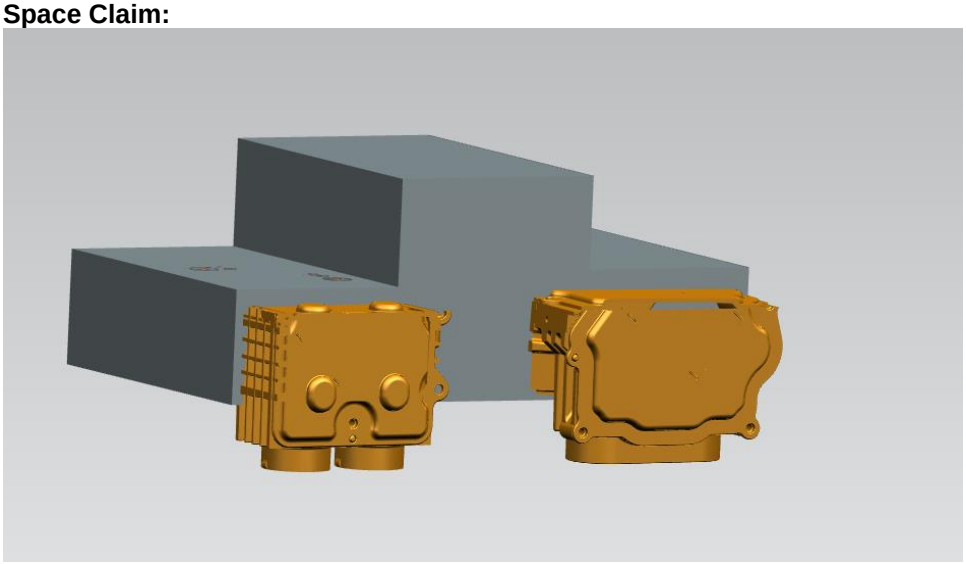
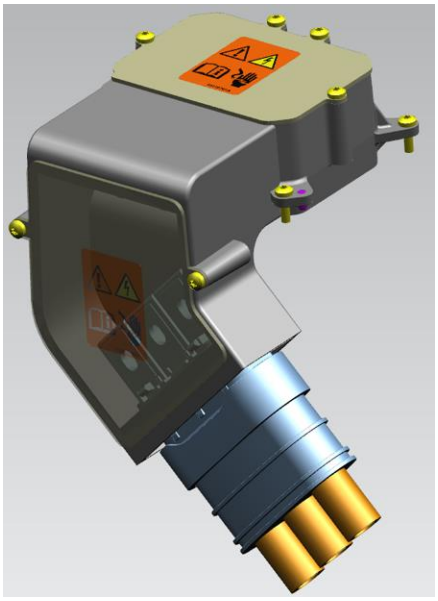
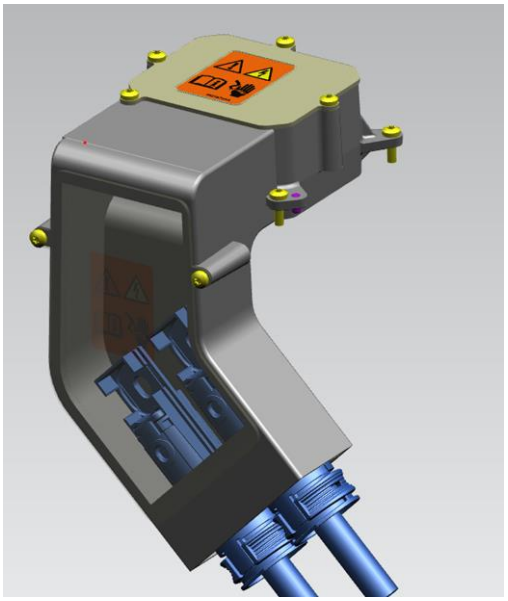


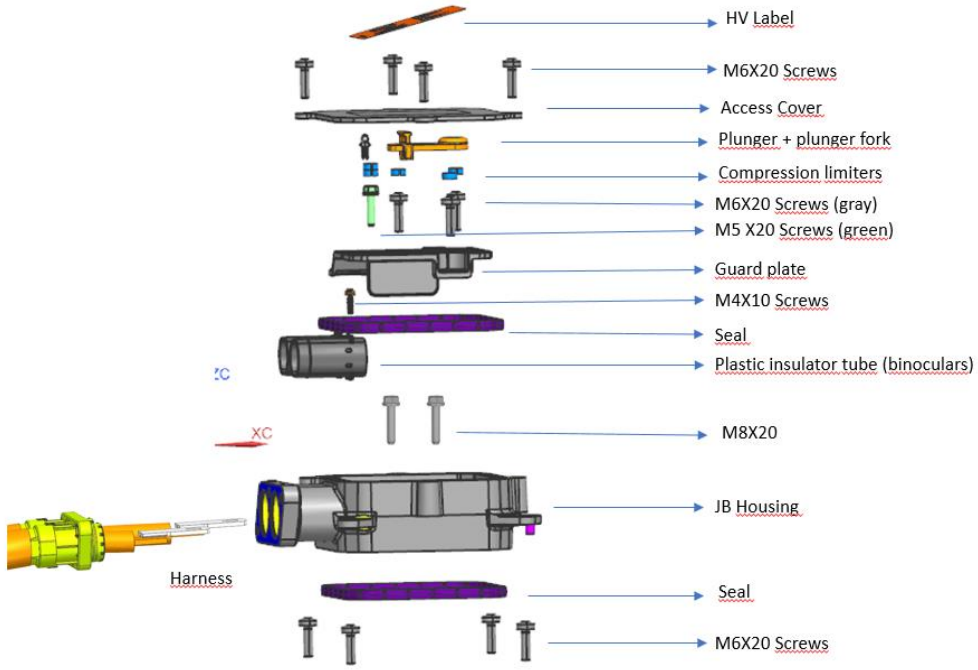
Figure 1: HD Generator PIM Vehicle Space Claim

AC & DC Junction Boxes:





Example Junction Box Exploded View (for reference)



Section 8 in this document shows the PIM sub-system functional objectives, and Section 2 REFERENCES shows the other references from Stellantis and industry standards that supplier must comply and adhere to. PIM supplier needs to utilize the Control board schematic developed by Stellantis. For details of the PIM Control Board design, refer to the Control Board Requirements attached as a separate source package line item. The intent of directing the control board design is to make common Stellantis software across various platforms within Stellantis Propulsion Systems beyond the scope of this document.

The Supplier shall also include in all quotes, as a separate line item for protective shipping covers for all cooling ports, LV and HV DC interface and the HV AC interface, or cover with HVIL if applicable.

During development, the PIM design shall have an external box to mount the xETK board with external access to install/uninstall the xETK. The supplier shall submit the quotation for the xETK instrumented PIM during sourcing.

1.2.1 PIM subsystem architecture

The PIM shall have a Power Stage and a physical separate Logic control board within the PIM physical envelope. The PIM logic control board may be sourced as a separate component, manufactured by the same supplier as the PIM supplier or it could be procured from a different supplier. The PIM supplier shall develop the PIM housing design to accommodate the PIM control board if sourced from a different supplier. The interfaces to the logic control board, if procured from a source different than the PIM supplier shall be quoted and planned for. The details for such interfaces shall be defined, documented and confirmed with Stellantis Design Release Engineer during supplier technical engagement of the quoting phase. The 3D CAD models provided with this source package gives the references interfaces to generator and battery assembly.

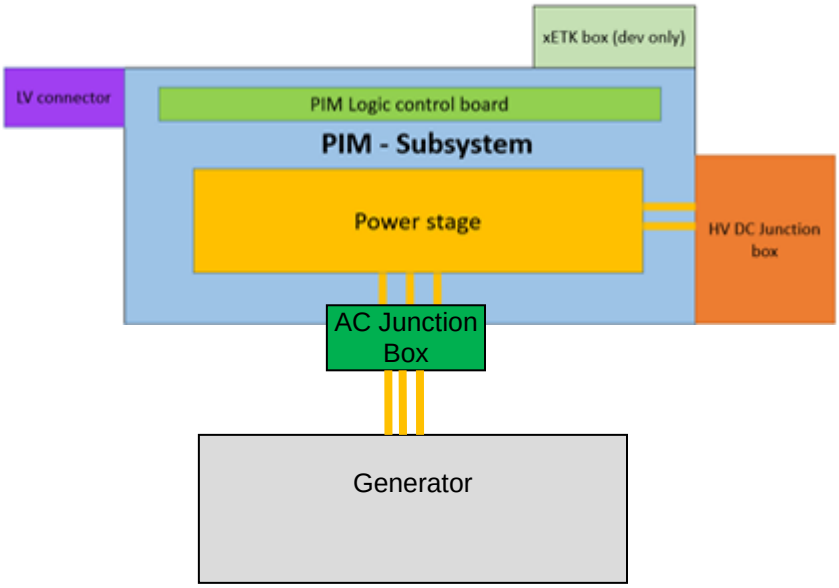


Figure 2: PIM Sub-system Architecture

Supplier shall work with other respective suppliers and together be responsible for PIM to Generator interface, PIM to HV DC and HV AC interface and PIM Power Stage and sensors to PIM control board interface.

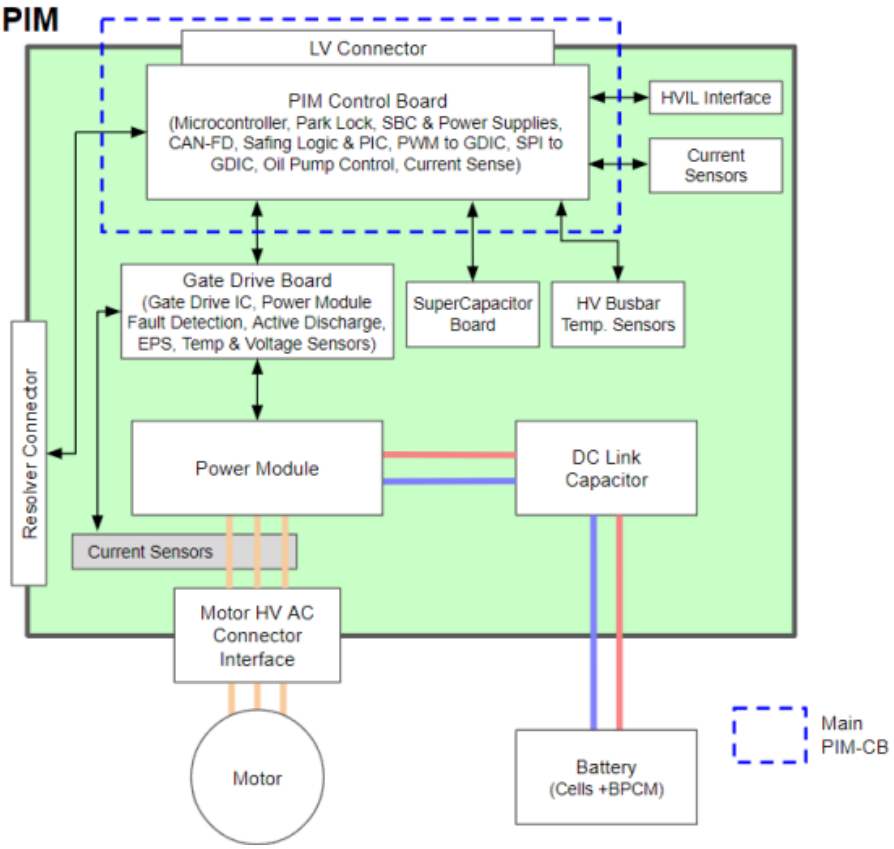


Figure 3: PIM Components Connection Strategy

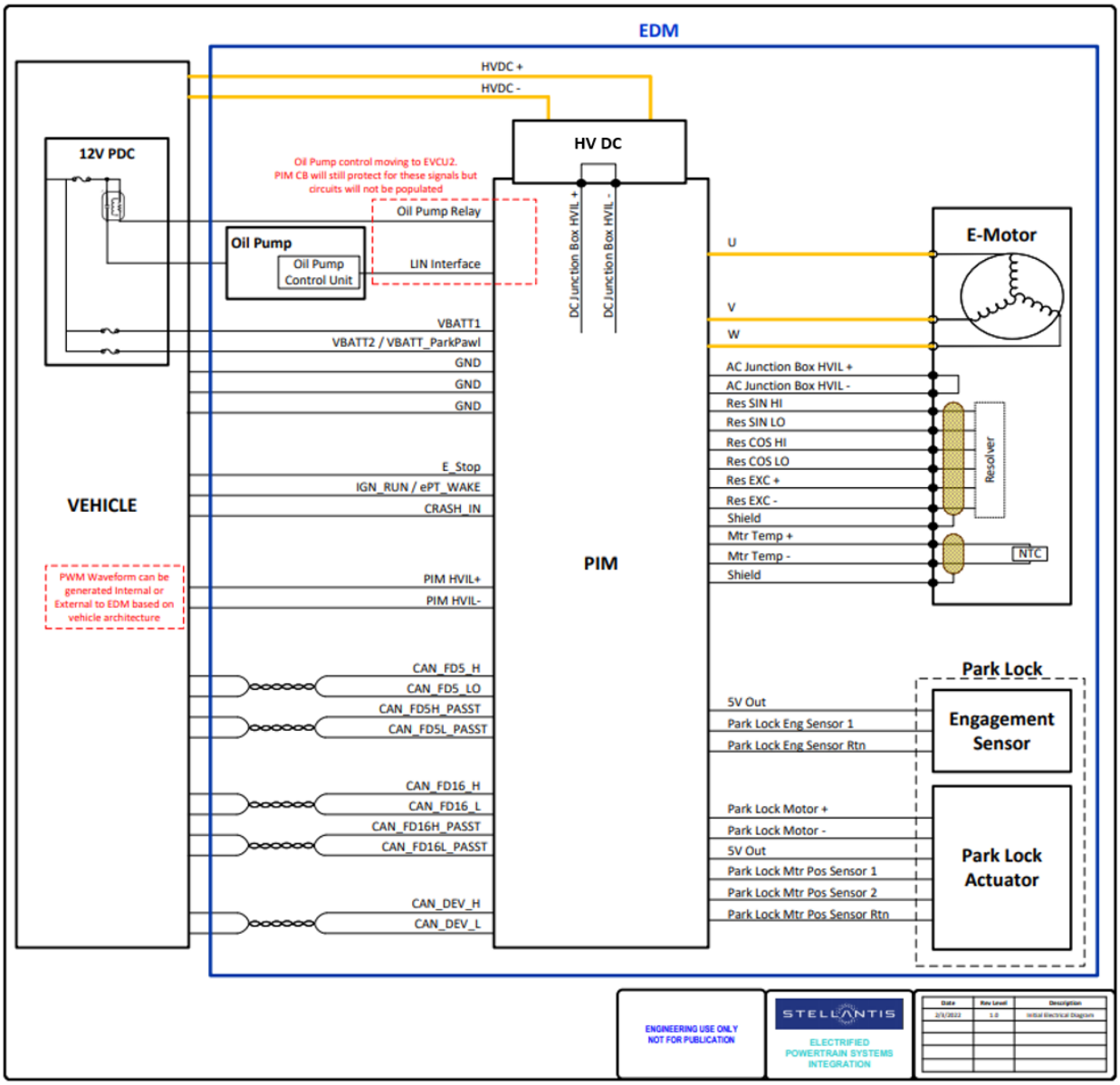


Figure 4: System level electrical connections

This specification will identify (but not be limited to)

1. Interfaces between the PIM and the low voltage vehicle components, electrified powertrain components (such as battery, charger and traction inverters), high voltage sources, high voltage loads and thermal conditioning components.
2. PIM and PIM control board interfaces.
3. PIM assembly packaging.
4. PIM (and sub-component) verification and validation.

The PIM shall consist of the key sub-components listed in *"800V HD GPIM BOM List Ver 2.0.xlsx"*.

The Supplier shall provide a detailed Bill of Material with their PIM quotation.

BOM does not include Broken PIM Samples with custom instrumentation for HIL or Power HIL verifications. These requirements for samples are included in XIL Project workbook.

Similarly other test equipment is described in the SSTS in detail, these include test boxes and suitcase testers etc.

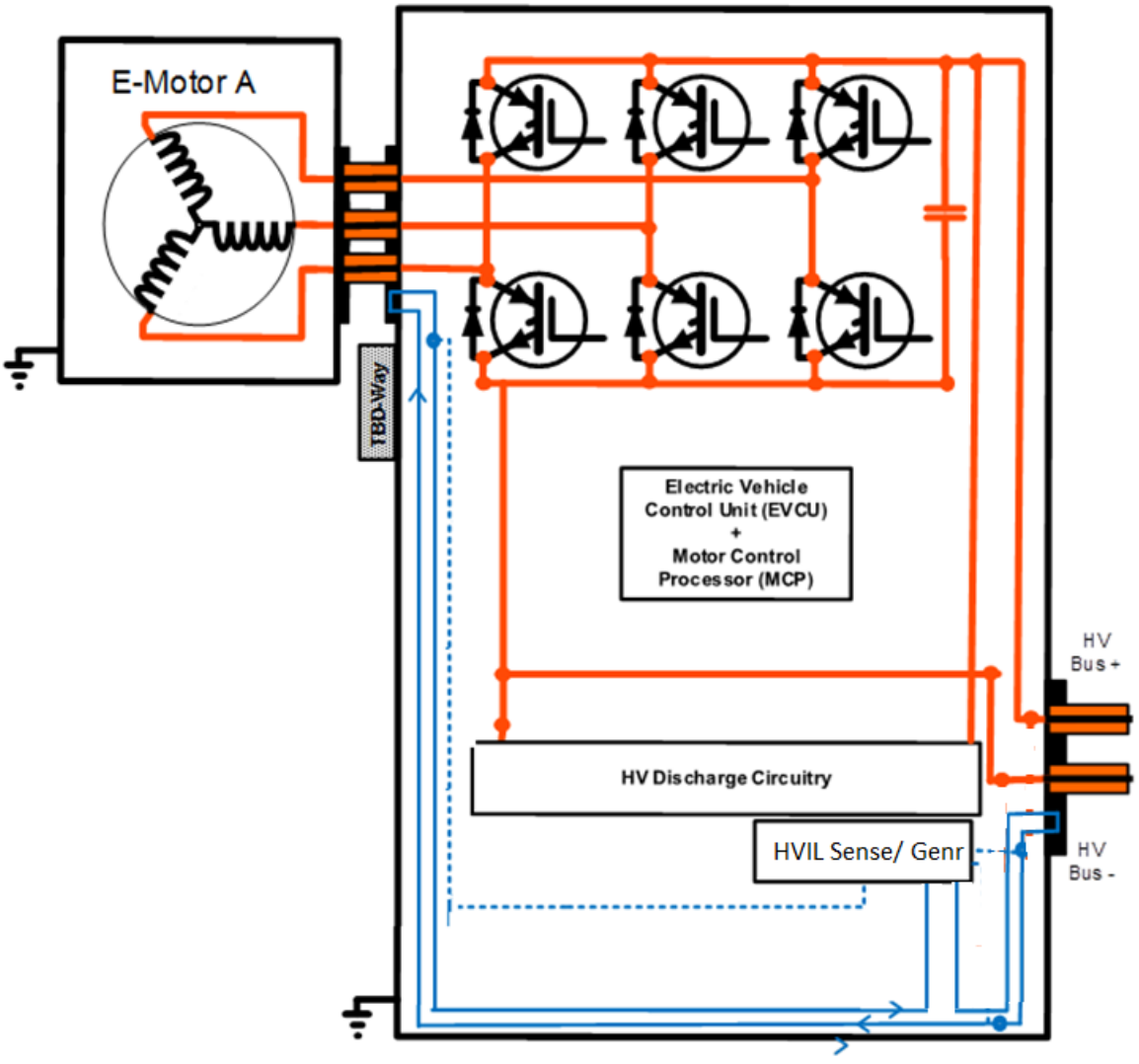


Figure 5: HVIL Strategy and HV Wiring Diagram

1.2.2 Power Stage tuning and modeling

PIM supplier shall provide the control board supplier with the required gate driver information to support CB supplier LLD SW development.

PIM supplier shall provide the power module junction thermal model to Stellantis.

PIM supplier shall follow the RASI chart attached below and the Development Interface Agreement (DIA) in Annex D to identify the responsibilities between PIM and CB supplier.

RASIC Chart.pdf

PIM Test SW

PIM supplier shall be responsible for developing the test SW and test setup for the PIM hardware verification and validation inclusive of End of Line (EoL) verification in production. PIM supplier shall work directly with the CB supplier to utilize the CB test SW platform.

EOL SW erase

In order to reduce SW Flash time at the Stellantis assembly plant and ensure a robust service process, the PIM supplier shall ensure the Test SW in the PIM Control Board (CB) is erased prior to shipping the PIM to the Stellantis assembly plant and/or to service. The PIM CB bootloader is specifically designed to detect an erased SW Flash and will set a "Module Not Flashed" fault code. The SW Flash must be completely erased for the fault code to set properly. Additionally, shipping the PIM erased will reduce SW Flash time at the vehicle assembly plant as it will not require the PIM to be erased before programming the application SW into the PIM.

Functional safety

The Supplier and Stellantis Engineering will identify resources and coordinate Functional Safety design reviews per the Stellantis Functional Safety Management (FSM) Process. The roles, processes and deliverables for implementing the required vehicle level functional safety strategy are defined in the Stellantis documents referenced in Section 2 (CS-00046). Stellantis Engineering will specify the vehicle functional safety concept that will include Torque Security Requirements and hardware circuitry based on Stellantis required components. The Functional Safety Logic will operate independently of software control and shall provide a safe state (3PS or 6SO) based on the type of faulted operation where applicable. The FSM documents shall be updated at design reviews and the supplier shall use the latest file from the design release engineer for meeting sample requirements as pertinent to the state of the PIM in the product life cycle.

Using the Stellantis approved gate driver IC, the PIM design shall provide overvoltage, overcurrent and short circuit detection. Additionally gate driver internal and circuit faults shall be latched and communicated through the defined Application Programming Interface (API). Specific failures of the Power Module assembly as detailed in the FSM Documents, attached as part of the source package shall force the 3 Phases controlled by the Microcontroller on the control board to reach a safe state in adequate amount of time to mitigate and control the specific failure. The FSM documents shall be updated at design reviews and the supplier shall use the latest file from the design release engineer for meeting sample requirements as pertinent to the state of the PIM in the product life cycle.

1.2.3 Resident engineer support

Additionally the Supplier shall provide dedicated resident engineering support for the length of the PIM program at the Stellantis Engineering and Manufacturing facilities for

- PIM hardware development, testing, debugging, and vehicle integration support

- PIM software integration debug and testing

The number of dedicated resident engineers shall be determined prior to the first PIM deliverable, but a minimum of two dedicated hardware resident engineers and one dedicated software firmware support engineer shall be required. The Supplier shall provide resident engineering support commencing 4 weeks after contract award through six months after the first vehicle production date. For follow-on vehicle programs resident engineering support will be reviewed at that time. However, the Supplier shall have local support resources through the PIM product life cycle that includes providing the below supports at the Supplier's local engineering office or regional Stellantis assembly facilities.

- Technical engineering to support HW design, SW design, ME design and PIM integration
- PIM debugging and failure analysis capabilities
- Motor test stands to support failure analysis and PIM integration and
- Technical project management
- Lead for DFMEA/ PFMEA activities
- Regional engineering support at the Stellantis assembly facilities during safe launch period and critical design phases.

1.2.4 Program Management Responsibilities

It is of utmost importance that the Supplier understand target vehicle launch date, all product function, design/development, validation, timing and logistical requirements to deliver prototype and production HW including affected subcomponent(s) to Stellantis designated locations and to supplier(s) to the program MRD schedules. A development and validation plan with timing must be supplied to Stellantis at the time of the sourcing technical review to include the hardware availability schedule supporting vehicle system integration, calibration and diagnostic development through the launch phase of the program. The timing must support all subsystem component hardware delivery to the program MRD schedules. Critical path issues and timing to resolve discrepancies must be clearly communicated in the form of an agree/disagree matrix during the technical review. Planned shipping times/customs clearances times should be noted in the schedules. Packaging and/or other models must be supplied to Stellantis at the time of the sourcing technical review to include but not limited to all interface and overall packaging dimensions, tolerances (GD&T), and run-out specifications. Delivery timing for models to support vehicle mule builds, step- release phases, and production releases must also be provided. Critical packages or interface specification discrepancies or clarifications must be clearly communicated in the form of an agree/disagree compliance matrix during the technical review. The supplier shall lead regularly scheduled design/development technical review meetings, maintain meeting minutes, and track issue assignment/resolution. Discrepancies to these fundamental packaging and performance deliverables must be communicated to Stellantis Engineering as soon as they are known.

1.2.5 Special Design and Program Consideration

The Generator PIM system must meet Regional Homologation requirements as well as requrements specified in section 5.3.12 (labeled traceability bar coded label) of this document. Supplier shall perform for the homologation certification testing. Suppliers will be responsible for all the Stellantis traceability and regional homologation driven markings, label requirements, and certification testing requirements. North American, China and EMEA market requirements should be considered. Stellantis purchasing can provide exact list of markets. Suppliers to include this cost into piece cost. Suppliers must manage and adhere to these requirements as needed even for future requirements. Additionally, suppliers will also be responsible for any regional certification related tests required, such as China certification. Suppliers will take full responsibility of scheduling, setup and completion of these tests at required lab location. Suppliers to provide final certification report to Stellantis. Cost must be provided to Stellantis purchasing at the time of quotation.

1.3 Application

This standard is limited in its application to those CAD files (such as CATIA/NX), drawings, or engineering illustrations which call out this standard number or refer to this standard within some other standard or specification.

1.4 Hazardous Material Control

Products and processes used to manufacture the products listed in this standard must conform to the employee and consumer health, employee safety, regulated substances, recycling, and environmental reporting requirements.

1.5 Mandatory, Recommended, or Specified Tests

Mandatory or suggested tests if any provided within this standard are meant to assure compliance to the specification but do not relieve the responsible entity from ensuring that the component or system meets all environmental, physical, electrical, mechanical, functional, regulatory, and durability requirements including all applicable system interface requirements as described in the standard for the entire duration of specified useful life.

1.6 Test Planning

A test plan (DVP&R) shall be developed to verify and validate all required functions specified in this standard. Individual test plans shall be developed and managed that detail engineering development and characterization (ED), design verification (DV), and production validation (PV) testing. The responsible entity shall provide any additional testing that is deemed necessary to meet functional requirements; the tables at the end of this document provide a summary of all the requirements and shall be used to develop the test planning. The Supplier shall provide the DVP&R prior to the Alpha PIM design freeze if using modified off the shelf concept. The DV and PV DVP&R's shall be supplied based on Stellantis supplied program timing two months prior to the Beta Design. Such DVP&R shall be based on the following:

- Design Calculations and simulation
- Characterization tests, thermal and power
- DFMEA documentation

All ED/Characterization/ DV/PV Samples provided to Stellantis shall be traceable, with build data and test results from Build process and End of Line testing documented and retained. These data may be requested by Stellantis in case of deviations found during testing of components. The End of Line test plan must be traceable to delivery requirements and be approved by Stellantis prior to every Sample Design freeze. The end of line test data results retained must be more than a simple pass-fail criterion of tests conducted during the development phase until successful completion of DV and DFMEA. DFMEA shall identify all End of Line parameters to be monitored after DV State is complete during the build process inclusive of data like ICT on Control Board, impedance checks on IOs from PIM etc. Further Parameters to be monitored and stored shall be identified during PFMEA to ensure process quality as well after DV. Supplier shall test all functional features of the Inverter in End of Line tests in all development phases as well as production phase.

Samples utilized for Design Verification (DV) shall meet specified drawings tolerance range. Samples for Production Validation (PV) shall meet statistical capabilities for machine and manufacturing processes.

Where necessary, each line item of the test plan (DVP&R) must be supported by a comprehensive test or laboratory procedure. A test plan (DVP&R) agreement by Stellantis does not relieve the responsible entity from ensuring that the component or system meets all environmental, physical, electrical, mechanical, functional, regulatory and durability requirements including all applicable system interface requirements, in the entity's area of responsibility, as described in the standard for the specified useful life.

The PIM will be subjected to full dimensional, functional verification and quality control measures. The PIS file outlines a draft of the expectation of a Part Inspection Standard to be used. This document shall be provided and is to be completed by Stellantis and the Supplier prior to Prototype part builds and based on the deliverables and schedule in this document.

The Supplier shall maintain adequate testing capabilities within the local technical offices of the supplier. This may include Dyno, HV Lab, EMC and LV lab facilities among other testing capabilities.

Where continuous electrical requirements are specified, the Supplier can use physical measurements taken after 30 minutes of operation as long as operation is stable (meets accuracy for specified electrical parameter) and internal thermal sensors have reached a steady state condition (temperature change shall not be greater than +/- 2 ºC per minute).

Supplier shall have the capability to perform full power burn-in for an extended period of time (typically minimum 2 hours, final implementation shall be reviewed with Stellantis) for every Inverter shipped during Mule, X0, X1, X2, X3 initial Job1 volume ramp-up. The details of the requirements will be discussed as part of the safe launch process. Safe launch process shall follow SQ.00009 Safe Launch Plan (SLP) document. The burn-in screening requirement can be relaxed once the supplier proves capability and reliability of the production process.

1.7 Suggested, Recommended or Specified Components and/or Suppliers

Suggested, recommended or specified components and/or suppliers, if any, are still required to comply to the specification and do not relieve the responsible entity from ensuring that the component or system utilizing these suggested, recommended or specified components and/or suppliers meets all environmental, physical, electrical, mechanical, functional, regulatory and durability requirements including all applicable system interface requirements, in the entity's area of responsibility, as described in the standard for the specified useful life.

1.8 Supplier Deliverables and Compliance Tracking

The Supplier shall deliver a PIM program compliance matrix that will provide traceability to the technical requirements, process-manufacturing capabilities, and overall program timing and all the referenced standards within this document or provided as part of the source package. The compliance matrix shall be delivered with the Supplier quotation and shall identify whether the Supplier proposed design, processes, validation, or manufacturing capabilities meets the requirements specified in this document. Any deficiencies shall be identified and a detailed explanation of all non-compliance items shall be discussed with Stellantis prior to Quote submission. The Supplier's acceptance to requirements in this document shall be absolute and cannot be rescinded at a later date without Stellantis engineering/purchasing and supplier operations.

Additionally, the following documents and/or files shall be delivered to Stellantis Engineering by the Supplier at all program milestones and other mutually agreed upon development stages in the program: The Supplier shall supply electronic searchable soft copies of the items within this section.

The Supplier shall provide part inspection and validation data that minimally includes:

- Verification of key mechanical and dimensional measurements or other characteristics
- Completed simulations, worst case analyses, FMEA's (failure modes and severities), DVP&R's and other analysis and reports as required based on the design phase.
- The supplier shall be prepared to share applicable DFMEA, DVP&R, PFMEA, and Control Plan documents during pre-sourcing technical reviews and ongoing design reviews. Reference: CS-00056
- Schematics in searchable PDF format and PCB layout excerpts for EMC evaluation.
- CAD Drawings for Inverter and necessary information for mechanical and thermal review of the PIM

- Test or characterization data that demonstrates the PIM design meeting required functionality based on feature roll out plan (FROP)
- Compliance and Traceability to open issues and technical issues based on hardware and software design changes or improvements
- Completed Requirement Analysis Report (Compliance Matrix) per CS.00077 and Component Version Validation Report per CS.00089. CS.00077 documentation shall be shared during sourcing and agreed with the DRE. The documentation must also include adherence or lack of compliance to reference documents listed in 2 REFERENCES
- Completed 01463_22_00308 _Filtering components characteristics_ referred to in Ch 6.8
- Virtual Fault Injection studies by Stellantis HIL/VRT team shall be supported with cracked inverter as required
- Other deliverables defined in the part inspection standard file in the source package

Additional Supplier deliverables are defined in the "*Supplier Deliverables and PIM Sample Definition"* document in Annex D. The Supplier shall also complete the Simulation and Analysis Planning Template in SD-A0311 and submit this document as part of their design proposal and quotation to Stellantis Engineering for approval.

2 REFERENCES

Table 1: Reference Documents

DOCUMENT	DESCRIPTION
PF.901106	Traceability NOTE: for EMEA, APAC and LATAM
9.55842/MS.90089	VARIOUS METALLIC PART PAINTING NOTE: for EMEA, APAC and LATAM
PF.90303	WIRING HARNESS – ASSEMBLY PERFORMANCE
01158	EMBOSSING CODES FOR FINISHING COMPONENTS AT SIGHT
07210	STANDARD UNIFIED DIAGNOSTIC SERVICES (UDS) ON CAN FGA / CHRYSLER
07287	ECU FLASH REPROGRAMMING Stellantis REQUIREMENTS DEFINITION BASED ON UDS SPECIFICATION 07210
07740	Qualification of production parts new components (buy)
09010	STANDARD DIAGNOSTIC REQUIREMENTS ON UDS FGA/CG
50180	CORROSION TESTS NOTE: for EMEA, APAC and LATAM
09010/01	DIAGNOSIS ADDRESSES AND NODE IDENTIFICATIONS FOR COMMON EE ARCHITECTURE FGA/CHRYSLER CONTROL UNITS
09010/02	STANDARDIZED DIAGNOSTIC DATA - UDS
52108844AA	Quick Connect Cooling Fitting
9.91320/02	CONNECTORS
AEC-Q10X/Q200X	Automotive Component Qualification Plans
CEP.00030	Global Component DFMEA template
CEP-042	WIRING, DEVICE CONNECTOR SELECTION REQUIREMENTS
CMVSS	CANADIAN MOTOR VEHICLE SAFETY STANDARDS

DOCUMENT	DESCRIPTION
CPM-INDEX	CHRYSLER PATTERN MATERIAL INDEX
CS.00010	Design Review for Electrical and Electronic Systems
CS.00010/02	Design Review for Electronic Systems - Hardware
CS.00010/03	Design Review for Electrical and Electronic Systems Diagnostic Protocols
CS.00010/04	Network Design Review for Electronic Systems
CS.00010/05	Design Review for Electronic Systems - Cybersecurity
CS.00011	NETWORK OPERATIONAL SPECIFICATIONS FOR THE CLASS C NETWORK WAKE UP STRATEGY
CS.00012	CAN Nodes-Stellantis Physical Layer Specification
CS.00012/01	Approved CAN and LIN Transceivers-Common Mode Chokes
CS.00012/02	NETWORK WIRING REQUIREMENTS
CS.00013	OEM-AUTOSAR Software Architecture
CS.00013/01	FCA Autosar Stack Change Management
CS.00014	Networking Autosar Requirements
CS.00016	AUTOMATIC CRASH NOTIFICATION, DIGITAL CRASH-OUTPUT PHYSICAL LAYER AND PROTOCOL
CS.00025	Diag Common Process Description
CS.00026	GENERAL HARDWARE REQUIREMENTS FOR POWERTRAIN ECUS
CS.00035	Embedded Switch Config
CS.00045	CAN STANDARD MESSAGE MAP FOR POWERTRAIN AND CHASSIS CONTENTS
CS.00046	FUNCTIONAL SAFETY MANAGEMENT PROCESS
CS.00046/01	FUNCTIONAL SAFETY MANAGEMENT PROCESS LEVEL II – WORKFLOW AND INSTRUCTIONS
CS.00047	FAS DIAGNOSTIC CARRY-BACK REQUIREMENTS
CS.00048	NODE IDENTIFIERS, DIAGNOSIS ADDRESSES AND ETHERNET MAC INSERTS
CS.00050	WIRING DESIGN AND PACKAGE REQUIREMENTS
CS.00051	FCA ITALY STANDARD UNIFIED DIAGNOSTIC SERVICES (UDS) ON CAN (LOW / HIGH SPEED)
CS.00052	GENERAL DIAGNOSTIC SPECIFICATION COMPLYING WITH COMMUNICATION PROTOCOL STANDARD CS.00051
CS.001	General Programming Requirements for Flash EEPROM, Extension for ECUs Compliant to Communication Protocol Standard CS.00051
CS.00054	ENVIRONMENT SPECIFICATIONS FOR ELECTRICAL AND ELECTRONIC HIGH VOLTAGE EQUIPMENT ELECTRICAL CHARACTERISTICS
CS.00056	CHRYSLER / FIAT - ELECTRICAL /ELECTRONIC (E/E) ENVIRONMENTAL SPECIFICATION
CS.00058	GUIDELINES FOR ELECTRICAL CIRCUIT DESIGNING

DOCUMENT	DESCRIPTION
CS.00077	Requirements Analysis Report (RAR)
CS.00089	Component Version Verification Report (CVVR)
CS.00091	FCA GLOBAL VEHICLE CYBERSECURITY STRATEGY: GATEWAY SECURITY MECHANISMS
CS.00092	FCA GLOBAL VEHICLE CYBERSECURITY STRATEGY: AUTHENTICATED DIAGNOSTICS ACCESS
CS.00093	FCA GLOBAL VEHICLE CYBERSECURITY STRATEGY: AUTHENTICITY OF FIRMWARE
CS.00094	FCA GLOBAL VEHICLE CYBERSECURITY CRYPTOGRAPHIC INFRASTRUCTURE
CS.00095	FCA GLOBAL VEHICLE CYBERSECURITY STRATEGY: MESSAGE AUTHENTICATION
CS.00097	FCA GLOBAL VEHICLE CYBERSECURITY STRATEGY: CYBERSECURITY ASSURANCE
CS.00098	FCA GLOBAL VEHICLE CYBERSECURITY STRAGETY: HARDWARE TRUST ANCHOR
CS.00099	DIAGNOSTIC REQUIREMENT STANDADRD - UDS
CS.00100	UNIFIED DIAGNOSTIC SERVICES (UDS) IMPLEMENTATION STANDARDS
CS.00101	ECU FLASH REPROGRAMMING REQUIREMENTS - UDS
CS.00102	STANDARDIZED DIAGNOSTIC DATA (SDD) - UDS
CS.00112	NETWORK OPERATING SPECIFICATIONS FOR THE GATEWAY
CS.00114	NETWORK OPERATIONAL SPECIFICATIONS FOR THE CLASS C NETWORK
CS.00119	HARDWARE REQUIREMENTS FOR AUTOMOTIVE ECUS
CS.00121	ECU FLASH REPROGRAMMING ADDENDUM - AUTHENTICATED FLASH REPROGRAMMING REQUIREMENTS (UDS)
CS.00124	SECURITY GATEWAY NETWORK REQUIREMENTS
CS.00130	Stellantis GLOBAL VEHICLE CYBERSECURITY STRATEGY: FIRMWARE OVER-THE-AIR
CS.00133	Global DFMEA – Working Instructions
CS.00144	STANDARD MESSAGE MAP RULES AND GUIDELINES FOR CAN AND CAN-FD NETWORKS
CS.00148	GENERAL SPECIFICATION FOR ADVANCED 'EOL' PROGRAMMING - PROXI
CS.00150	AUTOSAR Network Management Requirements
CS.00151	FCA SOFTWARE ARCHITECTURE USING AUTOSAR
CS.00158	GLOBAL VEHICLE CYBERSECURITY: PRODUCT LIFECYCLE SECURITY POLICY AND CERTIFICATES
CS.00176	ECU HARDWARE REQUIREMENT FOR FOTA
CS.00178	APPLICATION OVER THE AIR UPDATES: CYBERSECURITY REQUIREMENTS

DOCUMENT	DESCRIPTION
CS.00179	GLOBAL SERVICE DELIVERY PLATFORM (GSDP) DRM SIGNATURE
CS.00196	GENERAL ELECTRICAL AND EMC PERFORMANCE REQUIREMENTS FOR BEV AND HEV COMPONENTS
CS.11000	TRADEMARK IDENTIFICATION ON PARTS
CS.11405	Design for Environment Guidelines
CS.11736	Diagnostic Performance Requirements Standard (DPRS)
CS.11738	CAN NETWORKING PERFORMANCE SPECIFICATION FOR 125KBD/500KBD NETWORKS
CS.11825	ECU FLASH REPROGRAMMING REQUIREMENTS DEFINITION BASED ON UDS
CS.12227	STANDARD SOFTWARE - COMMUNICATION FOR ELECTRONIC CONTROL UNITS (ECU) GENERAL REQUIREMENTS FOR THE POWERNET ARCHITECTURE
CS.00171	PARTING LINE DESIGN SPECIFICATION FOR INJECTION MOLDED COMPONENTS AND TOOLING (E.G. STANDARD AND ZERO PL DESIGN SPECS)
CS.9003	SUPPLIER REQUIREMENTS FOR PRODUCTION AND SERVICE PARTS: MATERIAL CONTENT REPORTING, MARKING, AND RECYCLABILITY NOTE: for all plants worldwide, EMEA excepted
AS.00001	COLOR AND GLOSS REQUIREMENTS FOR INTERIOR, EXTERIOR TRIM, UNDERHOOD, AND FUNCTIONAL COMPONENTS
CS-A0403	High Voltage System Core Standard
CS.ROUTING	ROUTING REQUIREMENTS - TUBING, HOSE AND CABLES
CS-11729	UNIFIED DIAGNOSTIC SERVICES (UDS) – DIAGNOSTIC PROTOCOL
CS-A0288	FUNCTIONAL SAFETY MANAGEMENT PROCESS LEVEL II – NAFTA PT WORKFLOW AND INSTRUCTIONS
CS-A0513	O-RING CONNECTIONS FOR COOLANT, ENGINE OIL AND TRANSMISSION OIL DEVICES
CS.00081	CORROSION REQUIREMENTS - VEHICLE SYSTEMS AND COMPONENTS
DS-107	BSR DESIGN GUIDELINES
DS-11332	TEST-TO-FAILURE METHODS - EE COMPONENTS & SYSTEMS
DS-158	ERGONOMICS PROCESS DRIVEN DESIGN STANDARD
ECE	ECONOMIC COMMISION FOR EUROPE
FMVSS	FEDERAL MOTOR VEHICLE SAFETY STANDARDS
FPW.IFP057	TRACEABILITY
IEC 60664-1	INSULATION COORDINATION FOR EQUIPMENT WITHIN LOW-VOLTAGE SYSTEMS
ISO 26262	ROAD VEHICLES – FUNCTIONAL SAFETY
ISO-11898-1	ROAD VEHICLES -- CONTROLLER AREA NETWORK (CAN) -- PART 1: DATA LINK LAYER AND PHYSICAL SIGNALLING
LP.7M023	EVALUATION OF THE TEXTURE ON AESTHETIC AND TACTILE

DOCUMENT	DESCRIPTION
	SURFACES
LP-463DD-18-02	SCRATCH AND MAR RESISTANCE OF AUTOMOTIVE PLASTICS USING ERICHSEN SCRATCH HARDNESS TESTER
LP.7Z071	HIGH-SPEED CAN NODES NETWORK MANAGEMENT CHECK
LP.7Z079	ELECTRONIC SYSTEMS - LIN SYSTEMS TESTS
LP-384D-27	CAN 125/500 ECU TEST PROCEDURE
LV324/ED4701	Power Module Qualification Plan
MS.90053	COATINGS PERFORMANCE REQUIREMENTS FOR PAINTED INTERIOR PARTS
MS-3495	ALUMINUM CASTING INGOT AND SOWS FOR DIE CASTING
MS-4431	ALUMINUM ALLOY HOT METAL FOR DIE CASTING
MS.90011	ALUMINUM AND MAGNESIUM CASTING INSPECTION
MS-PZ-2-1	COATING SYSTEMS FOR EXTERIOR PURCHASED PARTS
PF.90012	STANDARD FOR AUTOMOTIVE ELECTRICAL CONNECTION SYSTEMS
PF-5262	SHIPPING CAPS AND PLUGS - AIR CONDITIONING SYSTEM PLUMBING AND COMPONENTS
PF-9710	AIR AND COOLANT TEMPERATURE SENSOR
PRO.00001	PROCEDURE FOR THE MAPPING OF COMPONENTS REQUIRING TEXTURE (GRAIN)
PS.50014	COPPER-NICKEL-CHROMIUM (CHROMIUM-PLATING) COATING OF THERMOPLASTIC PARTS
PS-1011	RADIOGRAPHIC INSPECTION OF CASTINGS
PS-11035	COOLING SYSTEMS EVACUATE AND FILL ATMOSPHERIC AND PRESSURIZED BOTTLE SYSTEMS
PS-11346	WARRANTY RETURNED PARTS AND ANALYSIS PROCEDURES
PS-11701	IN PLANT FLASH – SOFTWARE FLASH FILE HEADER FORMAT DESCRIPTION AND FLASH BAY FILE INTERFACE PROCESS FOR ENGINE CONTROLLERS
CS.00113	VEHICLE MARKING
PS-4480	IDENTIFICATION & BAR CODING OF PARTS
PS-4559<A>	DISTRIBUTION OF MASTER SPECIMENS FOR DESIGNATED APPEARANCE ITEMS
PS-5190	DIE CASTING - PROCESS CONTROL
PS-A0395	FLASH PROCEDURE REQUIREMENTS FOR ELECTRIFIED POWERTRAIN PIM OR MGU MODULES BY THE TRANSMISSION OR VEHICLE ASSEMBLY PLANT FLASH TOOLS
QR-10001	GLOBAL PRODUCT ASSURANCE TESTING (GPAT)
QR-10012	DIMENSIONAL QUALITY REQUIREMENTS
QR-10021	DVP&R Template (PD)
9.50207	PRESSED SHEET METAL COMPONENTS
PS-7000	Outside Designed & Developed Items- FCA US LLC and Supplier

DOCUMENT	DESCRIPTION
	Responsibilities
PF-EMISSIONS<E>	Identification of Emissions Items
PF-HOMOLOGATION	Product Homologation
PF-SAFETY<S>	PRODUCT SAFETY - USE OF THE SAFETY FLAG / SAFETY SHIELD
PS-7300<D>	Product Quality Use of Diamonds
CS.00080	FCA CAD STANDARD - GLOBAL REQUIREMENTS
PF-8500	Requirements For Verification, Validation and Continuing Conformance Testing.
PS-9227	CAD/CAM Data Exchange Policy
CS-9800	GENERAL REQUIREMENTS OF MATERIAL STANDARDS AND FCA SPECIFICATION SUBSCRIPTION SERVICES
CS.00022	General requirements for released drawings
PS-10052	INFORMATION SECURITY
FSD.00001/DIA<S>	BASELINE DOCUMENT - DEVELOPMENT INTERFACE AGREEMENT (DIA)
FSD.00001/SC<S>	Baseline Document DIA
PS-7099	GENERAL SPECIFICATIONS - FASTENERS AND FITTINGS
SQ.00002	MANUFACTURING FEASIBILITY ASSESSMENT (MFA)
SQ.00010	ADVANCE QUALITY PLANNING (AQP) & PRODUCTION PART APPROVAL PROCESS (PPAP)
SQ.00012	FOREVER REQUIREMENTS
LP.7T097	VEHICLE LEVEL - WATER FORDING -INTRUSION TEST
CS.00159	FAST COUPLINGS FOR FEEDING LINES OF ENGINE COOLANT AND PASSENGER COMPARTMENT HEATING DESIGN DIRECTIVES
PF.90331	QUICK CONNECTORS FOR ENGINE COOLANT
CS.00034	INSTALLATION DIMENSION OF COOLANT HOSES AND FITTINGS DESIGN DIRECTIVES
CD.80161	COOLANT HOSES AND PLUMBING ASSEMBLIES
SP.10024	PRE-OPENED CONSTANT TENSION HOSE CLAMPS
MS.90129	HOSE - HEATER/RADIATOR - TEXTILE REINFORCED - PEROXIDE CURED EPDM - HIGH TEMPERATURE RESISTANT
PF.90315	PLASTIC PIPES FOR ENGINE COOLANT LINES
SD-13438	GEOMETRIC DIMENSIONING AND TOLERANCING MICRO-STANDARDS FOR COOLING SYSTEMS – HOSE/TUBE ASSEMBLIES
CS.00171	PARTING LINE DESIGN SPECIFICATION FOR INJECTION MOLDED COMPONENTS AND TOOLING (E.G. STANDARD AND ZERO PL DESIGN SPECS)
CEP-A0782<E>	SUPPLIER AECD DISCLOSURE REQUIREMENT
CEP-045	MANDATORY AND DISCRETIONARY ENGINEERING STANDARDS
CEP.00060<S>	ACCEPTABILITY STANDARD FOR MANUFACTURING, INSPECTION AND TEST OF HIGH-POWER ELECTRONIC ASSEMBLY

DOCUMENT	DESCRIPTION
RR-A1051	PROPULSION SYSTEMS HARDWARE - SHARED DESIGNED AND DEVELOPED COMPONENTS/SYSTEMS
SAE J1939	RECOMMENDED PRACTICE FOR SERIAL CONTROL AND COMMUNICATIONS IN A VEHICLE NETWORK
SAE/USCAR-02	PERFORMANCE STANDARD FOR AUTOMOTIVE ELECTRICAL CONNECTOR SYSTEMS
SAE/USCAR-15	SPECIFICATION FOR TESTING AUTOMOTIVE LIGHT BULB SOCKETS
SAE/USCAR-21	PERFORMANCE SPECIFICATION FOR CABLE TO TERMINAL ELECTRICAL CRIMPS
SAE/USCAR-25	ELECTRICAL CONNECTOR ASSEMBLY ERGONOMIC DESIGN CRITERIA
SAE-J1211	Handbook for Robustness Validation of Automotive Electrical/Electronic Modules
SAE-J-1939	RECOMMENDED PRACTICE FOR A SERIAL CONTROL AND COMMUNICATIONS VEHICLE NETWORK
SAE-J-2284	HIGH-SPEED CAN (HSC) FOR VEHICLE APPLICATIONS
SAE-J962	FORMED TUBE ENDS FOR HOSE CONNECTIONS
SD.00015	GLOBAL VEHICLE CYBER SECURITY: SIGNING SCHEMES
SD.00045	VEHICLE CYBERSECURITY CRYPTO INFRASTRUCTURE TO CYBER BRIDGE REST API FOR AUTHENTICATED DIAGNOSTICS ACCESS
SD.00047	CYBER SECURITY CRITICAL FUNCTIONALITY OF ECUS
SD.00049	DIAGNOSTIC SERVICES SECURE ACCESS RIGHTS
SD.00053	MIRRORING CAN BUS TRAFFIC ON SECURITY GATEWAY EQUIPPED VEHICLES
SD.00078	CERTIFICATE FORMATS
SD.00080	SELF-UPDATER FIRMWARE UPDATE OVER WI-FI CYBER SECURITY REQUIREMENTS
SD-11401	DESIGN FOR SERVICE
SD-11471	STANDARDIZED DIAGNOSTIC DATA UDS
SD-11983	REQUIREMENTS FOR CHRYSLER COMPACT US WIDE (CUSW) ELECTRICAL ARCHITECTURE APPLICATIONS
SD-12009	TEST SELECTION MATRIX
SD-12018	Chrysler Diagnostic Source Package Addendum – Compact US Wide
SD-12219	EE Interface Checklist – Connectors and Wiring
SD-12501	PARAMETRIC EVALUATION TECHNIQUE (PET) SPREADSHEET
SD-12659	Supplier Process & Component Change Validation Requirements
SD-13152	ELECTRICAL TERMINAL PLATING CHART
SD-13296	FCA US Diagnostic Application New ECU Preprogramming Support Process
SD-13367	C-CAN1 AND C-CAN2 STANDARD VEHICLE NETWORK OPERATIONAL SPECIFICATIONS “ATLANTIS B” REQUIREMENTS
SD-A0087	BH-CAN2 STANDARD NETWORK OPERATIONAL SPECIFICATION

DOCUMENT	DESCRIPTION
	"VEHICLE CUSW" REQUIREMENTS
SD-A0311	SIMULATION & VIRTUAL ANALYSIS REQUIREMENTS AND PLAN FOR ELECTRICAL / ELECTRONIC PRODUCT DEVELOPMENT PROGRAMS
SD-A0517	DRBTR REQUIREMENTS FOR ELECTRICAL / ELECTRONIC / MECHANICAL PRODUCT DEVELOPMENT PROGRAMS
TS.80209/01	Wiring Harness Connector
CEP.00049	ACCEPTANCE STANDARD OF PRINTED CIRCUIT BOARD ASSEMBLY
CEP.00056	SUPPLIER FMEA REQUIREMENTS
UL 840	INSULATION COORDINATION INCLUDING CREEPAGE AND CLEARANCE DISTANCES FOR ELECTRICAL EQUIPMENT
RR-A1053	PROPULSION SYSTEMS HARDWARE - OUTSIDE DESIGNED AND DEVELOPED COMPONENTS/SYSTEMS

2.1 Order of Precedence

Deviations from this specification are permissible only with the express authorization of the design release engineer responsible. In case of disagreement between the text included on this specification and other documents cited herein, this specification has priority to anything else. However, nothing in this specification can replace applicable laws and regulations without a specific exemption. Discrepancy in this specification or difference between this specification and country-specific regulations shall be marked from the supplier without delay and it shall be discussed directly with the project engineer responsible.

All deviations shall require the Supplier to submit a Stellantis Engineering Change Request document prior to any PIM design freeze for approval. Additionally, at Stellantis defined milestones the Supplier shall be required to complete and submit Requirements Analysis (CS-00077), Component Validation (SD-12659) and completed DRBFM analysis documents.

2.2 Scope and Change Management

All deviations with respect to this document or its associated supporting documents on behalf of the supplier shall be addressed prior to the RFQ Response. The Supplier and Stellantis Engineering team shall use and document Change Request Form(Also known as project memo) for all individual changes/ deviations relevant to the PIM design as stated within this specification or its associated documents referenced within this specification prior to Beta Sample Design Freeze. All deviations from this specification or from Change requests applied prior to Beta Design Freeze shall be addressed through a formal Change Notice/Control Process. The formal change control process shall address the deviations and assign adequate amount and duration of tests to verify and validate the modifications requested. Post successful completion of full PV if any deviations are brought forward these shall be addressed via Change Control Process and SD-12659 template. Additionally, during each sample revision, the supplier shall provide adequate information detailing each individual change in the part or/and the process (Post DV). In all cases Supplier will be required to provide quotations for design changes within two (2) weeks from request. Quotations provided will include tooling changes and piece price changes, including break downs of labor and materials using the PBD format. All quotations are subject to evaluation by a Stellantis value analyst. The Supplier will provide any additional support documents for the analysis as required by the Stellantis analyst.

Cost, weight, investment status shall be updated with every design change and available at every AQP and Management review or upon request.

The Supplier will be required to use all efforts to ensure the design and sourcing of all the respective components results in the lowest piece price and investment achievable.

Changes required to meet original design characteristics/requirements/objectives will be at zero cost. A CN will be written to update design data with no cost effects. Changes may be initiated by the Supplier or Stellantis (ex. Fit & Finish changes {changing a radius, adding material to close gaps}, BSR elimination etc.). The updates to the models will be tracked in the Supplier model comment pages and then be pulled into TeamCenter under CN authorization.

With the approval of Stellantis Engineering, parts meeting fit, form, and function criteria, but not conforming to design characteristics, may be changed to conform to the part as produced. However, before this approval will be granted, the manufacturing process, along with error-proofing and control plans, shall demonstrate capability and stability.

Supplier initiated design changes will be at the Supplier's expense.

Stellantis initiated design change costs before tooling kick off may be submitted by the Supplier for approval to Stellantis only if the change results in additional material or direct assembly labor costs and:

- Additional content is added (above the specifications herein)
- Additional requirements are added to the program that the Supplier would not reasonably be expected to know.
    - Stellantis initiated design changes after tooling kick off shall add cost to Stellantis only if the change results in additional material or direct assembly labor costs and:
- Additional content is added (above the specifications herein)
- There is a change to the packaging environment for any of the system components.
    - In addition, costs of changing tooling may be submitted to Stellantis for approval only if any of the above specified conditions are met.

Any changes in the design planned by the Supplier at the time of this quote response shall be thoroughly detailed. All changes will be approved at Stellantis Engineering's discretion.

The Supplier is required to support and maintain the design through the entire life of the vehicle. This includes all NX models and TeamCenter. The Supplier shall also have eSupplier Connect portal access for all key personal and shall upload meeting minutes, design material, 3D models, etc,. to a designated Stellantis Collaboration Sharepoint site.

The Supplier will be responsible for replacing all active test parts if a failure occurs before specified performance requirements are reached.

3 DEFINITIONS/ABBREVIATIONS/ACRONYMS/SYMBOLS

Table 2: Definitions/Abbreviations/Acronyms

Acronyms	Definition
3PS	Three Phase Short
6SO	Six Switch Open
AC	Alternating Current
API	Application Programming Interface
BEV	Battery Electric Vehicle

REPB	Range Extended Paradigm Breaker
BICEEPR&U	Body, Interior, Chassis, Electrical, Engine System, Powertrain, Restraints & UConnect
BSR	Buzz, Squeak and Rattles
CAD	Computer Aided Design
CAN	Controller Area Network
CAN FD	Controlled Area Network Flexible Data rate
CC	Continuous Conformance
CMVSS	Canadian Motor Vehicle Safety Standards
Continuing Conformance (Post-Capability)	Post capability continuing conformance test program may be implemented after successful completion of the continuing conformance requirements. Tests must be completed with production parts on a continuing basis. Samples for these tests must be selected on a random basis to represent the entire production population as much as possible. In the event that any portion of these tests is not met, the reaction plan specified in the Supplier control plan shall be invoked.
Continuing Conformance (Pre-Capability)	Continuing conformance tests are used to demonstrate process compliance and must be completed using production castings, tooling, and processes. Continuing conformance tests are to be done at the specified frequency, until process capability or confidence is demonstrated per the defined test criteria. Continuing conformance tests are to be conducted at the specified frequency, for a minimum of three production days, or nine production runs, whichever is more stringent.
CUSW	Compact US Wide (New Chrysler vehicle architecture)
DC	Direct Current
DFMEA	Design Failure Mode and Effect Analysis
DOORS®	Dynamic Object Oriented Requirements System
DUT	Device Under Test
DV	Design Validation
DV	Design Verification
DVP&R	Design Verification Plan & Report
DVP&R	Design verification Plan and Report
E/E	Electrical/ Electronics
EAC	Electric Air Compressor
EAH	Electric Air Heater
EASL	Engineering Approved Source List
ECE	Economic Commission for Europe
ECU	Electronic Control Unit
ED	Engineering Development and Characterization
EE	Electrical/ Electronics
EM	Electro-Mechanical
EMC	Electromagnetic Compatibility
EPS	Emergency Power Supply

ESSD	Engineering Standards Supplier Distribution
EVCU	Electric Vehicle Control Unit
Stellantis	Fiat Chrysler Automobiles
Stellantis Italy S.p.A.	Used to be Fiat Group Automobiles S.p.A.
Stellantis LLC	Used to be Chrysler Group LLC
STLA	Stellantis
FMVSS	Federal Motor Vehicle Safety Standards
FSM	Functional Safety Management
HS	High Side
HSD	High Side Drive Output
HTHE	High Temperature Humidity Endurance
HTOE	High Temperature Operating Endurance
HV	High Voltage
HVIL	High Voltage Interlock Loop
HW	Hardware
I/O	Input / Output
IDCM	Integrated Dual Charging Module
IP	International Protection
kB/k Bd	Kilo Baud
LIN	Local Interconnect Network
LS	Low Side
LSD	Low Side Drive Output
LTOE	Low Temperature Operating Endurance
LV	Low Voltage
MCU	Motor Control Unit
ME	Mechanical Engineering
NVH	Noise, Vibration and Harshness
OBD	On Board Diagnostics
PET	Parametric Evaluation Test
PG	Proving Grounds
PIM	Power Inverter Module
PIS	Part Inspection Standard
PPAP	Production Part Approval Process
PSI	Integrated Test Plan (Piano Sperimentale Integrato)
PTCE	Powered Thermal Cycle Endurance
PV	Production Validation
PV	Production Validation

QRE	Quality & Reliability Engineer/ Engineering
SBC	System Basis Chip
SSTE	Shipping/Storage Temperature Exposure
SW	Software
Tenv.max	Maximum Environmental Temperature
Tenv.min	Minimum Environmental Temperature
TFO	Fiat Design and Organization Procedures
TH	High Temperature
TL	Low Temperature
Top.max	Maximum Operational Temperature
Top.min	Minimum Operational Temperature
TS	Thermal Shock
TTF	Test to Failure
UDS	Unified Diagnostic Services – An enhanced diagnostic protocol
UTmax	Maximum Operating Voltage
UTmin	Minimum Operating Voltage
UTtyp	Typical Operation Voltage
VP Build	Verification of Process Build

3.1 Ideograms (ISO Symbols) requirements

Not Applicable

4 SPECIAL TEST EQUIPMENT

All Test and validation equipment must be capable of performing the specified ED, DV, PV and CC tests and measuring the results of the test as specified in the requirements section of each respective test. All Supplier testing that is required for validation prior to a Stellantis MRD deliverable shall include a functional validation using Stellantis supplied application software. The Supplier and Stellantis shall develop a software development plan that meets the Stellantis software functional cadence and also meets the Supplier requirements for performing final testing with Stellantis supplied software. The Supplier should use the standard UDS protocol and definitions that are integrated into the Stellantis application SW for their testing where possible for supplier based final testing.

All test equipment used to test this part as specified by this standard and the standards referenced herein, shall be identified on the applicable Supplier's DVP&R, including detailed test procedures and shall be reviewed by the appropriate Stellantis Engineering Group prior to any ED (Alpha), DV (Beta), PV (Gamma), or Production/CC testing. All test equipment used to test or evaluate this part is subject to approval by the appropriate Stellantis Engineering, and shall provide continuous monitoring of test loads and process controlled variables. All characterization and validation data shall be retained and must have traceability to the applicable calibration standards. Prior to the Supplier beginning any validation phase the Supplier shall review test programs, tester controls, data collection, alarms, and shutdown limits for each test bench. Additionally, the Supplier shall provide test reports for each test bench based on the test commission and executing of the intended test. See the Stellantis provided Part Inspection Standard and Stellantis core PIM DVP&R for additional requirements for each PIM that is provided to Stellantis independent of design level, i.e.,Alpha, Beta, Gamma or series production.

The Supplier is responsible for designing, developing, building and/or purchasing the testers, load boxes or any other vehicle interfaces that are required for end of line testing, functional/validation testing and life testing along with the corresponding continuous measurements that are required to be taken. The PIM (DUT) shall be tested with dedicated power supplies, simulated motor loads and other simulated I/O and loads that replicate vehicle power busses or controls with vehicle noise signatures as detailed by the Supplier and approved by Stellantis Engineering. The use of a PIM as a load for another PIM under test shall not be allowed. Testing that requires full functionality with high voltage applied must be reviewed and approved by Stellantis Engineering. The Supplier shall have the capability to perform continuous electronic monitoring of the PIM to detect and record intermittent operation throughout all required tests. The monitoring methods and acceptance criteria shall be agreed upon by the Supplier and the Stellantis Product Release Engineer prior to the start of testing. Test equipment shall be capable of performing the tests and measuring the results of the test as specified in the requirement section of the referenced test.

4.1 Test Equipment and Fixture

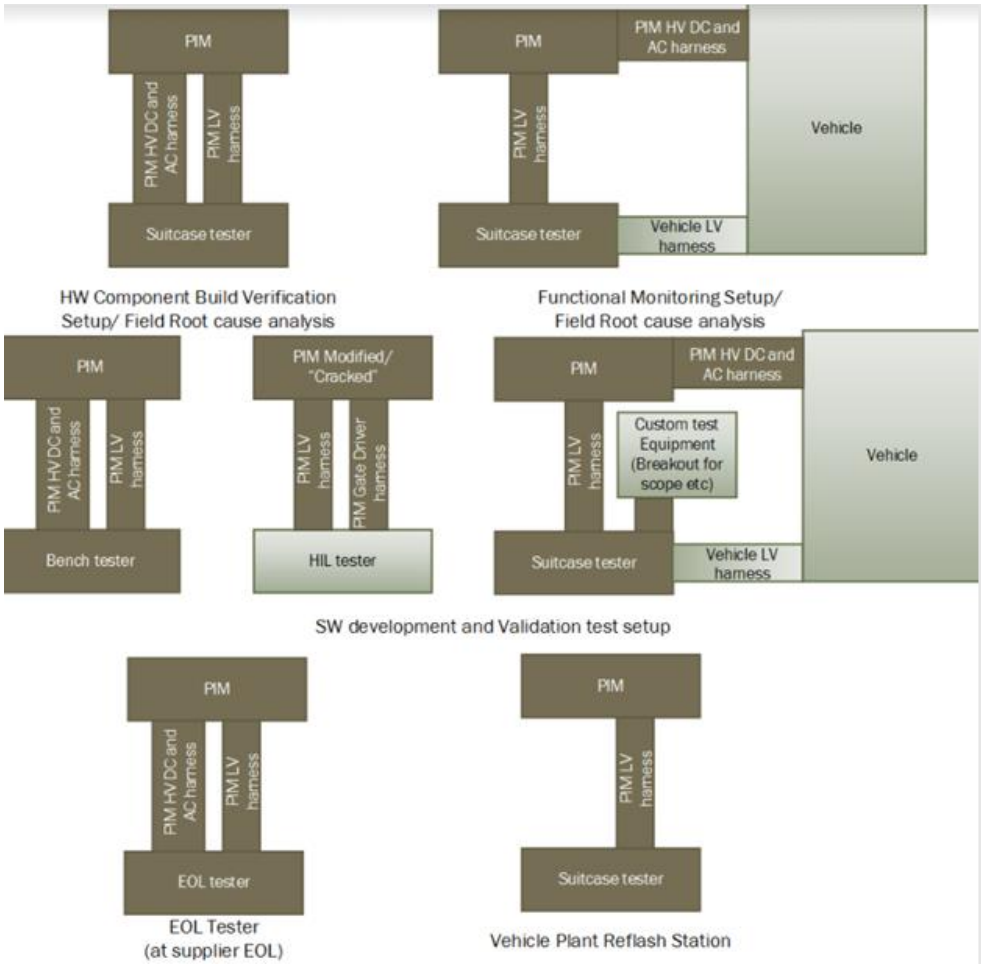


Figure 6: Various Test Setups

4.1.1 PIM Tester/Load Box

The Supplier is responsible for designing, developing, supplying, and updating (when necessary) based on PIM HW design changes to six (6) High Voltage (with gate driver-motor interface) and four (4) Low Voltage bench testers/load boxes for Stellantis Engineering. These tester/load boxes will be used by

Stellantis Engineering to aid in system/software verification. The testers/load boxes shall be able to interface with all PIM I/O including all communication buses and developmental interfaces. For each PIM I/O pin, the tester/load box shall be capable of providing the necessary input stimulus and output loads to allow for validation of control board hardware and software functionality. Additionally, the testers/load boxes shall be capable of switching all circuits to a short to ground or a voltage as well as providing an open circuit. The bench testers/load boxes shall be complete and supplied to Stellantis Engineering in conjunction with the delivery of the first PIM Alpha samples. The HV tester/load box will include LV tester/load box functionality as well as providing simulated loads and circuitry to support SW and motor control development without the presence of HV. Gate driver loads and feedback circuits/signals shall be provided in the HV load box so that typical power module faults and operation can be simulated. The design of the high voltage and low voltage bench testers shall be proposed by the Supplier and approved by Stellantis Engineering. The Supplier shall also provide all cables/harnesses required to interconnect the tester/load boxes to the PIM. The Supplier shall quote these tester/load boxes as a separate line item during the quoting process.

Additional requirements (PIM supplier shall meet the requirements applicable to the Gate driver board):

1. All digital, analog, and PWM I/O shall have breakout for banana plug connection for signal probing, connection to scopes.
2. Breakout bananas can be in the same test/load box or a separate breakout box. (Sometimes generic 'entire connector' breakout boxes are used.)
3. Shall be bananas for 12V Power Supply connection. Shall be a switch for Power On/Off. Shall be a separate switch for Key On/Off.
4. Controller digital outputs and PWM outputs (6 typical) shall also have LED in the test/load box to show if DO/PWM is on/off.
5. Controller digital input shall have switch and LED in the test/load box to allow assertion of DI on/off.
6. Controller analog inputs shall have potentiometer knobs to allow full range assertion of AI signal.
7. CAN interface(s) shall be present in the test/load box as typical DB9(s).
8. SPI interface to GDICs (if included in controller design) via Gate Drive Connector should not be routed to the test/load box. The wiring harness shall include SPI interface signals and present all these to a readily available connector in shortest wiring length possible. [Tx, Rx, Clk, Gnd, CS1..6 --- 10 pins total.]
9. The test/load box shall include a resolver emulator. This can be a DB9 presented to the box external and then a typical resolver spin stand connected to test box DB9, with separate resolver spin stand connection to a power supply. If the resolver spin stand approach is taken, then there shall be one resolver spin stand per test/load box. We need two of it.
10. Add Control Board and Gate Driver Board layout must be such that critical test points shall be accessible when using the Bench top versions of the HW. For this purpose additional adaptor boards may be considered or Test points in layout may be appropriately placed. A searchable layout drawing showing accessible points for critical power supply outputs, signal output/inputs, reset line and fault status signals shall be provided with each HW release to Stellantis.

4.1.2 HIL Testing

The PIM supplier shall refer to the XILProjectSource_WorkPackage_MCP document shared with the source package and other supporting source package documents and requirements in their entirety and provide a written ‘Response for Quote’ addressing acceptance, rejection or clarifications needed to the deliverables and requirements. If there are any requirements that can save cost, complexity, etc. the Stellantis XIL team is open to negotiations to modify deliverables or requirements. If timing of deliverables cannot be met, negotiations will be necessary to find solutions that work for Stellantis and the supplier.

XILPROJECTSOURCE_WORKPACKAGE_.docx

4.1.3 Functional / Parametric / End of Line (EOL) Tester

1. The supplier shall conceive an end of line test interface based on the Control Board and Low level drivers provided or approved by Stellantis to verify the end item assembly and basic functionality at end of line (EOL Tester), at Vehicle Plant and Service at Dealership (Suitcase Tester).
2. The supplier shall focus the scope of these tests to ensure the assembly of the product.
3. In areas where critical, relevant and feasible functional verification may be appended to the scope of deliverables.
4. The EOL test setup and Suitcase tester shall have appropriate ESD protection implemented.
5. All development units sent to Stellantis shall be tested adequately using a burn in process to simulate 5% of design life prior to shipment.
6. Supplier shall be able to track the number of burn in cycles and EOL test cycles performed within the memory of the PIM. Similarly, the test equipment shall monitor the number of operational cycles it has been used for and a maintenance program planned to monitor and control the wearing of the test setup
7. Test SW development shall be the responsibility of the PIM Supplier
8. Supplier shall share evidence of 100% component test coverage plan with Design Release & Validation Engineer using EOL processes inclusive of tests required by the PIS sheet, ICT tests, AOI inspection and other tests
9. The supplier is restricted to use lower than 60V within the suitcase tester but shall be capable of emulating HV load performance in instances such as inverter switching, testing of active discharge circuits etc.
10. The supplier shall have no restrictions on use of HV at EOL test setup in their Inverter assembly facility.
11. The supplier shall leverage reuse of common development tools to optimize the size of the suitcase tester. However, supplier shall plan for required LV signal generators by implementation of appropriate circuits within the suitcase tester.
12. A power supply regulated at 12 Volts +/-1.0 Volts DC with less than 1% AC ripple, and provide a minimum of 25 amps of current must be derived internal to the Suitcase tester from commonly available outlets in North America or EMEA. This power supply must be capable of operating in the range of 5V to 30V.
13. Other internal power supplies must be derived from the above 12V supply.
14. Connector types used for suitcase tester must be commonly available banana jacks, BNC connectors etc. LV connector harness should have capability to meet multiple mating cycles beyond the typical use case covered by vehicle production intent.
15. A representative block diagram allowing the user to understand the nature of internal routing shall be placed on the suitcase tester visible while operating the device.
16. A separate user manual shall be maintained and shared with Stellantis team as a soft copy. This document shall provide the operating procedures for various test modes, summary of tests and coverage of build verification.
17. All failure modes identified with Severity rating greater or equal to 7 must be detectable by the use of the Suitcase tester. Any deviations shall be notified to the Design release engineer at sourcing.
18. The Suitcase Tester User Manual shall provide for pass/fail criterions aligned with Worst case analysis and correlated with data from EOL tester.
19. The Suitcase Tester User Manual shall also contain the block diagrams, grounding strategy in each test configuration and schematics for the Suitcase tester.
20. Functionalities that must be considered for testing capabilities at EOL and Suitcase tester are provided below. Supplier is expected to provide compliance to following capabilities, and if any deviations exist it must be brought up prior to Project supplier sourcing completion.

a. Basic Passive checks (Power Stage assembly in circuit test, Control Board integration in Circuit test, PIM End assembly and Suitcase tester)
   - Cap Measurement
   - Resistance Measurement
   - Isolation measurements
   - Continuity Checks

b. Basic Power up Check (Power Stage assembly in circuit test, Control Board integration in Circuit test, PIM End assembly and Suitcase tester)
   - Voltage Measurement for all internal and external voltage sources
   - Power Draw current measurement for all external voltage sources and loads
   - CAN communication
   - Stellantis SW and HW version verification
   - Acquire Stored fault memory data
   - SW reflash capability
   - SPI Communication verification with GDIC
   - LV Load/ Source Emulation (Switch, Potentiometer, Rheostat, PWM generator)
   - Sensor Evaluation (Current, Voltage, Position sensing)

c. Power Stage Assembly Verification (Power Stage assembly in circuit test, Control Board integration in Circuit test, PIM End assembly and Suitcase tester- Reduced voltage)
   - Active discharge verification
   - Passive discharge verification
   - Emergency Power Supply verification
   - IGBT Switching performance (Rise/ fall time)

d. Vehicle-in-line testing(Suit case tester)
   - Signal Monitoring for scope (BNC)
   - Signal Monitoring for DMM (banana jack)
   - LIN activity Monitoring
   - Park Pawl testing

e. Build assembly test (End assembly tester)
   - Burn In Test-5% PTCE emulation with capability to exercise load through 9 point functional ranges.
   - Leak test
   - AOI inspection as applicable
   - 100% Check by camera

21. The supplier shall as part of the quoting process provide for a quote of 4 suitcase testers.

4.1.4 Test Software

The supplier shall work with the Control board supplier to provide Stellantis with PIM CB executable test software that has a PC based graphical user interface (GUI). The PC based GUI shall send commands over the CAN bus to a PIM running the executable test software for the purpose of actuating loads and reading sensors at a hardware device level. The test software shall be capable of reading inputs and actuating all loads simultaneously or individually. The special test equipment described in Section 4.1.1 above shall provide the PIM with the required inputs and loads. This software is intended to validate the hardware during the engineering development (DV) phase of the program. The supplier shall contact Stellantis PIM Control Board Engineering for information on test software execution requirements and communication protocols.

4.1.5 Special Test Equipment

The test equipment shall be capable of performing the tests and measuring the results of the test as specified in the requirements section of each respective test (See Table 3: Special Test Equipment). Additionally, in accordance with the reference documents CS.00056 and QR-10001, the supplier test

equipment shall be able to monitor and record key functional parameters as defined in conjunction with Stellantis to compare the statistical distribution of the sample population based on desired reliability/ confidence (such as, R95/C90 or R90/C90) to demonstrate conformance to acceptance limits during design validation process.

Parametric Evaluation Technique (PET) analysis is defined in “Global Product Assurance Testing (GPAT)” manual, QR-10001. For PET analysis during DV and PV tests (refer to red pentagon in the test flow sequences in Annex B of CS.00056), samples shall be measured for key functional parameters before start of any testing (pre-test measurement) and after completion of all tests (post-test measurements) under selected temperature/ voltage conditions (9, 7, 5 or 3 point checks). Suppliers shall use PET spreadsheet SD-12501 to demonstrate reliability/confidence targets specified in the component specific performance standard. All power supplies used in the test shall use remote voltage sensing at the unit under test point of load.

Three point checks shall be used only for the functional checks (blue diamond in the test flows in Annex B of CS.00056). Nine or seven point checks shall be used for “Safety or Powertrain” applications and at the minimum five point checks shall be used for convenience applications as part of full parametric checks at the start and end of the tests (red pentagon in the test flows in Annex B of CS.00056).

Table 3: Special Test Equipment

Function Tested	Test Equipment Specified
PTCE	High Voltage Power Supplies, HV Motor Loads
	High Pot Tester
	Capacitance test meter
	HVIL simulator
HTOE	High Voltage/Low Voltage Power Supply, Load & Motor simulator
EMC Testing	EMC Test Lab approved by Stellantis Engineering, High Voltage Power Supplies and Motor Loads are required to be operational during EMC component testing. The Supplier EMC Test Plan must be approved by the Stellantis EMC group.
Vibration Testing	High Voltage/Low Voltage Power Supply, Load & Motor simulator

4.1.6 Measurement Resolution

Test equipment must be capable of measuring the defined parameters in this PIM specification with resolution / accuracy one significant digit greater than quantity being measured. For example, even though a 0.1mA and 0.10mA might be the same current, an ammeter capable of 0.01mA may be used to measure the first current but an ammeter with 0.001mA resolution is required to measure the second current.

4.1.7 Test Repeatability and Calibration Requirements

Repeatability studies shall be performed on all laboratory equipment after initial calibration and before their use for product evaluation. Individual meters and gages must be certified to the manufacturer’s specifications. All equipment used for product evaluation shall be repeatable to within 10% of the specification value. Calibration Certificates or equivalent documents for all test equipment shall be

provided to Stellantis Engineering prior to starting validation and are to be kept on file for a period of one year unless specified differently by the Stellantis Product Release Engineer.

4.1.8 Tolerances

Unless otherwise specified, room temperature shall be a default temperature for all tests. In the absence of any tolerance specification, the following default tolerances shall apply:

Table 4: List of Default tolerances

Frequency	+/- 1% of stated frequency across module.
Humidity	+/- 5% RH in a range from 20% to 95% over a dry bulb range of +38 degrees C (100 degrees F) to 85 degrees C (185 degrees F). +/- 10% RH in a range from 20% to 95% over a dry bulb range of +20 degrees C (68 degrees F) to +37 degrees C (98 degrees F) +/- 15% RH in a range from 20% to 95% over a dry bulb range of +7 degrees C (46 degrees F) to 19 degrees C (66 degrees F)
Temperature	+/- 2 degrees C (3.6 degrees F)
Time	+ 5%, -0%
Vibration	+/- 3dB in the PSD profile over the test range +/- 5% of the specified Grms level (average for a control loop)
Supply Voltage	+/- 3% of the smallest voltage supplied
Current / Load	+/- 3% of specified value
Resistance	+/- 1% of specified value
Force	+/- 5% of specified value
Distance	+/- 1% of specified value

4.1.9 Default Parameters

Table 5: List of Default Parameters

Default Battery Voltage	13.5 +/- 0.5VDC measured at the PIM
Ambient (Room) Temperature	23 +/- 5 degrees C or 73 +/-9 degrees F
Relative Humidity	50% +/- 30%
Atmospheric Pressure	650mm Hg- 800mmHg

4.2 Testing Requirements

Prior to the first component MRD or any validation testing, the supplier shall be required to deliver Failure Analysis process based on DRBTR process and Stellantis requirements.

It is mandatory for the Supplier to demonstrate 100% success for all the tests listed within this specification. A test shall be considered successful if the component functional and parametric checks conform to requirements referenced or stated within this specification after the completion of each applicable test. Additionally, the DRBTR process should reveal no serious deviations at sub-component level indicative of quality and reliability concern.

If a component fails during any test, the Supplier shall conduct root cause analysis that may include disassembly of failed components and/or some other diagnostic tests to determine cause(s) of failure(s). Any disassembly shall be based on inspection procedure that includes inspection/measurement charts, pictures and other physical measurements as detailed in the Failure Analysis procedure (DRBTR). The Supplier shall provide a full 8-D report to Stellantis detailing the root cause of the failure. Disassembled components shall be inspected for potting/seal failures, liquid/solid intrusion, corrosion, etc. as applicable. This part shall meet the testing requirements as specified in CS-00056. The failed tests shall have root cause and 8D’s submitted with Stellantis engineering approval prior to the mandatory repeating of any failed test or prior tests in the affected test leg. If the failed test required conditioned parts, then the Supplier shall provide parts that meet the approved DV/PV plan.

Furthermore, the supplier shall have full power EOL test capability with temperature controlled liquid cooling if required in their PIM manufacturing process. For Safe Launch Plan (SLP), the supplier shall provide a functional full power cycling capability for a minimum of two hours. Once the supplier has proven process capability then Stellantis will consider a reduction in the burn-in requirement but the requirement for full power EOL testing will not be relaxed. See Stellantis provided Part Inspection Standard and Stellantis core DVP&R for additional requirements.

4.3 Test Documentation

Supplier shall provide a written report on the complete qualification procedure as described within this specification. The testing procedures (equipment including test parameters, test environment, test sequence etc.) and detailed test results (results of parametric measurements as defined in CEP.00056, additional documentation such as photographs, diagrams etc.) shall be documented according to the engineering state of the art (results measured as numerical values must not be reduced to pass/fail information but should be documented as numerical values) and shall be delivered to Stellantis Product Release Engineer on request and at the completion of ED/DV/PV and production CC testing. All PIM's provided to Stellantis shall be traceable to the supplier supplied functional, characterization, validation or production EOL test as defined in the Stellantis provided Part Inspection Standard and Stellantis core PIM DVP&R independent of design level, i.e Alpha, Beta, Gamma or series production.

The Supplier shall document test plans and results in the Stellantis approved "Design Verification Plan and Report (DVP&R)" template.

5 APPEARANCE / PHYSICAL / MECHANICAL & INSTALLATION REQUIREMENTS

5.1 Appearance Requirements

Note: The following appearance requirements are applicable based on the packaging location of the PIM, they are applicable if the PIM is mounted to the generator motor and these appearance requirements might not apply if the PIM is mounted to the chassis.

For Stellantis designated appearance items (AS-10119<A>), under Stellantis purchase orders for Stellantis Joint-Venture (JV) programs, Mopar and its suppliers; the following appearance requirements shall be met representing the minimum requirements. The requirements as noted below will be assessed and verified by the appropriate Stellantis Studio(s).

If the PIM has a first appearance surface: inside cabin/ trunk/ underhood it shall meet Stellantis applicable requirements:

- All reference graphics, Design Office Information transmittals, Master Letter Patterns (MLP's), artwork, clear-cells, texture and color Master Specimens, etc., used for the development of production-level components/assemblies must be specified, released, and approved by the Stellantis Product Design Office.

- All individual components of these assemblies must be reviewed and approved for design intent by the Stellantis Product Design Office assigned Studio Manager or Lead Designer. Surface requirements for parting line executions must meet CS-8891<A>. A-Surface gates are prohibited, unless otherwise agreed to by the Product Design Office. Failure to comply will result in automatic AAR rejection for appearance PPAP.

- As applicable, all Pre-texture, Post-texture, Graphics/Ornamentation approvals must be followed, adhered to, and documented on the Appearance Approval Report (AAR) form, per CS-9022<A>.

- If production-intent components include a 1st surface coating (such as, paint), then the parts submitted must represent both the pre-process (unpainted) and post-process (painted) conditions.

- All production-level graphics or illuminated display technologies on components must be visually reviewed and approved for design intent by the Stellantis Product Design Office assigned Studio Manager or Lead Designer, prior to X0 and X1 production builds.

- Final production-level components/assemblies (built-up) must be submitted and approved by Stellantis Product Design Office assigned Studio Manager or Lead Designer, prior to submitting the Appearance Approval Report (AAR) package per CS-9022<A> to the appropriate Studio for Material, Color, and Gloss evaluation of appearance PPAP submit.

For Stellantis Italy appearance components/assemblies (07724), under Stellantis Italy purchase orders for Stellantis Joint-Venture (JV) programs, Mopar, and its suppliers; the following appearance requirements shall be met representing the minimum requirements. The requirements as noted below will be assessed and verified by the appropriate Stellantis Italy departments.

Since the (Add part/commodity name here) has a first appearance surface: inside cabin/ trunk/ underhood/ residing on body exterior/ or functional application (delete any text that does not apply from the previous wording), it shall meet Stellantis Italy applicable requirements:

- All texture/color Master Specimens, etc., used for the development of production-level components/assemblies must be specified, released, and officialized by the Stellantis Italy CoDeP group. Masters will be distributed by Stellantis Italy Purchasing.

- As applicable, all components specified to receive grain (texture) through photogravure (chemical/acid-etch) process must follow Procedure PRO.00001 to ensure aesthetic certification and accurate communication utilizing properly completed Tool Graining Specification Sheet (TGSS) document.

- Final production-level components/assemblies (built-up) must be submitted and approved by the appropriate Stellantis Italy department for Appearance PPAP - 07740 per LP.7M029 for the color evaluation, LP.7M032 for the gloss evaluation, and LP.7M023 for the grain (texture) evaluation. Successful completion of these assessments and respective test results will be documented on the Technical Approval Form (TAF) to obtain official approval.

5.1.1 Aesthetic Requirements

For Stellantis sourced designated appearance items (AS-10119<A>) under Stellantis purchase orders or Stellantis Italy sourced appearance components/assemblies (07724) under Stellantis purchase orders Joint-Venture (JV) programs, Mopar, and its suppliers; consider the following:

It is recommended that a consensus meeting be scheduled during CAD Step 2 (prior to Pre-sourcing packages) between the responsible groups (ie: Engineering, PDO, EQ&C, Centro Style, Purchasing) to communicate the specific direction that must be understood and could affect sourcing decisions.

Examples of appearance characteristics, attributes, or features can be associated with, but are not limited to materials, texture (grain), finishes, pattern, orientation, process technology, tooling, color, etc.

There must be guaranteed aesthetic quality of the component and aesthetic matching of the components with the adjacent parts.

5.2 Physical Requirements

The supplier shall demonstrate dimensional capability of P99C90 during DV and PV phase respectively for any key dimensions identified on CAD files (CATIA/ NX) or other digital or electronic media describing the module/ component design specifications. The Components shall not show any signs of BSR after Vibration, Shock and Handling Drop tests.

5.2.1 Material Requirements

The PIM shall be compliant to the Annex II in European directive 2000/53/EC, decision number 2010/115 and following updates. The PIM shall have a 94-V0 Flammability Classification, according to the UL 94 standard.

5.2.1.1 Casting Material Selection, Process and Inspection Requirements:

The casting material selection shall be jointly reviewed and approved by Stellantis engineering. The supplier must consult with Stellantis for the material selections. Vehicle architecture and ACE team will provide the material requirements as per functional crash, durability and NVH simulations. The results of these simulations will be the mandatory requirements for the material selection with mechanical properties.

Based upon above specified requirements, the supplier needs to refer to below Stellantis specification for selection of materials. The casting process and inspection requirements should comply with the standards below in Table 6.

Table 6: Casting and Inspection Standards

PS-5190 CLASS F-2	DIE CASTING PROCESS
MS.90011 Service Class 1	ALUMINUM CASTING INSPECTION
PS-1011	RADIOGRAPHIC INSPECTION
ASTM E 505 LEVEL III	STANDARD RADIOGRAPHS FOR ALUMINUM DIE CASTING
PS-1128	FLUORESCENT LIQUID PENETRANT INSPECTION
CS-11171	PART VALIDATION STANDARD
MS-10372 Grade A MS-10372	IRON DUCTILE ALUMINUM DIE CASTING LOW IRON DUCTILE ALUMINUM DIE CASTING
*MS.50125	Die Casting Aluminum and Magnesium
*MS.50115	SAND AND PERMANENT MOLD CASTINGS

*Needs Stellantis engineering team approval for the selection of casting materials.

- Material with high elongation, yield and ultimate stress such as A356 and A365 are recommended. If required, the supplier shall apply a heat treatment process to meet the requirements. Material with lower material properties such as yield, ultimate and elongations are not recommended, such as A380, A360, A383 etc. unless otherwise reviewed and approved by Stellantis engineering team.
- The verification of casting material properties such as Tensile test shall be performed as per ASTM B557M, ASTM E8/E8M or equivalent approved by Stellantis to meet minimum material properties defined by supplier and Stellantis. Supplier shall obey the Stellantis safety simulation recommendation for Tensile test requirements.
- The Pass/Fail criteria shall be defined by reliability or durability per QR.10001.
- The casting material properties shall be defined in the drawing such as, minimum yield, ultimate and elongation and if required by Stellantis, the material properties must be either diamond or Safety key characteristics. Supply shall obey the control plan and inspection requirements as specified by critical characteristics.

- Supplier must perform casting inspection as per MS.90011 Service Class 1 due to high voltage safety components. Any deviation will need Stellantis engineering team approval.
- Supplier must provide the 100% X ray inspection reports for the all DV and PV samples as part of the test plan approval process. The DV/PV tests should not be started without X-ray inspection approval from Stellantis engineering.
- Supplier shall mention the critical and non-critical interfaces for the X ray inspections. Critical interfaces shall include coolant channels, all sealing surfaces and machining interfaces as a part of 2D drawing with minimum allowable casting porosity definitions.
- The part manufacturing process for the DV and PV must be similar. For example, if the supplier wants to use die casting as a production process then DV parts must use the same process. Any deviation will require Stellantis engineering team approval.

5.2.1.2: Stamping Component Material

The Stamping material shall meet requirements as per Stellantis specification MS-8580. If coating is required, then it shall follow Stellantis specification PS-11036 OR PS.50031.

5.2.1.3: Corrosion Requirements:

The components shall meet corrosion requirements as per Stellantis specification CS.00081. For BEV vehicles, the component shall meet the 12 years of service with no loss function or perforation due to corrosion, unless otherwise specified. For PHEV and MHEV, the component shall meet the 15 years of service with no loss function or perforation due to corrosion, unless otherwise specified. If common parts are used in BEV & PHEV, they default to 15 years. Also, refer to the CS.00081 for more information.

5.2.2 Dimensional Requirements

The PIM shall meet the dimensional requirements specified in the released engineering drawing and shall adhere to the procedures and guidelines identified in Stellantis QR-10012, Dimensional Quality Requirements.

5.2.3 Weight Requirements

The target weight of PIM is less than 15kg.

5.3 Mechanical Requirements

The PIM along with its HV, LV electrical connector(s) and thermal coolant inlet and outlet ports shall fit in the packaging space claim, and meet the system weight target.

Table 7: PIM Space Claim

800V PIM Variant	Length	Width	Height	Height with coolant port
300 kW	414mm	310mm	160mm	

The reference PIM design CAD file is shared with the source package, the PIM supplier can use it for identifying the overall PIM packaging and mounting points on to support structure. The final design will be reviewed by the Stellantis engineering team before design freeze.

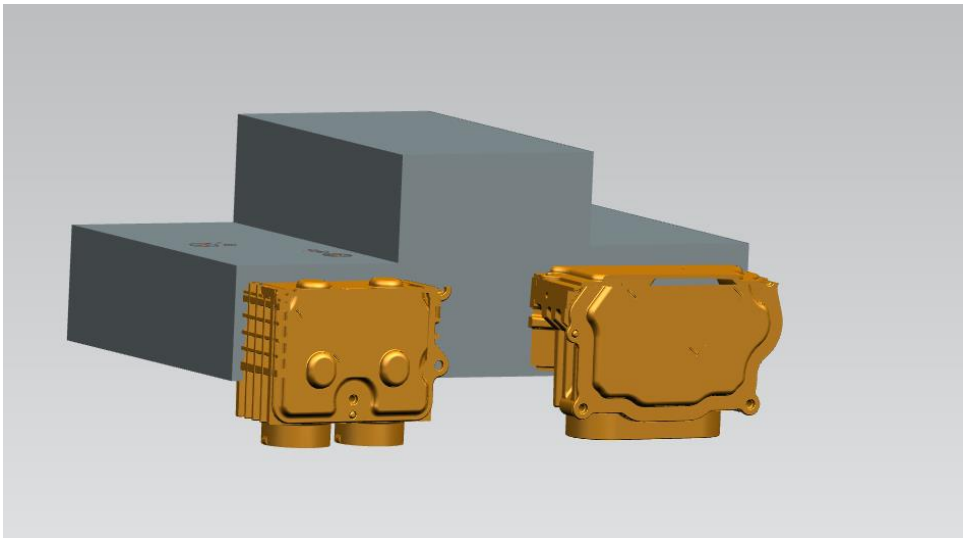


Figure 7: Reference Generator PIM space claim

NOTE 1: If module size and/or weight needs to be expanded beyond maximum dimensions specified, approval must be obtained by Stellantis.

5.3.1 PIM Mounting requirements

The supplier shall use minimum M8 size mounting screws to install the component to the next level component in the system. Any other mounting strategy needs to be discussed with Stellantis engineering team. This is applicable to the components direct assembly to Stellantis vehicle plant or sub-assembly as well as sub-suppliers. The mounting position will be defined and discussed with the Stellantis at a later date if the supplier is manufacturing only the PIM module. The component should meet the Stellantis vehicle functional requirements at any vehicle installation/mounting orientations. The supplier must prove that different orientations of the components do not impact the thermal efficiency by performing the required pressure drop and thermal simulations.

5.3.2 Coolant Ports

The Coolant ports design shall be designed as per Stellantis specification CS.00159 solution A without angular references. The supplier shall share the coolant port drawing for Stellantis approval and the drawing shall include dimensions, tolerances, material, coating and assembly requirements.

For poke-yoke, the coolant tubes shall be in two different diameters. Inlet diameter of the coolant port shall be bigger than outlet. The selection of the coolant port diameter shall be based upon the supplier module thermal simulation results. The supplier adheres to the corrosion requirements for the coolant ports.

5.3.3 Fasteners

The Stellantis engineering recommends the supplier to have a standard MAT point for the internal and external fasteners to avoid the cross threading during assembly. All fasteners shall meet the minimum thread engagement as per Stellantis specification PS-809 Table 4 and corrosion requirements.

The supplier shall pre-capture the screws for any end assembly sub-component that is installed at the Stellantis plant. It is mandatory to perform the joint validation (Torque Testing) on all fasteners before the DV test. The supplier needs to provide the testing results with Torque graph and pictures of the testing parts to show the failure mode. The Supplier shall provide the fastener specifications at the time of CDR

(Critical Design Reviews) in the Stellantis recommended template and Stellantis recommended templates will be shared before CDR.

For fastener corrosion requirements, please refer to the below chart:

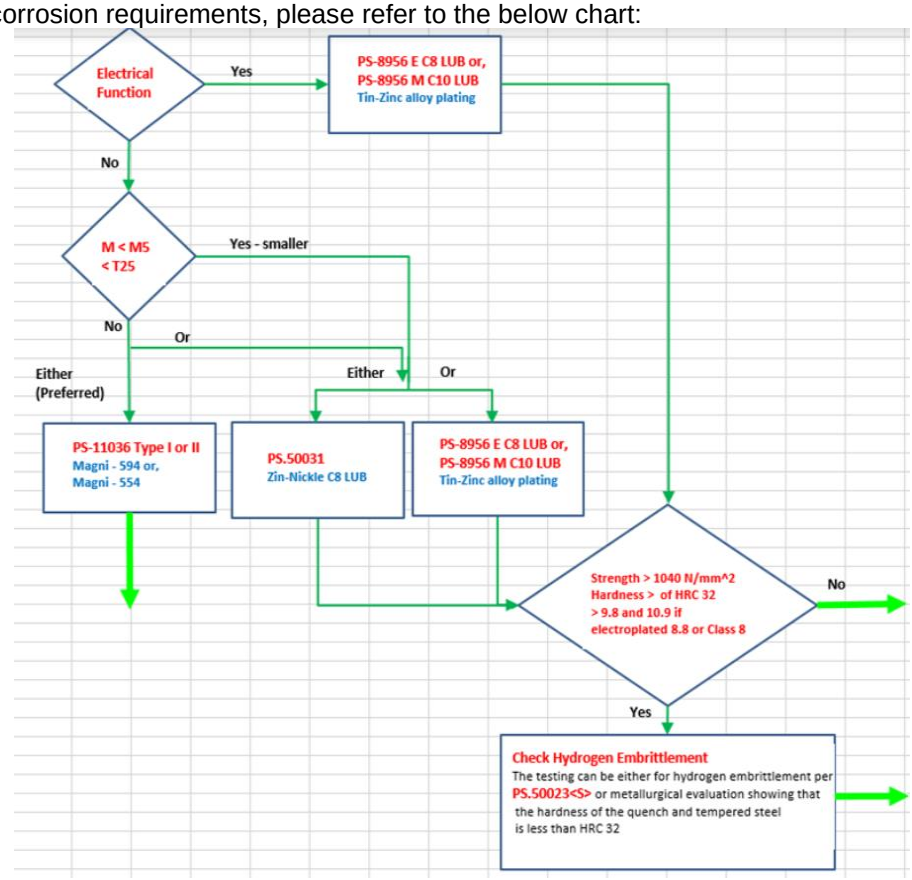


Figure 8: Fastener Corrosion Requirement

5.3.4 Sealing

The Supplier shall provide the sealing/sealant specifications at the time of CDR (Critical Design Reviews) in the Stellantis recommended templates. As required, the supplier shall use PIP gasket design for the environmental sealing for service parts such as HVIL access covers, etc. Supplier shall provide the FEA simulation to provide the sealing analysis details such as compressions, volume fill for worst case (LMC and MMC) tolerance conditions. Supplier shall provide the design specification sheet & process for the thermal performance material used inside the part. For example, thermal pad or gap filler.
PIMs specified in the Source Package are EDM mounted hence HV AC busbars are required to be sealed from any motor oil vapors.

5.3.5 Lifting Assist

If the part weight is more than 9 kg then the supplier needs to add lift assist features on the component. Supplier needs to provide the simulation analysis to evaluate the strength of the lifting features with 3 times gravity or any other applicable loads. The simulation results shall be approved by Stellantis engineering team. Supplier shall refer to DS-158 for more information

5.3.6 Leak Test Requirements

The leak requirement is zero fluid leakage during customer usage. The 100% Casting Sub-Component EOL minimum pressure decay leak test recommended test limit:

- Pressure decay leak rate of Power Electronic cooling passages: 0.05 ml/min @ delta P = 2 bar using dry air (or appropriate).
- For the Complete assembly leak test, the supplier needs to provide the details about the leak test methods, parameters and supporting data on how they will meet the Stellantis requirements. It is not acceptable to mention “It is based upon their previous experience with similar components”.

- The recommended limits above are preliminary values for manufacturing equipment estimation purposes. The final values shall be correlated (adjusted) to zero bubbles under water at 4.5 bar for 5 minutes to ensure leak requirement of ZERO fluid leakage. Following the correlation study, the above pressure decay specifications shall be revised accordingly (potentially more or less stringent). The above 4.5 bar / 5 min values are designed as an accelerated pressure with minimum time test and may need to be modified depending on max limits of design.
- It is the supplier’s responsibility to ensure that process control parameters are identified, monitored and maintained to ensure that this component does not cause a fluid leak.
- Supplier must identify the leak test methods, parameters and provide the testing data to prove it.
- During technical reviews at the sourcing stage, supplier need to provide the details about the leak test methods, parameters and supporting data on how they will meet the Stellantis requirements. It is not acceptable to mention “It is based upon their previous experience with similar components”.
- Supplier shall provide the DFMEA and PFMEA parameters for the leak test as part of supplier technical reviews.
- It is the supplier responsibility to ensure that process control parameters are identified, monitored and maintained to ensure that this component does not cause a fluid leak.
- It is recommended to create a master sample (Red Rabbit) part to verify the quality of the leak tester. Supplier needs to review the design with Stellantis engineering team as part of DV and PV design freeze.
- Supplier’s part manufacturing process must be exactly the same for design validation(DV) and production process validation(PV). Any deviation will have required approval from Stellantis engineering team.
- Supplier shall propose plan and details about the manufacturing line leak test equipment at the time critical design reviews for design validation(DV).
- For the approved leak test verification processes, refer to the Stellantis casting pressure testing procedures specification PS-4236.
- Supplier EOL leak test verification process and pass/fail criteria have to be approved by Stellantis.

5.3.7 Component Drawing Requirements

The 2D drawing files shall be submitted during the alpha, beta and gamma design phase in pdf and .CGM format through Rocket software to the Stellantis design team. Supplier must provide the 2D drawing with and without xETK 2D drawing for the review.

- Drawing should have all geometric, cross sections and isometric views to show all the Stellantis interface details. Also, include coolant, fastener and sealing joint cross section details.
- Geometric dimensions and tolerances shall be defined for all the features.
- All HV and LV connectors part numbers with pin out details shall be included.
- Coolant port dimensions such as internal diameter and hose connection sealing area shall be added. “IN” and “OUT” markings shall be included.
- The casting material properties shall be defined in the drawing as minimum yield, ultimate and elongation and if required by Stellantis the material properties must be either diamond or Safety key characteristics. Supply shall obey the control plan and inspection requirements as specified by critical characteristics.

- Supplier shall mention the critical and non-critical interfaces for the X ray inspections. Critical interfaces shall include coolant channels, all sealing surfaces and machining interfaces as a part of 2D drawing with minimum allowable casting porosity definitions.
- Supplier must include the leak test parameters into the final layout drawing which will be released in the Stellantis system. The following note must be added with all the parameters filled out. This note must be added for DV drawing.

Leak Test Parameters: Method: XX, Pressure: XX, Time: XX, Leak Rate: XX

- Table needs to be added for all fasteners with columns details such as Size, Torque and coating.
- Part identification and traceability label shall be included in the drawing. Refer to the label requirements sections for more details.
- High voltage warning labels shall be added to the drawing. High voltage warning shall follow the dimensions as per the Stellantis engineering requirement and shall have the part number listed in the Stellantis system.
- Add the center of gravity and Moment of inertia details with drawing views in the 2D drawing.
- Following notes shall be included in the notes section of the 2D drawing

1. Key Characteristics as per Stellantis specification PS-7300.
2. Geometric and Dimensions tolerances shall be checked against Cpk 1.33
3. Overall profile tolerance shall be XX (defined by the supplier).
4. Coolant tubes geometric dimensions and tolerances shall be as per Stellantis specification CS.00159.
5. Parts shall be free of sharp edges and burrs.
6. Weight of the component

5.3.8 Casting cleanliness Requirements:

Supplier shall refer and meet the Stellantis specification PF.90080 section 6.3 for the coolant system cleanliness requirements. Supplier shall refer and meet the Stellantis specification PS-9647 for the casting cleanliness inspection procedure. Acceptance criteria shall be discussed with Stellantis engineering team.

Deliverables to Stellantis include but not limited to

1. 3-D model of sample, proposed HV/LV/Thermal interfaces. Any updates to housing material, mass, moment of inertia (MOI) and center of gravity (CG) – Stellantis to confirm packaging
2. 3-D model of component internals, including CG, MOI, Stresses at mounting points of sub-components.
3. Structural Analysis including modal, random vibration, mechanical shock and durability of full unit and internal components such as bus bars etc. Joint stress analysis (sealing and fasteners).
4. 2D drawing along with worst case tolerance stack study including internal components of Alpha, Beta components and subsequent drawing reflecting all mechanical changes as they happen
5. Documented change history log of updates made to 3-D models

5.3.9 Buzz, Squeaks and Rattle

Anti-rattle devices shall be employed where necessary to prevent all BSR. This shall be specifically documented during mechanical vibration testing in according with the CS.00056 “CHRYSLER / FIAT - ELECTRICAL /ELECTRONIC (E/E) ENVIRONMENTAL SPECIFICATION” and CS-11982 “CHRYSLER / FIAT - ELECTRICAL /ELECTRONIC (E/E) ENVIRONMENTAL SPECIFICATION”.

Noise level shall be evaluated with the component assemblies mounted in the appropriate vehicle location using standard 7.N0007 “FINISH COMPONENTS VEHICLE INTERNAL/EXTERNAL PROTECTIONS Noise at the bench.

5.3.10 NVH requirements
The PIM shall meet NVH requirements and successfully pass Stellantis durability testing in vehicle, as well as federally mandated performance and crash testing.

Power Inverter Module (PIM) Switching Noise NVH Target:
The PIM assembly will generate a switching frequency wave form of TBD frequency and has the potential of making an intrusive tone that may be heard in the vehicle's cabin. The amplitude of the switching frequency tone shall not exceed 20 dB(A) sound pressure level over the broadband noise in the near field, during operation. The PIM noise will be measured at a ½" free field ICP microphone located a distance of 6 inches from the top of the PIM during sweep from 0 to max rpm at 150 rpm/s. This figure shows a reference spectrum of a 10 kHz tone with respect to the broadband frequency content. In order to plot the spectrum in a similar fashion as the figure below, the data must be post-processed using linear average at 50% overlap, 1 Hz frequency resolution, Hanning window, spectrum peak hold sampling, and A-weighting.

System level sound power (at dominant orders) w and w/o PIM masking < 0.3 dB(A).
To be verified in each EDM operating condition at full EDM assembly assessment.

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The graph below shows a reference spectrum and a 10 kHz tone with respect to the broadband frequency content to use as an example. In order to plot the spectrum in a similar fashion as Figure 9, the data must be post-processed using a linear average with 50% overlap, 1Hz frequency resolution, Hanning window, spectrum peak hold sampling, and A-weighting. If the plan of record is to switch at more than one frequency, the test must be run at all possible fundamental switching frequencies.

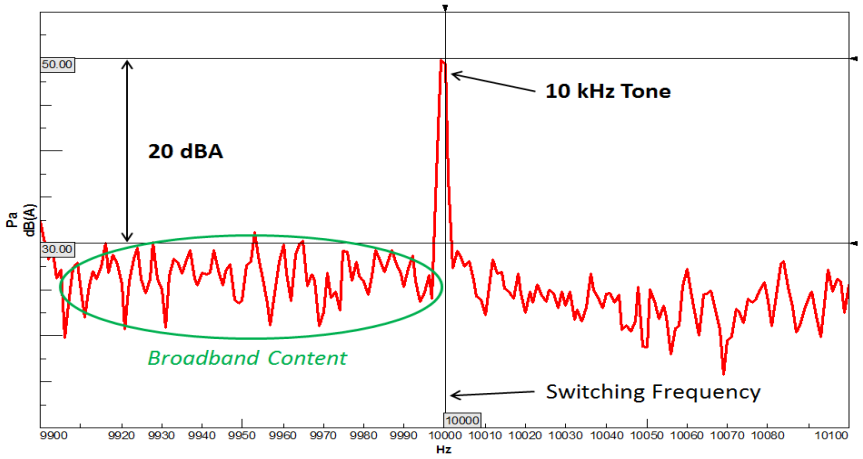

Figure 9: Reference Plot of Averaged Spectrum Peak Hold of Near Field PIM Noise

Vibration Profile for Tests and Simulations (Mechanical Loads)

Vibration Requirements shall follow the CS.00056 Standard for the particular use cases depending on the mounting location. Compliance with the standard will be further reviewed during the design process with the Stellantis NVH and Mechanical Engineering teams.

5.3.11 CAE Simulation Requirements

Supplier shall provide the following list of items to validate their simulation studies by Stellantis Engineering. These items are also discussed in other sections. These data are to be supplied to Stellantis at Alpha, Beta and Gamma Design (CDRs) gates and or Stellantis Management Review Gates (MRs)

5.3.11.1 Generic content expected from all supplier CAE analysis reports shared:

1. Background History/ Part change level information
2. Material properties, Mass & Moment of Inertia information as required by the simulation.
3. Key Assumptions.
4. Initial & Boundary Conditions, Loads and their application in the model.
5. Detailed results and key take-away.
6. Summary page with most relevant results and conclusions.
7. Next Steps in the development activity

5.3.11.2 Sub-system level - Simulation Black Box Models

1. Inverter model (Input/output interface to be discussed with supplier team)
2. Motor and Inverter controller model (Input/output interface to be discussed with supplier team)
3. Lumped thermal masses for black-box model development

5.3.11.3 Component level – Simulation Black-box Models

1. Supplier shall provide black-box simulation models for each module.
2. All simulation models should be parametrized for passive components
3. Switching frequency
4. Switching component details
5. Material properties (if applicable)
6. Geometry parameters (if applicable).
7. All parameters should be described in a given black-box simulation model (Ex. L_{if}: High voltage side input filter inductance).
8. Simulation input/output results should be provided for the reference design

5.3.11.4 Inverter Parameters

1. Inverter Topology: Diagram and Description of the Inverter.
2. Switching device datasheet
3. Switching Frequency: in kHz, Capability limits, Control protocol (if variable switching frequency)
4. Modulation Technique: SVPWM/Third Harmonic Injection/SPWM/ other?
5. Input/ Output filters: If any – Inductance and Capacitance values
6. Controller constants – A generic control circuit topology picture/ sketch that shows all the controllers and their P & I constants.

5.3.11.5 Inverter Parameters: others

1. Circuit Schematic
2. Bulk capacitor value and component datasheet
3. Bus bars: Inductance value, materials, CAD file or geometry
4. Passive component values
5. PCB layout: footprint and package
6. Input/output Test Data
7. PIM Loss (see section 8 FUNCTIONAL REQUIREMENTS)

- **Switching Component**
- Switching device datasheet
- Component lifecycle
- Component thermal characteristics

- **Controller Circuit**
- Circuit Schematic
- Controller transfer function
- Passive component values
- PCB layout: footprint and package
- IC Chip datasheet and package

- **EMI Filter**
- Circuit Schematic
- Passive component values
- PCB layout: footprint and package
- Switching device datasheet (if applicable)
- Switching frequency
- Input/output Test Data

- **Cooling**
- Cooling method
- Cooling components (Compressor, pumps, heatsinks)
- Flow rate of the cooling fluid
- Geometry of the cooling channel
- Cooling fluid material properties (heat transfer coefficient, heat capacity, density)

5.3.11.6 CAD models – Power Inverter Module

1. Detailed 3D CAD models (.step, .parasolid) are requested for:
    a. Housing
    b. Internal components
2. eCAD (electronic CAD format: odb++)
3. Detailed information about the criteria used for components connection.
4. Isolator specification (rates), if present

5.3.11.7 Mass Properties – Power Inverter Module

1. Mass, center of gravity and inertia tensor for:
    a. Total (w/ and w/o fluids)
    b. Single components requested in CAD model section

If the total mass (w/o fluid) doesn't correspond to the sum of single components masses, for instance, since some 3D components are missing, it must be clarified where mass has to be added in order to reproduce the total mass.

5.3.11.8 Material Properties – Power Inverter Module

1. Material Name/ Type, Young modulus, Poisson Coefficient, density at both room and operating temperature, Plastic Data, Coefficient of thermal expansion
2. Density, Relative Permeability, Bulk Conductivity, Thermal Conductivity, Specific Heat and Coolant Dynamic Viscosity, Core loss model.
3. Frequency dependent damping ratio characteristics for damped material (for instance MPM or damping patches), if present. Both at room and operating temperature
4. Supplier must:
    a. guarantee accuracy from the beginning of the project, by equivalence on detailed FE model and/or CAE-testing correlation on its similar previous eMotor application
    b. confirm accuracy based on static test (hammer test) at component level on standalone stator and rotor. Set-up and results to be shared with Stellantis as soon as the first proto

is available, with possible update during the development (if significant changes will be implemented).

5.3.11.9 Finite Element models – Power Inverter Module

1. Structural FEA Model (Nastran, optistruct, abaqus, we prefer the first two) including material properties.
2. Mesh requirements:
    a. Casted / forged components: tetra 2nd order or hexa 1st order elements (3 to 5 mm)
    b. Stamped components: quad shell elements 3 to 5 mm
    c. Non-structural components (adding mass but not stiffness): lumped mass connected by means of distributed couplings
    d. Mesh size from 3 to 5 mm
3. Connection requirements:
    a. Rigid + beams at bolts connection (washer as 1.5 * bolt diameter)
    b. Contact or congruent mesh at press fit areas
4. Material properties requirements:
    a. Both at room and operating temperature
    b. Frequency dependent characteristics for damped material (for instance MPM or damping patches), if present

5.3.11.10 NVH simulation – Power Inverter Module

Supplier shall perform the following analyses.

1. Housing acoustic transmissibility
2. PIM radiated noise.

5.3.11.11 Durability Simulation Requirements

1. Thermal requirements
    a) Heat sources/heat flow
    b) Coolant flow rate and temperature

2. Mechanical requirements
    a) Mechanical shock/deterministic vibration (g-time profile)
    b) Random vibration (g-frequency profile)
    c) Assembly CAD with all components

3. Sealing
    a) Type of gaskets (Oruig/PIP)

4. Material properties
    a) Young's Module
    b) Poisson ratio
    c) Thermal expansion
    d) Stress strain curve @20 and @150
    e) Density
    f) Damping factor
    g) Fatigue strength

5. FEA requirements
    a) Models and input files
    b) If the FEA is not available, a cross section with GDET

5.3.11.12 3D Thermal Simulation Requirements

1. CAD geometry of the whole assembly including all relevant solid components.
    a) Insulation/coating information (thickness, conductivity)
    b) Thermal properties of all solid/fluid material involved (density, viscosity, conductivity, capacitance)
    c) Mass/ Volume information of all components involved.

2. Key operation conditions and related thermal load/loss map and distribution.
3. Operation conditions
4. Cooling architecture/approach and surrounding information.

5.3.12 Part Identification and Marking

All components/assemblies installed on Stellantis motor vehicles as original equipment, spare parts or accessories must be marked to typify the component as “GENUINE” and express brand image and “DISTINCTIVENESS” e.g.: Fiat / Chrysler / Mopar Trademark; Part number; Recycle mark, Material abbreviation; Supplier number etc.

The Stellantis Engineering shall be notified, in writing, of inclusion of any optional part markings or changes to any previously agreed upon markings. Products furnished to Stellantis and products and processes used by Suppliers to manufacture those products must conform to PS-4480, PS-8800, and CS-11000. The Supplier shall be responsible for designing and providing part identification markings and labels for the intended vehicle usage market. The labelling shall also include the correct regional HV identification markings as required. All part identification and labelling shall be submitted to Stellantis Engineering for approval and shall be compliant with the respective regional or country specific regulations.
All labels shall be visible on the component installed position in the vehicle. High voltage warning labels shall be placed near or top of the high voltage connections on both PIMs and Coax Junction Box. If access cover is required, then label shall be placed on top of the cover.

Mandatory permanent marking shall consist of the following:

- Stellantis Part number.
- Traceability number shall be included on the part identification with a bar code identifier, as required by Stellantis Engineering. Refer to PF.90106 “Component Parts Traceability” for additional information.
- Additionally, the Supplier shall identify major internal components or assemblies that are tracked by serial number or other internal tracking numbers shall be identified for consideration for electronic storage in the module.
- Label shall not have any supplier name, brand or logo information unless otherwise approved by Stellantis.
- China label, ground symbol required as per GBT-18488

5.3.13 Traceability

The PIM shall meet all component parts traceability requirements defined in PF.90106 “COMPONENT PARTS TRACEABILITY”. The Supplier shall provide a definition of standard traceability components and the PIM serial number format for production units before the Gamma sample design freeze.
Additionally, the Supplier shall identify major internal components or assemblies that are tracked by serial number or other internal tracking numbers shall be identified for consideration for electronic storage in the module.

5.4 Installation Requirements

Installation of the PIM in any of their normal vehicle mounting applications (within design tolerances) shall not distort them or cause a change in any operating characteristics such that they would not meet the requirements of this standard. The supplier shall ensure ergonomic access to all commands and visibility cone of all keys, dashboard and display ideograms according to the eye - points and the vehicle illumination requirements.

5.4.1 Ergonomics Requirements

Definition of Ergonomics: It is the study of relations existing among man, objects, machines and environment during any activity, in order to improve efficiency, safety and welfare state.

Ergonomics requirements will require the approval of the Stellantis manufacturing group responsible for installation of the PIM. The Supplier shall support the review of packaging, ergonomic and manufacturing studies with the Mechanical engineering, Manufacturing and Assembly teams to evaluate the need and the design of the lift assist required for the PIM. All parts to be designed to avoid any sharp contactable areas which require access during assembly or service.

5.4.2 Assembly Requirements

The PIM shall meet all assembly requirements given in DS-158 and CS-ROUTING "ROUTING REQUIREMENTS – TUBING, HOSE AND CABLES" and if Electrical applicable, SAE/USCAR-25 and CS.00050 "WIRING DESIGN AND PACKAGE REQUIREMENTS". In addition, specific PIM Ergonomics Design Standards can be obtained from the Program Ergonomist, New Programs Ergonomics Group.

The Mechanical Engineering team's evaluation for the design feature to locate the PIM in the vehicle during the assembly process will be supported by the supplier through all development stages. Supplier shall add the locating features as required for assembly.

Any Supplier provided end item assembly components to Stellantis vehicle plant shall be designed to survive handling during Stellantis manufacturing. Screws and sealing such as O-rings must be retained and captured. Seal or O-rings must not be deformed by handling in the assembly plant. All Stellantis interfaces screws must have a standard MAT point for ease in assembly at Stellantis vehicle plant. Stellantis interface screws tool clearance shall be designed as per Stellantis manufacturing requirements. Discuss with Stellantis engineering team for more details at the time of technical reviews.

The Supplier shall provide the draft manufacturing process flow proposal prior to delivery of β- Samples as well as provide with a final manufacturing flow proposal prior to VP Build once the PFMEAs are completed. The supplier shall hold reviews with Stellantis Engineering and QRE team during the development of this manufacturing flow proposal.

- The Supplier is responsible for the design of assembly aids, including features required for assist arm loading of the PIM in the transmission or vehicle assembly plant.
- All installation processes shall be designed to be performed to minimize operator error and installation variation.
- Any variance to the guidelines shall be reviewed and approved by Stellantis Engineering and Advance Manufacturing groups.
- The Supplier is responsible for identifying all necessary manufacturing aids.

5.4.3 Serviceability

The PIM shall meet applicable unique service requirements given in SD-11401.
- Supplier shall design the component for design for serviceability at Stellantis. O-rings, screws, access coves shall be designed to be serviceable and replaceable components. Supplier shall develop and provide the service kit as required.
- Supplier shall provide and support the service procedure process document. Details as required such as CAD images, torque information shall be provided.
- If the component weight is more than 9kg, the supplier shall provide lifting hooks for PIM.

5.4.4 Material Handling / Logistics / Transportation

The supplier is responsible for Material Handling and Logistics for PIM. The Supplier shall work with Stellantis logistics and transportation groups to define shipping containers, packing and any reusable dunnage. Material handling / logistics / transportation costs for the purpose of this quotation shall not be included. The PIM supplier shall independently define these requirements and negotiate costs with the control board supplier.

- If awarded these handling and logistics costs will be added to the final purchase order (this is for PIM source package)

Labeling and Shipping
This section pertains to correct labeling of PIM and shipping dunnage labeling.

1. Module and Shipping Container Labeling
   a. The PIM shall include the correct labeling for safety, warnings, and handling.
   b. Supplier shall provide a Safety and Warning label and include in a readable position on an external surface in a place visible during installation on the transmission and agreed to by the PIM DRE. Applicable standards for this label can be found in the attached PIP document.
   c. A High Voltage Warning Label shall be attached to the PIM exterior near the high voltage connectors/connection and fuses when the PIM described in this source package has a full voltage greater than 60V DC. The Unit when in transit shall not contain energy stored within the unit corresponding to a voltage value greater than 0.3V.
   d. PIM Cold Plates must be free of any liquids that may flow out of the PIM.
2. Shipping Dunnage
   a. Dunnage shall be correctly labeled per 49 CFR 173.185
   b. Supplier is required to maintain dunnage shipping labels and replace any damaged labels prior to the dunnage's use in transporting PIMs.
   c. Packaging must support the PIM while it's transported by Land, Sea and Air to avoid dislodge from the nest
      Refer PIP label requirements for additional instructions.
   d. Shipping Caps:
      a. Supplier shall protect for the inclusion of shipping caps for connector and coolant ports, based on assembly plant requirements, this will be reviewed during development.

      1. General:

      Based upon the shipping requirements to be differ between Stellantis vehicles and component assembly plants, it is recommended to have the shipping caps as a part of the source package. If the Stellantis vehicle assembly plant is not a direct recipient of the parts shipped by supplier (component assembly plant for subassembly) then it is mandatory to include shipping caps to avoid contamination to the components after the subassembly process. It is also recommended to add shipping caps in the normal process.

      Shipping caps must protect the component connections from dust, humidity, water, debris etc. Supplier must perform the design reviews with the Stellantis engineering team. Following requirements shall be met. Any deviation will require Stellantis engineering team approval. Stellantis engineering team has authority to add or remove the requirements of caps for cost optimization, plant complexity etc. depending upon part handling requirements at selected plant after the sourcing.

      - Shipping caps shall be included for all electric(connectors) and coolant connections.
      - Shipping caps must not detach until vehicle installation.
      - Shipping caps must be provided from beta sample design

      2. Design Criteria:
         2.1 Coolant Connections**:**
      - Shipping caps must have a "grenade pin" or "wine glass" style pull feature as per CS-A0513.
      - Cap pull off-force must be between 35 to 53 N (8-12lb) as per Stellantis specification CS-A0513.
      - When removing the cap it must not dislodge any seals or blind on stud or any other surrounding components.
      - Shipping caps must protect any sealing surfaces and seal lubricants.

- Shipping cap must protect the exposed thread of any studs.
- Looks for an existing cap to keep commonality before developing any new designs.
- Caps should be shown in 2D drawing of part, and as background in 3D models that can be hidden for design purposes.
- Plumbing caps should be made from polyethylene. Any other material used should be approved by Stellantis engineering team.

2.2 Electric Connectors:

- All electric connectors shall meet USCAR-43 requirements for the shipping caps design.
- For insertion & extraction force requirements, please refer to the USCAR-43 as well as Stellantis specification DS-158. In general, the shipping caps pull out force must be less than 25N.
- Shipping caps must have a tab or handle for uninstallation. Design of the handle shall be as per USCAR-43 and Stellantis AME ergonomics standard DS-158. Supplier must work with Stellantis engineering team to verify that design meets hand access and ergonomic requirements. Any design robustness suggestions from Stellantis engineering, the supplier needs to adhere to it.

3. Design Validation:

3.1 Performance and Functions:

Following test must be performed to meet the shipping caps performance. Testing requirement shall be discussed with Stellantis engineering team and shall be part of component level DV and PV testing. Any testing exceptions require Stellantis engineering team approval.

3.1.1: Water Leakage test: Water leakage test shall be performed to meet IPX3 requirements.

3.1.2: Insertion and extraction forces measurements test**:** Supplier shall perform the test and provide results to Stellantis engineering team for evaluations. Both Stellantis and the supplier needs to agree with the test results.

Additional function Test:

The supplier shall meet following additional functional requirements.

1) Yellow Color parts
2) Cannot touch the pins inside the electric connectors.
3) Must stay in place and can't fall off for all the shipping conditions within the temperature range -40^{0}C to 95^{0}C. (please refer to ISTA-1B Test Protocol for vibration analysis)
4) Can't leave a residue on the component interfaces (silicone, mold release, etc.)
5) Can't deform or damage the interfaces on the component.
6) Light weight - like TPM material.
7) Unbreakable, no sharp edges or other handling hazard.
8) Throw away part. (none reusable parts)

5.4.5 Recycling

The Supplier shall offer Stellantis a process for the recycling of the PIM at the end of its service life. The final Recycling practice for the PIM shall be agreed upon, between the Supplier and Stellantis.

6 ELECTRICAL-ELECTRONICS REQUIREMENTS

6.1 Electrical Architecture Requirements

ECU Components shall meet the requirements of the Technical Specification (Sourcing, 1A, 2A, etc. releases) for the specific vehicle(s) that may include the following

- Component Electrical Technical Specification (ETS)

- Component Functional Description (VFs by component - ECU.docx)
- Network Transmission Matrix
- CAN bus communications requirements
- Diagnostic requirements
- Other requirements documents

All components (ECUs, EMCUs, etc.) shall meet the 'Engine Cranking Low Voltage – Warm cranking / Stop – Start' requirements per CS.00054 specification (i.e., assume all vehicles support the stop start function).

All references (if any) to former Fiat or Chrysler organizations found in program documentation shall in effect be superseded by the equivalent Stellantis references. References to non-harmonized standards such as Fiat or Chrysler design documents, norms, standards and other design requirements still apply unless explicitly stated otherwise.

The Electrical Technical Specification (ETS) for a specific vehicle shall be available in the Galileo Browser. If the supplier has any difficulty in getting these documents from Galileo Browser, they should contact the EE Systems Integration PC.

6.2 Wiring Requirements

If the component includes wiring (pigtails), it shall meet applicable wiring requirements per CS.00050, PF-10099, 9.91192, PF.90012, SAE/USCAR-21 and DS-158.

For HV Connector interfaces suppliers shall use a combination of applicable tests from PF.90012, USCAR-2, USCAR-21, USCAR-38, ISO20076, LV214, & LV215 test specifications.

6.3 Connector Requirements

The PIM design shall contain both external (connections to vehicle interfaces) and internal (connections to internal PIM components) connectors. Internal and External classification will depend on the Supplier's PIM design concept. All connector types and classifications shall be finalized prior to the Alpha design freeze date.

Connectors and wire harness (including pigtails) shall be reviewed by Stellantis Release Engineer, EE QRE (Quality Reliability Engineer) and Wiring & Connector responsible engineers for any EE Interface issues with the adjoining sub-systems for compliance to Stellantis Preferred Practices.

Prior to engineering design freeze, EE or EM Components and Connectors located in the wet areas shall be evaluated for using sealed enclosures/ bezels (use of sealed components or connectors) or other effective water or liquid intrusion prevention techniques, such as, packaging orientation, use of canopy or barriers, tape or grease application, etc.

Refer to CS.00050 section 5.15 (Wet Areas) for current wet area definitions and requirements. The following is a brief list of package environments considered wet areas:

For example:
- All vehicle exterior surfaces;
- Inside door or lift gate areas;
- Cabin or trunk floor areas under the carpet;
- Underhood, Chassis or Wheel Well locations; and
- Area determined by BICEEPR&U-QREs to be at risk for moisture exposure.

EE or EM Components & Connectors in such locations shall be validated to withstand possible water or liquid intrusion requirements identified in section 7.1 & 7.2 of this document.

The connector shall meet the requirements of PF.90012 and SAE/USCAR-25. Approved connectors can be found in the Ridbul Catalog. If the connector is sourced by Stellantis, CEP-042 must be used. Any deviation must be approved by EE Power & Signal Distribution Package/Design Department.

The connectors shall be rated to meet all applicable environmental requirements (temperature, fluid / solid intrusion, and vibration).

Irrespective of design lead all connectors must meet the ergonomic requirement of SAE/USCAR-25, when they are in their specific vehicle packaging location or the connector system must be changed to compliant connector systems.

Component, system (device) or vehicle validation tests shall use mating connectors and harnesses manufactured with wires of correct gauge size and crimping from production intent designs and processes. If the wire harness or connectors used for system or component test are not production intent, the test set-up must be pre-approved by Stellantis Engineering and Wiring Harness Group.

If the connector is pre-selected, it shall be E/E Component supplier's responsibility to obtain test reports from connector supplier to show compliance to connector specific Environmental, Electrical and Mechanical requirements from PF.90012 or other equivalent connector standards. Component or Module supplier shall verify applicable mechanical and Electrical requirements from PF.90012 including (but not limited to): Terminal to Terminal Engage/ Disengage Force, Terminal - Connector Insertion/ Extraction Force, Connector – Connector: Mating/ Un-mating Force, Audible Click, etc. along with Connector orientation to prevent water/liquid ingress, etc. During environmental validation (tests), the production intent approved connectors and wiring harness/ pigtails shall be used.

6.4 Connector Pin-Out

Reference attachment "*Master PIM-CB Source Package-20230227.zip*" for requirements.

6.4.1 LV Connector Pin-Out

Reference attachment "*Master PIM-CB Source Package-20230227.zip*" for requirements.

6.4.2 Internal LV HVIL Connector Pin-Out

Reference attachment "*Master PIM-CB Source Package-20230227.zip*" for requirements.

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6.4.3 Development Interfaces

Reference attachment "*Master PIM-CB Source Package-20230227.zip*" for requirements.

xETK Control board interface:

During the development phase, PIM supplier shall design a housing for the xETK boards, the xETK boards can be assembled by the PIM supplier or Stellantis may buy the PIM as xETK-ready PIM and assemble the xETK PIMs when necessary.

6.5 Non-ECU and EMCU Component Design Parameters

Not Applicable

6.6 Electrical interface Requirements

Connectors and wire harness (including pigtails) shall be reviewed by Stellantis Release Engineer, EE QRE (Quality Reliability Engineer) and Wiring & Connector responsible engineers for any EE Interface

issues with the adjoining sub-systems for compliance to Stellantis Preferred Practices using SD-12219 “EE Interface Checklist”.

6.7 Electrical System Compatibility Requirements

The PIM shall conform to the applicable Electrical System requirements specified in CS.00054. Verification test plans for these requirements shall be developed using Electrical and EMC test plan templates. The test plans shall be approved by Stellantis Product Release and EMC Engineers. Component level DV and PV validations shall be performed at a Stellantis Recognized EMC Laboratory. Contact E/E Systems Compatibility Department for the detailed procedure. As a low-cost option, the EMC/EE Testing may be performed at the Stellantis EMC Laboratory.

The nominal operating voltage for PIM shall be 13.8 V (UTTYP). The supply voltage range shall be 6.0 V (UTMIN) to 16 V (UTMAX).

The nominal operating voltage for the High Voltage section of the PIM shall be as detailed in Annex F.

6.8 Electromagnetic Compatibility (EMC) Requirements

The PIM shall conform to the applicable component level EMC requirements specified in CS.00054 and CS.000196. Verification test plans for these requirements shall be developed using Stellantis Electrical and EMC test plan template. The test plans shall be approved by Stellantis Product Release and EMC Engineers. Component level DV and PV validations shall be performed at a Stellantis Recognized EMC Laboratory. Contact E/E Systems Compatibility Department for the detailed procedure. As a low-cost option, the EMC/EE Testing may be performed at the Stellantis EMC Laboratory. High Voltage shall be applied to vehicle simulated loads and representative vehicle mounting shall be used in the PIM component EMC tests as defined in the Supplier EMC test plan and approved by the Stellantis EMC group. Contact E/E Systems Compatibility Department for the detailed procedure.

The PIM shall additionally comply with B21 7112 and 7110. The supplier shall share the detailed schematic of the EMC filter by detailing the EMC filter topology and sharing the values of CY capacitor and common mode choke. The supplier shall share the detailed characteristics of all the components of the EMC filter and complete the EMC filter excel sheet. The supplier shall share the detailed characteristics of the DC link capacitor and complete the DC link capacitor excel sheet. The supplier shall make use of the document 01463_22_00308 _Filtering components characteristics_ attached below to document the above request prior to quote submission.

B21 7110 applicative requirements for e-machine.pdf
B21 7112 Enviromental Specification for electrical and electronic high voltage equipment electrical characterization.pdf
01463_22_00308_Filtering component.xlsx

The supplier shall provide the current profiles (.txt or .csv format) between the power module and the dc link capacitor to evaluate the DC ripple generated by the eDrive on the network for speed between 500rpm to MaxSpeed by step of 500 rpm and torque between -Tmax to Tmax by step of 10Nm. PIM supplier shall stay below 31.5Vpp as mentioned in Tech spec and meet frequency domain requirements mentioned in Section 7.1.6.7 of B21 7112.

The supplier shall guarantee the lifetime and durability of the PIM design regarding the mission profile of DC ripples.

Stellantis will provide different cycles and occurrences during the lifetime before B sample.

The supplier shall provide the detailed model of all the derating concepts about voltage, current, temperatures

7 ENVIRONMENTAL REQUIREMENTS

7.1 General E/E Component Classification (CS.00054,, CS.000196, B21 7110, B21 7112)

Component Classification shall be based on the Standard CS.00056 “Chrysler / Fiat - Electrical /Electronic (E/E) Environmental Specification”, CS.00054 “GENERAL ELECTRICAL AND EMC PERFORMANCE REQUIREMENTS FOR E/E COMPONENTS”, and B21 7110 “Applicative requirements for e-machine” which will be developed using component weight, application, mounting, location, etc. as shown in Table , Table contains the worst case conditions for the PIM mounted in engine compartment and chassis/axle mounted PIM use cases. The Supplier shall validate the PIM common design to these requirements.

Table 8: PIM General E/E Component Classification

Classification	Type
Device Type (Section 1.4.1 of CS.00056 and CS.00054 Section 1.9 “Device Classification”) Design Life Section 1.4.12 of CS.000056	E3-HV 15years/200,000miles
Function immunity (CS.00054 Section 1.9 “Device Classification”, Table 2” Component Immunity Classifications”)	IL1
Installation (Section 1.4.3 of CS-00056) Installation Classification	CI4
Low Temperature (Section 1.4.4 of CS-00056) Temperature Classification	TN1 for all LV electronics and HV related safety logic.
High Temperature (Section 1.4.4 of CS-00056) Temperature Classification	TC3
Weight (Section 1.4.8 of CS-00056) Weight Classification and Component Soak Time	W6 TBD
Vibration (Section 1.4.9 of CS-00056) Vibration Classification	V2 – Chassis Mount
Supply Voltage (CS.00054, Section 1.9 Device Classification, Table 3 Supply Voltage Range Classification)	A2 for Limited LV Functionality A1B for HV Functionality
Transient Interference (Section 2.7 of 9.90110) Transient interference classification	SI2
Electrostatic Discharges (Section 2.8 of 9.90110) Electrostatic discharge classification	SE2
Quiescent Current (CS.00054 section 1.9 Device Classification, Table 4 IOD Classification)	CC5
IP Category ((section 1.4.10 of CS-00056)) Dust & Water Intrusion (using IP Classification)	IP6K8/IP6K9K

7.2 EE/ EM - Component Specific Test Requirements

The requirements listed in the table below represent environmental factors that the component/system shall endure to and must continue to be fully functional. The component/system must remain operable,

as defined in the ACCEPTABILITY CRITERIA column, during and after subjecting the part to any of the conditions listed. Refer to Annex B for the applicable test items and test flows.

DV and PV DVP&R shall be reviewed and approved by Stellantis QRE team before start of the tests.

Table 9: Applicable Environmental Conditions

Applicable Tests/ Requirements	Test Duration	Refer to **CS.00056** for Applicable Tests/ Requirements
A. Climatic Stresses:		
1. Thermal Shock (TS)	500 Cycles - Between Tenv.max and Tenv.min (non-operational)	As per Thermal Shock Requirements & the customized Test Flow for the Component
2. Powered Thermal Cycle Endurance (PTCE)	500 Cycles - Between Top.max and Top.min (Intermittent Operation)	As per Powered Thermal Cycle Endurance Requirements & the customized Test Flow for the Component
3. High Temperature Operating Endurance (HTOE)	1,300 Hours (at Top.max - Operational)	As per High Temperature Operating Endurance Requirements & the customized Test Flow for the Component
4. High Temperature and Humidity Endurance (HTHE)	1,000 Hours (85 C & 85% RH per specified operational sequence)	As per High Temperature and Humidity Endurance Requirements & the customized Test Flow for the Component
5. Shipping/ Storage Temp. Exposure (SSTE)	54 Hours - Hot & Cold	As per Shipping/ Storage Temperature Exposure Requirements & the customized Test Flow for the Component
6. Low Temperature Operating Endurance (LTOE)	48 Hours at Top.min - Intermittent Operation	As per Low Temperature Operating Endurance Requirements & the customized Test Flow for the Component
7. Thermal Humidity Cycle (THC)	240 Hours between -10 C and 65 C/ 93% RH (Intermittent Operation)	As per Thermal Humidity Cycle Requirements & the customized Test Flow for the Component
8. Solar Radiation Soak	Not Applicable	
B. Mechanical Stresses:		
9. Device Restraint Performance	8 times module weight or 20 N (whichever is greater)	As per Device Restraint Performance Requirements & the customized Test Flow for the Component
10. Vibration	16 hrs/axis for Random & Sinusoidal vib (total: 48 hrs each)	As per Vibration Requirements & the customized Test Flow for the Component
11. Mechanical Shock	60 Shocks - Test No. 1 & 18 Shocks - Test No. 2	As per Mechanical Shock Requirements & the customized Test Flow for the Component
12. Mechanical Shock Endurance	Not Applicable	
13. Handling Drop	1 meter drop/axis - Total 6 drops	As per Handling Drop Requirements & the customized Test Flow for the Component

14. Mechanical Operational Durability	As per Duty Cycles specified in the Component Specification	As per Mechanical Operational Durability in the Component Specification & the customized Test Flow for the Component
15. Gravel Bombardment	Gravel Bombardment Applicable (non-operational)	As per Gravel Bombardment Requirement & the customized Test Flow for the Component
C. Dust/ Water Intrusion:		
16. Dust Intrusion	IP 6K or IP 5K - 1 day (non-operational)	As per IP dust category specified in the Component Specification & the customized Test Flow for the Component
17. Water or Steam Intrusion	IP 9K - Steam Cleaning (1 day / non-operational)	As per IP water spray category specified in the Component Specification & the customized Test Flow for the Component
18. Saltwater Immersion	20 Cycles (non-operational or intermittent operation - as defined in PF)	As per IP 7 (water immersion) specified in the Component Specification & the customized Test Flow for the Component
19. Mud Resistance	66 hours - Operational	As per Mud Resistance Requirement & the customized Test Flow for the Component
D. Chemical Exposure:		
20. Salt Fog	96 hours - Intermittent Operation	As per Salt Fog Requirement & the customized Test Flow for the Component
21. Mixed Flowing Gas	14 Days - Non-operational	As per Mixed Flowing Gas Requirement & the customized Test Flow for the Component
22. Chemicals Exposure	Chemical Exposure - Outside Cabin (non-operational) - 4 days	As per Chemical Exposure - Inside Cabin Requirement & the customized Test Flow for the Component
E. Other Requirements:		
23. EMC - Component	EMC - Component Requirement Applicable	EMC - Component Requirement per CS-11979 & the customized Test Flow for the Component
24. EE System - Component	EE System - Component Requirement Applicable	EE System - Component Requirement per CS-11979 & the customized Test Flow for the Component
25. Connector & Wiring	Applicable Connector & Wiring Requirements	Connector & Wiring Requirement per Component PF & the customized Test Flow for the Component
26. Solder Evaluation	Solder Evaluation Requirement Applicable	As per Solder Evaluation Requirement & the customized Test Flow for the Component
27. Test-to-Failure	2x Life	
28. LV324 or equivalent power module qualification		

NOTE: Use temperature classification listed in Harmonized Standard CS.00056

After successful completion of component level Production Validation (PV) tests, for any design or process related changes in the component, engineering and supplier shall use the recommended validation requirement suggested in Annex C, which is based on SD-12659.

NOTE: Use of SD-12659 is not allowed if PV test is not successfully completed.

7.3 Thermal Profile Distribution

Thermal Profile distribution shall follow the table provided below:

Table 10: Thermal Profile Distribution

Thermal Profile Distribution based on Thermal Classification	
Distribution for Application	**Temperature**
6%	-40° C
20%	23° C
65%	76° C
8%	120° C
1%	125° C

	Table 11: List of Chemical/ Fluids			
CS.00056 - Annex C Chemicals	**COMPONENT APPLICATION**			
	GASOLINE ENGINE	**DIESEL ENGINE**	**GASOLINE & DIESEL ENGINE**	**REPB APPLICATION Deviation from *CS.00056 SPEC.* *Refer to Annex C of CS.00056 for Application methods relevant to each Chemical as marked below.***
Soapy water	x	x	x	X
Saline solution 10% salt (NaCl) by	x	x	x	X
Transmission fluid	x	x	x	X
Engine oil (Multigrade Oil)	x	x	x	X
Coolant additive (undiluted antifreeze fluid)	x	x	x	X
Diesel fuel		x	x	X
Ethanol Fuel (E-85)	x		x	X
Petrol/Gasoline unleaded	x		x	X
Brake fluid	x	x	x	X
Windscreen washer fluid	x	x	x	X
Car wash chemicals	x	x	x	X
Battery fluid	x	x	x	X
Bio Diesel		x	x	X
Methanol	x		x	X
Hydraulic fluid / Power steering fluid	x	x	x	X
Differential Oil	x	x	x	X
Greases	x	x	x	X
Urea (Nox reduction agent)		x	x	
Glass cleaner	x	x	x	X
Wheel cleaner	x	x	x	X
Cold cleaning agent	x	x	x	X
Ammonia containing cleaner	x	x	x	X
Denatured alcohol	x	x	x	X
Runway de-icer	x	x	x	X
Coolant (OAT)	x	x	x	X

8 FUNCTIONAL REQUIREMENTS

The Supplier shall meet the functional objectives and driver interfaces provided in the CFO sheet below for the PIM.

ComplianceMatrix_800V_Generator PIM_TechSpecs_01202023.xlsx

8.0 PIM Loss Maps

PIM Losses shall be equal to or better than the Stellantis target. Additionally, the supplier shall collaborate with Stellantis on further loss optimization during development. The supplier shall provide "PIM Loss Maps" and "PIM Loss at Top Points" . During the sourcing process, the loss may be based on simulation. During development the supplier shall provide the loss based on simulation and measurement.

Operating conditions:

- Power Module junction temperature: 100C
- Switching Frequency: specified in each section below
- PWM method: SVPWM
- Power Factor: 1.0
- The Modulation Index (AC voltage output) is assumed to have negligible impact to loss.
    - The effect of reduced switching events at over-modulation up to six-step is captured in the loss maps as a function of switching frequency.

PIM Loss Maps:

PIM Loss Maps shall be provided as a function of various inputs:

- Vdc (min, typical, max)
    - separate loss map(table) for each Vdc
- 1st axis: Phase current [0 to max in steps of X (target ~20 total phase current levels)]
- 2nd axis: Switching Frequency [2 to 16kHz in steps of 1kHz (15 total switching frequencies)]

PIM Loss at Top Points:

The PIM supplier shall provide total PIM loss at each of the operating points and must meet the weighted total energy consumption target.

Operating points and targets to be provided.

8.1 Gate driver IC

Reference attachment "*Master PIM-CB Source Package-20230227.zip*" for requirements.

8.2 Gate board schematics requirements

Reference attachment "*Master PIM-CB Source Package-20230227.zip*" for requirements.

8.3 Bulk capacitor requirements

The final bulk capacitor selection and characteristics shall be reviewed and approved by the Stellantis Engineering team.

Below is the simulation that the supplier must perform and review with Stellantis Engineering team during the sourcing process.

The aim is to calculate the voltage and current ripples with provided eMotor current, power factor, voltage maps and consider EOL/tolerance range worst case capacity value for dimensioning.

DC ripples analysis by simulation:

The aim is to evaluate the DC ripples (Voltage/current) generated by the PIM and EM for the all the operating points Torque/Speed of the EM.
Set up per B21 7112 A

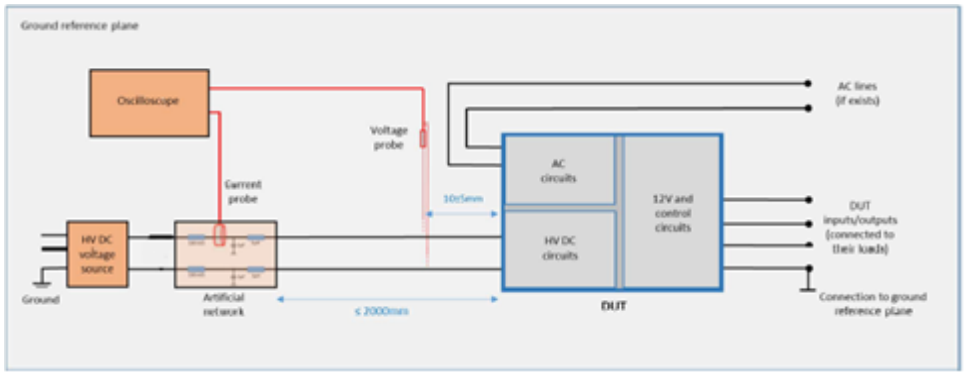


Figure10: Bulkcap simulation set up

The artificial network emulates the dynamic behavior of a vehicle power-net and the internal resistance of the battery. The suitable artificial network in order to provide representative load as in the vehicle is defined:

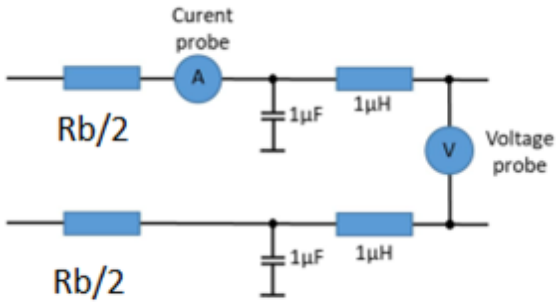


Figure11: Network set up for Bulkcap simulation

Where Rb is the internal resistance of battery pack.
The HV wiring harness between the PIM and the artificial network shall have a length lower than **2m**. the cross section of the HV wiring to be used should be the final one chosen for the vehicle**.**

5. **Conditions:**
   - Simulation shall be done in motor mode and generator: map
   - DC voltage : Min/Nom/Max
   - Consider for all your assessments results and/or maps for 10kHz SVPWM and Full Wave
   - Calculate with provided eMotor current, power factor, voltage maps and consider EOL/tolerance range worst case capacity value for dimensioning

Deliverables:
for each DC voltages values min/nom/max, the supplier shall provide:

- 2D Maps of the voltage ripples peak to peak values in motor and generator modes
- FFT voltage ripples curve in motor and generator modes
- FFT current ripples curve in motor and generator modes

- Value of the PIM DC link capacitor used
- Minimum switching frequency maps for min/nom/max DC voltages (motor and generator) needed to ensure the voltage/current ripple requirements

Requirement per B21 7112 A:

7.1.6.7 Requirements

Requirement in Time Domain:

The peak-to-peak value Upp of the generated ripples, on each operating point, shall be less than 20 V: Upp ≤ 20 Vpp.

Requirement in frequency domain:

Measured amplitudes with FFT on each operating point, shall be lower than the following limit, see Table 13:

Table 13: Voltage and Current Limits

-	-	Voltage ripple limit: U_{pp}	Current limit: I_{pp}
Frequency range f1	10 Hz - 3,165 kHz	6,6 Vcc	41,5 A
Frequency transition 1	3,165 kHz - 5 kHz	33,20 log (FMHz) – 109,56	41,5 A
Frequency range f2	5 kHz - 20 kHz	13,3 Vcc	83 A
Frequency transition 2	20 kHz - 118,85 kHz	-16,6 log (FMHz) + 84,66	24,9 A
Frequency range f4	118,85 kHz - 200 kHz	0,41 Vcc	8,3 A

Figure12: Voltage ripple limit and current limit

8.5 Power Module

Alternative power module solutions for all the PIM variants can be proposed by the supplier and shall be discussed and analyzed with the Stellantis engineering team. The number of max. occurrence over the life of the power module shall be more than 100k times.

Components which require Stellantis approval, will require the supplier to provide datasheet or other performance documentation and qualification test results to the appropriate automotive and industry standards. If not PPAPed component, the component PPAP timing must be provided.

Verification tests to be done by the PIM supplier (but not limited only to the following):
Power losses optimization data, thermal map for the power module integration including the substrate data and mechanical inter-connections to the busbar system.
Supplier shall use the 300kW Vmax and WOT cycle profiles for power module performance and life estimates. 250kW profiles shall be shared with supplier after sourcing.

8.6 Busbar

The supplier shall design the HV AC and DC busbars. The current density and geometry (cross section), the coating and the busbar thermal mapping will be reviewed in the tech review meetings.

The PIM supplier shall have temperature sensors to monitor the temperature of the HV DC busbar temperatures. The temperature values shall be read by the Control Board microprocessor to control the performance.

8.7 Passive discharge

In case of active discharge failure, passive discharge shall deplete the system HV energy.
Implementation should support creepage requirements of the PIM.

8.8 Current and thermal sensors

The selected current and thermal sensors shall be reviewed and approved by the Stellantis Engineering team in design review meeting. The Current sensor sensitivity error (including the thermal drift for the entire range of the sensor) shall be limited to 1.5%. The offset error (including the thermal drift) shall be limited to 1%.

8.9 Control board interface

Supplier shall develop the mechanical interface on the PIM housing for the control board based on the 2D drawing provided and the final design will be reviewed and approved with the Stellantis PIM engineering and Control board engineering team.

- Supplier shall develop Vehicle LV connector interface to the PIM housing
- Supplier shall be responsible for the LV connector sealing interface to the PIM housing.
- Supplier shall provide the PCB locating features for the control board.
- Supplier shall meet the creepage and clearance requirements for the internal LV connectors and PCB.
- Supporting plate shall be added between the control board and rest of the PIM.
- All the electrical harness shall be CS.00050 for the bend radius, cable routing, cable fixation and cable insulation.
- System level tolerance stack up analysis for the control board and PIM shall be performed by the PIM supplier.
- If required, the supplier shall provide thermal pad between control board and supporting plate.

8.10 Control board to Gate board – Integration

The PIM supplier and control board supplier shall work together to define the below interface specifications. The supplier shall follow the RASI chart to identify the responsibilities of the Control board supplier.

- Mechanical interface for Gate board and Control board
  - Mounting points
  - Fastener details
  - Locator positions for assembly (fiducial, etc.)
- Electrical interface (I/O definition and connector selection details)
  - Type of the connectors
  - Position/location of the connectors
  - Pin-out configuration (The document has the reference pinout configuration)
- SW interface

Stellantis Eng team, control board supplier team and PIM supplier team will work together to define and finalize the implementation of the interface.

8.11 EMC board

HV DC EMC filter shall be connected close to the HV DC connector. EMC design shall be complaint to the CS.00054 and CS.00196 standard.

8.12 Inverter HW Requirements

Inverter shall:

a. Implement derating strategies without overly affecting the performance capability of the system. All such strategies or needs must be communicated with Stellantis during sourcing and proof must be provided to show that such strategies are limited in use only for the protective purposes and NOT due to design limitations.

b. All interfaces connected on the vehicle connector shall be protected against shorts to 12V and shorts to ground.
c. All interfaces connecting between the motor or the vehicle securement actuator and the Inverter must be protected from short ground where possible. All these interfaces must be protected against corruption from inverter switching noises. Any deviations or special wiring requirements must be communicated early on during design reviews.
d. Implement diagnostics for current sensors and where possible shall implement plausibility check. Diagnostics to consider:

1. Short to neighboring circuits in harnesses
2. Short to ground
3. Short to power supply feed
4. Open Circuit
5. Noise injected in circuit
6. Noise injected in power supply lines
7. Plausibility check by Ia+Ib+Ic=0
8. Offset failure
9. HW Overcurrent (Threshold 1)

e. Implement diagnostics for position sensor faults and where possible shall implement plausibility check. Diagnostics to consider:

1. Short to neighboring circuits in harnesses
2. Short to ground
3. Open Circuit
4. Noise injected in circuit
5. Noise injected in power supply lines
6. Plausibility check by redundant paths
7. Offset failure

f. Implement diagnostics for redundant hardware position sensing faults

1. Plausibility check by redundant paths

g. Implement diagnostics to monitor for HV DC Bus inputs outside Operating ranges. Diagnostics to consider:

1. Overvoltage
2. Voltage derating upper limit
3. Voltage derating lower limit
4. Undervoltage

h. Shall have means, up to the extent of the state of art, to separately diagnose position sensor failure vs controller circuit failures.
i. Implement diagnostics for Power device switching or gate driver faults and where plausible shall implement a plausibility check. Diagnostics to consider:

1. Power Supply failure
    1. Drift
    2. Noise
    3. Short to gnd
    4. Open
2. Short Circuit on one of the switching power devices
3. Open Circuit on one of the switching power devices
4. HW Overcurrent (Threshold 2)
5. Overtemperature of the power device
6. Overtemperature of the gate driver circuits
7. Loss of Communication faults within the Gate driver board
8. Loss of Communication faults between Gate driver board and the control board
9. Cross conduction faults due to violation of dead time
10. Loss of Isolation on the 3 Phase AC outputs to the motor

j. Implement a Safety concept with a functional monitoring block independent of the Motor control functional block to prevent excess motoring or braking torque.
    1. Such a safety concept shall:
        1. Monitor torque achieved vs torque commanded
        2. Redundantly prevent systemic or systematic failures that could cause unintended acceleration or deceleration.

k. Implement measures in hardware with a controller monitoring level, means to verify the integrity of the above safety concept implemented inside the microcontroller as well as for the power supply powering the microcontroller.

l. Implement mechanism to alternately power and store energy derived from the HV Bus to address loss of primary power in the inverters

m. Implement checks for the communication of torque achieved, torque commanded and signals communicated over CAN relevant to the safe operation of the vehicle.

n. Evaluate and apply permissible limp home strategy in the event of fault detection

o. Ensure torque production is prevented if the vehicle is stationary and a limp home option is not available for detected failure.

p. Ensure safe state of vehicle is maintained if faults are detected while the vehicle is in motion until the vehicle reaches a safe state of being stationary, without direct access to HV and secured.
    1. Highest priority in such a circumstance shall be to prevent/minimize unsafe conditions to human life.
    2. Next priority shall be to prevent propagation of failure leading to above conditions.
    3. Third priority shall be to protect other hardware within the vehicle.
    4. Safe state implies all capacitive and inductive energy is maintained to less than thresholds capable of being an electric hazard and all electrochemical energy disconnected safely from the rest of the vehicle circuits.

q. Ensure that Inverter switching does not produce unwanted ripples on the HV DC Bus impeding the proper functioning of the system per the specification provided.

r. Ensure implementation of Direct access protection feature. For such a feature the following shall be considered:
    1. HV Interlock loop and its associated diagnostics which can separately detect each interface that it protects, for failure.
    2. Components chosen for the loop shall ensure means to prevent nuisance failures to the extent possible by the state of the art.
    3. Bleeder resistors or alternate Active Discharge paths must be defined that are not interfered by safe state implementation of the inverter or the motor.
    4. Appropriate protections must be made in design and diagnostics to prevent hardware damage by overuse in the case of overuse under Battery pack contactor weld conditions.
    5. Passive discharge implementations must be implemented to prevent electrical hazards during component handling

s. Where applicable, ensure proper securement of the vehicle and:
    1. Shall recalibrate/diagnose vehicle securement relevant actuators periodically as appropriate for the hardware and permissible by the system.
    2. Shall have redundant means to confirm actuation status of the securement system.
    3. Shall function to ensure vehicle safe state of being secured as permissible by the system under loss of primary energy source.
    4. Shall have the capability in hardware to determine the speed of the vehicle prior to engagement of vehicle securement actuator

t. Shall have means, up to the extent of the state of art, to separately diagnose vehicle securement actuator failure vs controller failures.

u. Where possible, ensure retention of a fault history in a location using methods isolated from corruption of data under failure modes described above.
v. Where possible, ensure retention of a performance history in a location using methods isolated from corruption of data under failure modes described above.
w. Ensure reliability of circuits used for defined use over the specified design life of the component consistent with the ASIL rating of the device in accordance with the ISO 26262
x. Compliance to the following Stellantis standards and this document are mandatory. Any deviations shall be called out during Sourcing and maintained using Stellantis RAR(Requirement analysis reporting) template:

1. CS.00012
2. CS.00012/01
3. CS-A0403
4. CS.00054
5. CS.00056
6. CS.00196
7. CS.00081
8. Mechanical Requirements
9. Component Functional Objectives
10. Functional Safety Documents
    1. DIA
    2. HARA
    3. TSR
11. SD-12009

9 SAFETY AND REGULATORY REQUIREMENTS

Supplier shall ensure compliance to all applicable regulatory requirements for the PIM in the markets where the vehicles are sold.

China Homologation:
PIM shall comply to the altitude requirements of 5400m with maintaining the Clearance/Creepage distance as per IEC 60664-1 or similar standard. Generator PIM and generator motor system shall have GBT 18488 certification from the China testing agency and PIM hardware shall have the performance label in Chinese language, ground symbols and other requirements as specified in the GBT 18488.

China Regulation 2017 Chart Format.pdf
China Regulation 2017.pdf

9.1 Direct Access Protection

Direct access protection in Stellantis shall comply with CS-A0403 HVIL requirements. All PIMs mentioned in this source package shall have HVIL protection for all relevant HV interfaces. HVIL strategy for junction box shall be reviewed during sourcing.

10 RELIABILITY / DURABILITY (DEPENDABILITY) REQUIREMENTS

Reliability/durability tests are required to demonstrate (with a given probability and level of confidence) that a component will perform its intended functions over the expected service/useful life, under all anticipated operating conditions and environments as specified in the preceding sections. The tests shall correlate to 95th percentile customer usage as defined by design responsible Engineering Group. The tests must ensure that expected design and process variations are covered, resulting in adequate product robustness. Test to Failure (TTF) is the preferred test methodology. Test planning/methodology, sample

size planning and analysis methods for reliability demonstration shall comply with QR-10008, “Product Assurance Testing”.

The following paragraphs contain the reliability/ durability (dependability) requirements of the component or subsystem, where reliability/ durability (dependability) is the ability of the component/ subsystem to function during its target life within the performance levels specified.

10.1 Useful Life

The criterions of the reliability objectives verification are defined in CS.00056 Table 1 and Table 15.

Table 12: Classification of service life (Reliability)

Vehicle Design or Service Life Requirements	15 years / 200,000 miles
Minimum Reliability and Confidence demonstration	R95 / C90
Ignition ON/OFF Cycles	54750 cycles

Thermal Shock/ Powered Thermal Cycle Endurance, High Temperature Operating Endurance, High Temperature Humidity Endurance, Vibration, and Mechanical Operating Endurance Requirements stated in section 7.2 shall be considered as part of ECU reliability/ durability requirement verification as these tests represent life cycle requirements for stated environmental stresses.

Test-to-Failure (TTF) shall be required for new technology or new application for the vehicle program, new supplier, new processes, and high warranty or based on engineering judgment for design robustness. TTF shall also be required to validate design changes resulting from any DV or PV test failures. Supplier shall use DS-11332 as a reference for conducting TTF using constant load or step-stress as agreed between Stellantis and Supplier Engineering. Purpose of TTF shall be to identify any design weaknesses and use the findings to improve reliability and durability of the component.

Required reliability targets shall be met by the Supplier and demonstrated through validation testing and Weibull analysis. The Supplier shall propose ED and DV test plans that shall verify that these requirements are met.

Stellantis and the Supplier shall define validation test cycles that will be used in electrically powered cycles of ED, DV and PV tests as defined in Stellantis standards. The Supplier shall be responsible for procuring, designing and constructing load boxes (both high voltage and low voltage) and other power sources that will be activated during all powered cycles of validation testing. Electrical components used in the PIM design shall be automotive qualified based on the appropriate standard. Power modules shall be qualified per AQG-324 or ED4701, and discrete electrical components per the respective AEC or IEC standard. The Supplier shall provide a detailed bill of materials that will contain details of component qualification for review with Stellantis.

10.2 Reliability Target

The Reliability Targets are re-assumed in Table below:

Table 13: PIM Reliability Target

TESIS code	TESIS description	12 Months [R/100]	24 Months [R/100]	36 Months [R/100]
-----	PIM	0.010 C/1000	0.018 C/1000	0.026 C/1000

Refer to Table for additional details on classification

10.3 System and Vehicle Level Requirement

Stellantis Engineering shall perform system and vehicle level tests on development phase vehicles (such as, System bench, Plywood Buck, Hardware in Loop, Corrosion, PG Driving, BSR, Hot/Cold Trips, etc.) during program development. Stellantis Proving Grounds shall conduct vehicle durability validations such as, PTSR, SXV, PT-7, etc. or reliability validation on 3/36 vehicle fleets to verify EE system interface and customer usage applications during different stages of program development (FDV, VP, PS and Job 1).

Any degradation to functional and/ or performance requirement involving component reliability/ durability issues shall be promptly addressed by component Supplier. Corrective actions shall focus on issue prevention and may involve changes to design including any component validation testing.

11 PRODUCT ASSURANCE

The manufacturing facility for a particular component or system shall develop an appropriate PPR (Process Planning Review) and PAT (Process Audit Tool), in accordance with the Stellantis PPA (Process Planning and Audit) manual and the Stellantis Italy PSP (Product Development Process - 08101) to assure the part meets the quality, durability, and reliability targets throughout the manufacturing process.

11.1 Approved Best Practices

Stellantis approved practices information shall be shared with the responsible entity chosen for the commodity during product development.

11.2 Design Failure Modes and Effects Analysis (DFMEA)

The DFMEA must address and correlate to all of the functions which are specified in this Performance Standard. All potential Failure Modes, as described, must be evaluated and taken into account in the DFMEA risk analysis. FMEA analysis shall be included in the timing plan shared and agreed with the supplier at project start. A complete DFMEA is normally property of suppliers and available for examination at their site. Supplier will be responsible for DFMEA execution and content accuracy; Stellantis component or system specialist shall analyze and approve supplier’s analysis.

12 WARRANTY RETURNED PARTS TEST AND ANALYSIS PROCEDURES

Program Warranty Targets

- Program warranty targets are used for pre-launch and post-launch continuous improvement activities led by engineering, platform quality, supplier quality, and suppliers. Warranty reduction activities shall be planned in order to meet or exceed the target.
- The Supplier Associated Warranty Reduction Program (SAWRP) is the basis for the Stellantis Warranty EBSC (External Balanced Scorecard) and will govern supplier reimbursement of dealer warranty claims. Please refer to the e-Supplier Portal for more information.
- The program warranty component target is zero C/1000 at 3 Months-In-Service (MIS), on a per component basis, unless otherwise specified in the Functional and Design Requirements section of the Source Package.
- The product shall be under warranty for 10years/150,000km whichever comes first.

The product design, development and manufacturing entities shall comply with PS-11346 Warranty Returned Parts and Analysis Procedures.

Safe Launch Plan:

- The supplier shall develop Safe Launch Plan (SLP) during product and manufacturing process development, the supplier shall refer to the SQ.00009 for more details and for other reference standards are SQN-A0490, SQN-A0556, SQ.00008 and SQ.00010.
- The SLP plan needs to be reviewed and approved by Stellantis Engineering and Supplier Quality teams.

Burn-in process:

- The supplier shall develop a burn-in test procedure to verify the PIM module functionalities at various operating voltages and temperatures for a defined time period during SLP.
- Supplier and Stellantis engineering team shall work together to develop the test parameters during product development.

Annex A
(Normative)
Design Verification & Production Validation Summary

Table 14: Design Verification & Product Validation (Mandatory)- (Note 4)

Function	Section #	Sample Size (Note 1)		Acceptance Criteria (NOTE 5)		Comments & Responsibility
		DV	PV	DV	PV	
PHYSICAL	5.2 **Physical Requirements**	(Note 2)	(Note 2)	Meets Requirement	Meets Requirement	Supplier
MECHANICAL	5.3 **Mechanical Requirements**	(Note 2)	(Note 2)	Meets Requirement	Meets Requirement	Supplier
INSTALLATION	5.4 **Installation Requirements**	(Note 2)	(Note 2)	Meets Requirement	Meets Requirement	Supplier
ELECTRICAL INTERFACE	6.6 **Electrical interface Requirements**	(Note 2)	(Note 2)	Meets Requirement	Meets Requirement	Supplier
EE/EM – COMPONENT SPECIFIC TESTS	7.2 **EE/ EM - Component Specific Test Requirements**	(Note 2)	(Note 2)	Meets Requirement	Meets Requirement	Supplier (Note 3)
FUNCTIONAL	8 **FUNCTIONAL REQUIREMENTS**	(Note 2)	(Note 2)	Meets Requirement	Meets Requirement	Supplier
SAFETY AND REGULATORY	9 **SAFETY AND REGULATORY REQUIREMENTS**	(Note 2)	(Note 2)	Meets Requirement	Meets Requirement	Supplier/ Stellantis (as applicable)

Table 14: Design Verification & Product Validation (Mandatory)- (Note 4)

Function	Section #	Sample Size (Note 1)		Acceptance Criteria (NOTE 5)		Comments & Responsibility
		DV	PV	DV	PV	
RELIABILITY/ DURABILITY	9.1 **DIRECT ACCESS PROTECTION** **DIRECT ACCESS** protection in Stellantis shall comply with CS-A0403 HVIL requirements. All PIMs mentioned in this source package shall have HVIL protection for all relevant HV interfaces. HVIL strategy for junction box shall be reviewed during sourcing. **10 Reliability / Durability (DEPENDABILITY) REQUIREMENTS**	(Note 2)	(Note 2)	Meets Requirement	Meets Requirement	Supplier

Table 14: Design Verification & Product Validation (Mandatory)- (Note 4)						
Function	Section #	Sample Size (Note 1)		Acceptance Criteria (NOTE 5)		Comments & Responsibility
		DV	PV	DV	PV	

NOTE 1: If provided, the sample size shown is the Stellantis recommended samples per QR-10008, which in conjunction with the analysis method indicated best demonstrates the Acceptance Criteria has been met. The Supplier is responsible for meeting the Acceptance Criteria specified and may use other valid sample sizes and analysis methods approved by Stellantis.

NOTE 2: Applicable tests, sample sizes and acceptance criteria shall be per requirements specified in each of these sections. If not specified, Release Engineering & Supplier shall define those in the DVP&R. (INSTRUCTIONS: Engineers should include sample size, test procedures and acceptance criteria for each of these requirements, if not identified in the component PF or referenced standards, CS-11982, CS.00054 and CS-00056 etc.).

NOTE 3: PET analysis method (refer to section 8.8 for details) is based on the Statistical Tolerance Limits explained in SD-12501. PET (shown as a red pentagon in the test flows in Annex C) shall be completed on test samples at the start and after completion of test for the key functional parameters identified in section 8.8

NOTE 4: Where applicable, module qualification for DV & PV shall follow the test flow sequence given in Figure C-1 or C-2 (Combination of both test flow is not allowed).

NOTE 5: Engineer shall specify objective or subjective acceptance criteria (Example: P99C90, R95C90, No failure or functional degradation, no physical degradation, etc.) in the DVP&R document.

CONTINUING CONFORMANCE: The Continuing Conformance or CC table below shall include only those tests which are required to ensure ongoing quality of supplied components. Purpose of CC tests is to identify manufacturing spills before parts leave the Supplier manufacturing locations. Changes resulting from the “Forever Requirements – design or process changes” should not be included. If there are supply-chain related changes to design, process, manufacturing moves or packaging environment for any EE or EM component, applicable validation requirements from SD-12659 shown in Annex D shall be identified by Stellantis Engineering, Quality and SQA team.

Table 15: Continuing Conformance				
Function (1)	Section #	Sample Size	Acceptance Criteria	Frequency
PTCE		2		Every 6 Months

NOTE 1: Above tests are in addition to all the in-process functional verifications identified in the Control Plans to prevent potential Design & Process failures.

End of Annex A

Annex B
Test Flow

Following is Stellantis recommended DVP&R for PIM system and sub-components. This list is not a comprehensive list and therefore the supplier must review and add additional tests needed based on the known failure modes of the design.

Supplier is also responsible to create, populate, and execute an Analytical DVP&R, which includes all design analysis to document design robustness and justification to freeze design and initiate TKOs. Initial Simulation and test Checklist is attached, supplied may add additional items as deemed necessary. Supplier and Stellantis team shall work together to decide the distribution of number of samples for different HV-DC connection orientation.

Supplier shall follow the Test Flow in attachment "*800V HD GPIM DVPnR v2.0.xlsx".*

End of Annex B

Annex C
(Normative)
Supplier Process & Component Change - Validation Requirement

Supplier Process & Component Change - Validation Requirements (SPCCVR)

#	Reasons for the Changes	Is this affected?	Thermal Shock (Note 1)	Powered Thermal Cyde Endurance	High Temperature Operating Endurance	High Temperature Humidity Endurance	Shipping Storage Temperature Exposure	Low Temperature Operating Endurance	Thermal Humidity Cyde	Mechanical Operating Durability	Vibration	Mechanical Shock	Mech. Shock Endurance (only if Gravel Bombardment (if applicable)	Solar Radiation Soak (if applicable)	Mud Resistance (if applicable)	Handling Drop	Water or Steam Intrusion	Dust Intrusion	Salt Water Immersion (if applicable)	Salt Fog	Mixed Flowing Gas (if applicable)	Chemical Exposure	Other tests (Ozone, Vehicle Drive Cycle, etc.) (Note 2)	Solder Evaluation	Applicable EMC Cmpt/Veh. Tests - CS.00054, CS.00055	Electrical System Tests CS.00054	Connector Tests (SAE/USCAR-2), if	Wiring Requirement Tests (CS-11510)	Test Flow (SD-12659) (Note 3)
1	PCB Layout / PC Board material Changes		X			X					X	X												X	Note 4	Note 4			1
2	Passive component change (ex: resistors, inductors, capacitors, etc.)		X			X					X	X												X	Note 4	Note 4			1
3	Solder material, terminal lead material or process change (Ex: Lead to lead-free or vice versa)		X			X					X	X												X	Note 4	Note 4			1
4	Plant/ Location move (Geographical location change)	Yes	X			X					X	X												X	Note 4	Note 4			1
5	In-Plant Location move (without new equipment - same equipment)		X			X					X	X												X	Note 4	Note 4			1
6	In-Plant Location move (with new or additional equipment)		X			X					X	X												X	Note 4	Note 4			1
7	New Manufacturing Line Added		X			X					X	X												X	Note 4	Note 4			1
8	Component (electronic) Change (new part with different pad / lead geometry) - ex: IC, Diode, etc.		X		X	X		X			X	X												X	Note 4	Note 4	X	X	2
9	Component (electronic) Change only (totally new part) - no change to layout or pad geometry - ex: IC, Diode, etc.		X		X			X			X	X												X	Note 4	Note 4	X	X	3
10	Conformal Coating changes Adding, removing, changes to the material / chemical properties, process change, or adding new conformal coating equipment.		X			X																							4
11	Changes in bezel/ case (example, change in the rubber or plastic material for sealing, case)		X								X	X		X	X	X		X	X	X	X	X	X	X						5
12	Sealing material changed (ex: change in the rubber or plastic material for sealing, case)		X								X	X				X		X	X	X	X	X	X	X						5
13	Mounting or packaging location change without change in the temp class		X								X	X		X	X	X		X	X	X	X	X	X	X		Note 4	Note 4			5
14	Mounting or packaging location changed **with** change in the temp class		X		X	X					X	X		X	X	X		X	X	X	X	X	X			Note 4	Note 4	X	X	5
15	Connector Changes		X								X	X				X		X	X	X	X	X	X		X			X	X	5
16	Mounting Bracket Changed		X								X	X									X									6
17	Electro - Mechanical (Switches Relays)		X							X	X	X														Note 4	Note 4			7

Note 1 - Thermal Shock Cycles will be used to reduce overall test time for combined Thermal Shock and Powered Thermal Cycles as shown in the applicable Test Flows (**SD-12659**).

Note 2 - For some situations, other applicable (Component, System or Vehicle Drive Cycle) tests shall be selected by Engineering, QRE and Supplier team.

Note 3 - Refer to the tab "Test Flow-5" for additional details.

Note 4 - FCA US EMC Department will make final determination on applicable EMC and EE System requirements for the proposed design and/or process changes.

Additional Notes:

- Final approval for any validation plan requires FCA US QRE concurrence. In some cases, **additional tests** may be required based on supplier's warranty or product development history.
- Test durations for HTOE and HTHE tests may be higher or lower depending on operational test parameters used. Refer to "Special Test Situation" tab for test parameters.

Figure C-1: Test Selection Guideline for Supply-Chain Changes

SD-12659.xlsx

End of Annex C

Annex D

List of Supporting Documents:

Functional Safety:

The Supplier shall use the latest version of the document prior to quote for quote purposes. The Functional Safety engineer may update the requirements after the review of the functional safety during initial design phase to accommodate/offset the supplier's system architecture. The program shall follow the latest functional safety document version prior to each design freeze.

Safety Goals.pdf
DIA_800V_HD_GPIM_V1.xlsx

Control Board: Reference attachment "*Master PIM-CB Source Package-20230227.zip*"

HIL: *XILPROJECTSOURCE_WORKPACKAGE_MCP.docx*

PIM Space Claim: As mentioned within Section 5 of this document, Reference 3D CAD

SW API files: The Supplier shall use the latest version of the below documents prior to quote for quote purposes.

EDM2.0 Low Level Software Requirements
MCP Application Program Interface

Other Documents:

Powertrain Electrification Components Statement of Work 0.1
Component Cyber Security Technical Specifications PIM

Power Electronics and Electronics SOW.pdf
A EDD PBD-800V HD GPIM - version 15j - 8-13-20.xlsx
CCTS_LB SRT_PIM.doc
XILPROJECTSOURCE_WORKPACKAGE_.docx
MCP Application Programming Interface.docx
EDM2.0 Low Level Software Requirements.docx
Electrical Technical Specification.pdf
Master PIM CB Source Package <yyyymmdd>.zip

The Supplier shall use the latest version of the document prior to quote for quote purposes. Stellantis engineering team may update the requirements after review of the initial design assessment phase to accommodate/offset the supplier's system architecture. The program shall follow the latest version of the documents listed above prior to design freeze. Change Management shall be driven by statements in the Section Deviations from this specification are permissible only with the express authorization of the design release engineer responsible. In case of disagreement between the text included on this specification and other documents cited herein, this specification has priority to anything else. However nothing in this specification can replace applicable laws and regulations without a specific exemption. Discrepancy in this specification or difference between this specification and country-specific regulations shall be marked from the supplier without delay and it shall be discussed directly with the project engineer responsible.

All deviations shall require the Supplier to submit a Stellantis Engineering Change Request document prior to any PIM design freeze for approval. Additionally, at Stellantis defined milestones the Supplier shall be required to complete and submit Requirements Analysis (CS-00077), Component Validation (SD-12659) and completed DRBFM analysis documents.

End of Annex D

Annex E

Tools used for Development Boards

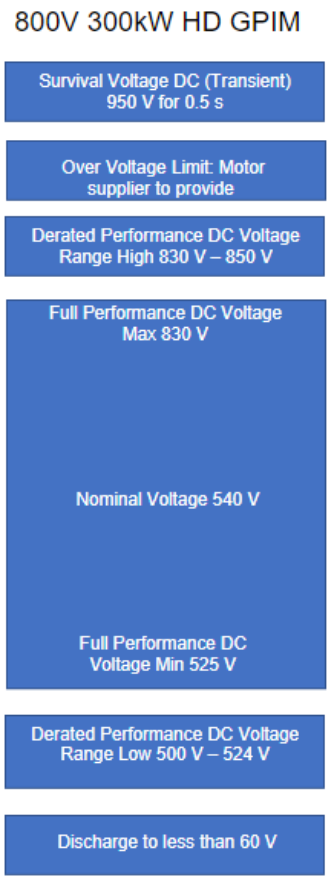
The supplier shall work with production PIM supplier and Stellantis Engineering to finalize the SW/CAL Dev Tool solution.

Reference attachment "*Master PIM-CB Source Package-<yyyymmdd>.zip*" for requirements.

End of Annex E

Annex F

HV Voltage Levels explained



End of Annex F

Annex G
Part Inspection Document

Part Inspection Standard_REV0.xlsx

End of Annex G

Annex H
Virtual Engineering

Supplier is required to provide Stellantis engineering the following inputs for NVH and Dynamics simulations for evaluation of PIM and vehicle level NVH based on the file attached below as applicable to the components supplied. These virtual engineering inputs are to be delivered at the start of each design phase ex. Alpha, Beta, Gamma etc. on time according to defined program milestones

ePWT_Calculation_input_data_20220310.xlsx

End of Annex H