LGE Internal Use Only

LGE VS [OEM Name] [Project Name]

**System Requirements Specification**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **About This Template**   * Template title: LGE\_VS\_SysRA\_T01\_System Requirements Spec (SysRS) * Management Department: VS SW Process Team * Revision History  |  |  |  |  |  | | --- | --- | --- | --- | --- | | Version | Date | Comment | Author | Approver | | 1.5 | 2016-09-30 | Initial Release  (System Requirements Specifications template of 'Foton S7N1’ project is referred) | VC Smart SW Process team,  CTO SW Engineering Lab | VC Smart QE FD | | 1.6 | 2019-02-19 | Update due to annual organization restructuring (VC 🡪 VS) | VC Smart SW Process team | VS Smart SW Process team | | 2.1 | 2021-08-20 | (\* actually updated in 19.02.21 by Guawnrok Park, Architec team)  Updated overall   * Contents * Document structure | VC Smart SW Process Unit | VC Smart SW Process Unit Leader | | Updated security notice of this template  (Before: LGE Confidential->After: LGE Internal Use Only) Security level related note (the last sentence in red color below) |  * Blue fonts is just an example for reference. * The contents of this template may not be 100% right for all projects, so authors should use it after tailoring the contents to the project characteristics. * Once you have finished this document, delete "About This Template" part. * This template can be created one per project, or it can be divided by feature. * In this template, only SyRS\_ID, Requirements, Higher Traceability (CRS\_ID), and Allocation are indicated. For requirements management, Status, Type, Priority, Sys Element, VM(Verification Method), VC(Verification Criteria) are required * Allocation can be divided into HW, SW, HW-SW, ME, and HW-ME, and the requirements classified into SW and HW-SW are subject to SRS. * Chapters 1 and 2 are used to help the understanding of documents, so they are classified as Type = Information. * The notice “LGE Internal Use Only” is for this template itself. The document which use this template needs to be classified as suitable security level according to its content |

About This Document

Document Information

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# Introduction

## Purpose

|  |
| --- |
| Describe the purpose of this document. |

This document specifies the System Requirements Specifications for XXX.

Table 1.1 System Objective

|  |  |
| --- | --- |
| System name |  |
| Purpose of the system in vehicle | *Describe the purpose and brief functionality of the system in the view point of vehicle function* |

*[Use the Customer requirements and stakeholder requirements to create system requiements spec. (informative)]*

## Scope

|  |
| --- |
| Describe the scope of this document. |

* Scope covered by this document:
* Scope of this document (OEM/model/country):
* Scope of development / undeveloped scope of this project:

## Audience

|  |
| --- |
| Describe the audiences of this document. |

The target audience of this document is:

* Requirement engineer who will point out any contradiction between the design and the requirement
* System / Software architect who will evaluate the design of the system / software
* Component developer who will implement the design in actual code
* XXX project participants who want to understand the architecture of the [System Name]
* Test engineers who verify [System Name] and others related

## Conventions

|  |
| --- |
| If there is a notation used in this document, explain it. |

Example 1: unit of measure

**Units**

The unit of speed keeps consistency for each destination.

Japan: km/h

U.S.: mile/h

Example 2: This document follows UML notation 2.0

## Acronyms / Glossary

|  |
| --- |
| Describes abbreviations used in this document and their interpretations. In the table, the abbreviations/terms are indicated in alphabetical order. In addition to explaining abbreviations, it is written when explanations of terms are required. |

|  |  |
| --- | --- |
| Acronym | Description |
| CAN | Controller Area Network |
| DD | Download Descriptor |
| ERR | External Remote Reflash |
| IRR | Internal Remote Reflash |
| LIN | Local Interconnect Network |
| SRS | Software Requirements Specifications |
| SysAD | System Architectural Design |
| SysRS | System Requirements Specifications |
| VC | Verification Criteria |
| VM | Verification Method |

|  |  |
| --- | --- |
| Glossary | Description |
| OOOO | OOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOOO |
|  |  |

## Related Documents

|  |
| --- |
| Describe the list of documents referenced when preparing this document.  Describe the document title. If there are multiple versions of a document, the version name of the referenced document is also described.  Customer requirements, customer feedback, environmental restrictions and their effects, the results of design analysis performed in advance by our (technical community), relevant international standards and internal technical documents can be referred to. |

Documents related to this document include:

[1] LGE, Customer Requirements Specifications, pjt\_CRS, v1.0 [Date] [Page]

[2] Author, Document title, Document version [Date] [Page]

Documents referenced from this document include:

[11] LGE, SyRS template, pjt\_SyRS\_feature (LGE VC SyRS tpl v2.0), 2017.6.10

## Verification Environments

|  |
| --- |
| When creating Verification Criteria for each requirement, if there is a common reference such as test environment, it is defined here and used in the document. |

[Ve1] Face: FDDC-238

[Ve2] Eyes: FDDC-3054

[Ve3] Canoe

[Ve4] Measurement system

# General System Description

*[■ Note:*

*- Structural information related to technical design and implementation should not be indicated.*

*- In the case of assumption, it is stated that it is an assumption or summarized as ‘2.5 Assumption’.]*

## System Context

*[■ Contents: Draw the relationship (External Interface) between this system and an entity outside the system and briefly explain it. In the diagram, the development scope of the project is specified and the legend of the line, color, and figure used in the diagram is described.]*

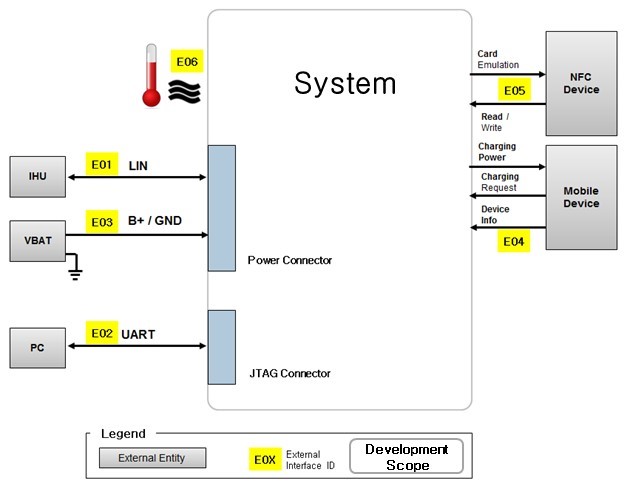


Figure 2.1 System Context Diagram

*Describe external interface in the table as follows.*

Table 2.1 External Interfaces

|  |  |  |  |
| --- | --- | --- | --- |
| Interface\_ID | Interface Name | Connected Entity | Description |
| E01 | LIN | IHU | LIN protocol v2.0 |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## System Modes and States

*[■ Contents: When describing the system mode or state, follow the UML standard or define the meaning of the notation used]*



Figure 2.2 System Modes and States

*Table 2.2 explains the details of the mode and the transition described in Figure2.2.*

Table 2.2 System Mode and Transition

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| No. | State | Description | Event | action | Next State |
| *1* | *Idle* | *Complete bootup & ready to play* | *Play* | *On Amp* | *Run* |
| *Timeout* | *Off Display* | *Sleep* |
| *2* | *Run* | *Play state* | *Stop* | *Off Amp* |  |
| *error* | *Safety Action :*  *1) Display ‘error detected’*  *2) Off Amp* | *Safety* |
| *3* | *Sleep* | *Power Save Mode* | *Touch* | *On Display* | *Idle* |
| *4* | *Safety* | *Error detected & recovery mode* | *Diag fail* | *Set timer* | *Safety* |
| *Diag OK* | *Reset* | *Idle* |

## Major System Functions

*[■ Contents: System major functions are described in the table or level 1 use case diagram (Informative)]*



Figure 2.3 Level 1 use case diagram

Table 2.3 Use case list

|  |  |  |
| --- | --- | --- |
| UC\_ID | UC\_Name | Description |
| UC1 | Update | On-line Software update by user request |
| … |  |  |
|  |  |  |
|  |  |  |

## Operational Scenarios

*[■ Contents: Considering the items below, describe use case or operating scenario of system (Informative)*

*: System behavior on vehicle key on*

*: System behavior during vehicle driving*

*: System behavior on vehicle key off*

*: System behavior on specific condition (incl. severe external stress condition, operation in safe state, operation concept of fail/safe mode)]*

|  |
| --- |
| The below chapters can be added when it is needed.  2.5 User characteristics  2.6 Assumption and dependency |

# Physical Requirements

*< This chapter provides physical requirements.*

*‘3.1 Durability’ and ‘3.2 Adaptability’ can be moved to ‘5. Quality Attribute Requirement>*

## Durability

*[■ Contents: Customer requirements and LGE quality policy*

*Create durability-related requirements based on customer requirements and LGE quality policy]*

Table ‎3.1 Durability

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
| *D1* | *10,000 recharge cycle in nominal temperature* | *Customer RFQ* |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Adaptability

*May be the requirements for the connector. (standards and requirements for physical interfaces)*

*[■ Contents*

*- Create adaptability-related requirements based on customer requirements*

*: Requirements for adaptability from the electrical/electronic and SW point of view (e.g. AUTOSAR, JENNIVI application, etc.) are written (Interfaced connectors, Housing outer shape, etc.]*

Table ‎3.2 Adaptability

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
| *A1* | *The system should follow [customer] standard connector specification* | *Customer RFQ* |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

*■ Note:*

*- Adaptability should be described from the perspective of the high level system. For example, if the DDM is mounted on the door assembly, all the requirements that must be considered for the DDM to be correctly mounted on the door assembly can be described.]*

## Environmental Conditions

*[■ Contents*

*Considering the items below, all environmental conditions exposed to this system and development requirements to overcome them are described.*

*: Electrical conditions (e.g. Max. leakage current, voltage swing, reverse voltage, supply voltage decrease/increase, etc.)*

*: Mechanical condition (e.g. Vibration pattern, free fall condition, scratch resistance, etc.*

*: Climate conditions (e.g. Temperature cycle, salt spray, ice water shock, solar radiation, dust, heat resistance, etc.)*

*: Chemical conditions (e.g. Exposure for fuel (e.g. diesel, gasoline), battery leakage, cleaner, etc.)*

Table ‎3.3 Environmental Conditions

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
| *E1* | *Operating temperature range: -40 ~ +125 degree* | *Customer RFQ* |  |
| *E2* | *Storage temperature range: 0 ~ 40 degree* | *Customer RFQ* |  |
|  |  |  |  |
|  |  |  |  |

*[■ Note*

*- Note that the environmental conditions exposed are different depending on the installation   
location of the system. (e.g. engine room. passenger cell, etc.)]*

## Installation Requirements

*[■ Contents*

*- Create installation-related requirements based on customer requirements..]*

Table ‎3.4 Installation Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
| *I1* | *Case dimension tolerance: under 0.5m* | *Customer RFQ* |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

## Hardware Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
|  | *Case dimension tolerance: under 0.5m* | *Customer RFQ* |  |
|  |  |  |  |

## Mechanic Requirements

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
|  | *Case dimension tolerance: under 0.5m* | *Customer RFQ* |  |
|  |  |  |  |

# Functional Requirements

*[This chapter covers functional requirements.*

*Most of the system requirements fall into this category.Devide into subsections for each feature.]*

## Feature1

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirement | CRS\_ID | Allocation |
| *SyRS.207007* | *The battery management system ECU(BMS) acts as a master in the immobilizer functionality, based on the xxx* | *Customer RFQ* | *SW* |
| *SyRS.206935* | *After updating the authentication parameters in EEPROM successfully, BMS ECU shall send the acknowledgment message (ACK\_M) to ICU* | *Customer RFQ* | *SW* |
| *SyRS.207371* | *The BMS shall provide the flashing service based on UDS(Unified Diagnostic Service)* | *Customer RFQ* | *HW-SW* |
| *SyRS.206563* | *The measurement range shall be from 1V to 4.5V* | *Customer RFQ* | *HW-SW* |
|  |  |  |  |

## Diagnosis

*[■ Contents: Describe diagnosis-related requirements required for the system.]*

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
| *SyRS.207008* | *The BMS shall provide the function for diagnostic communication finally based on "Mahindra\_UDS\_SPecification\_Ver2.0.0.pdf"* | *Customer RFQ* |  |
| *SyRS.207009* | *DLC(Data Length Code) shall be fix to 8 byte* | *Customer RFQ* |  |
| *SyRS.207011* | *CAN IDs for the diagnostic communication are as below*  *- CAN ID for functional request: 0x7*  *- CAN ID for physical request: 0x7B0*  *- CAN ID for physical response: 0x7B8* | *Customer RFQ* |  |

## System Configuration

*[■ Contents: Describe system configuration and calibration-related requirements]*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| SyRS\_ID | Parameter name | Description | Value Range | Meaning of value | Application method | CRS\_ID | Allocation |
|  | *Number of applied cell module* | *Number of cells that applied to the pack system can be configured* | *1 ~ 24* | *Number of cells* | *Parameter adjustment after SW build*  *(Flashing tool)* | *Customer RFQ* |  |
|  |  |  |  |  |  |  |  |

# Quality Attribute Requirements

## Performance Requirements

*[■ Contents: Describe performance-related requirements (time efficiency, resource efficiency).]*

Table 5.1 Performance Requirements

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SyRS\_ID | Quality Attribute | Requirement | CRS\_ID | Allocation |
|  | *Regeneration Efficiency* | *Charging efficiency in battery regeneration mode should be higher than 90% with regards to generated electrical power from generator motor* | *Customer RFQ* |  |
|  | *Battery temperature power* | *BMS should have the performance to lower down the batter temperature in Max. gradient 3℃ / a minute @ 85 ℃* | *Customer RFQ* |  |
|  |  |  |  |  |

## Security Requirements for Embedded Data and Communication

*[■ Contents: Describes the security requirements for the software code embedded in the controller and the communication-related security requirements.]*

Table 5.2 Security Requirements for Embedded Data and Communication

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
|  | *Embedded SW data should not be exported by any means without certification code* | *DAESUNG own rule* |  |
|  | *Access to protected area should be denied* | *Customer RFQ* |  |
|  |  |  |  |
|  |  |  |  |

*[■ Note*

*- In addition, the identified quality attribute requirements are described in a separate section. (Quality Attribute classification refers to ISO9126 (functionality, reliability, efficiency, usability, maintainability, portability)*

# Constraints

## Business Constraints

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
|  |  |  |  |
|  |  |  |  |

## Technical Constraints

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
|  |  |  |  |
|  |  |  |  |

## Standard Constraints

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
|  |  |  |  |
|  |  |  |  |

## Policy and regulation Constraints

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
|  |  |  |  |
|  |  |  |  |

## Test Requirements

*[■ Contents: Describe system test requirements based on customer requirements]*

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
| *SyRS.207475* | *Operating voltage test -8V, 12V and 16V as reference document ISO 16750-1* | *Customer RFQ* |  |
| *SyRS.207531* | *Conducted Emission(CE) test - power/signals, frequency range: 150KHz - 108MHz as reference document CISPR25* | *Customer RFQ* |  |
|  |  |  |  |

## Requirements for Production, Service and Decommissioning

*[■ Contents:* *It is described only when needed based on customer requirements.]*

|  |  |  |  |
| --- | --- | --- | --- |
| SyRS\_ID | Requirements | CRS\_ID | Allocation |
|  |  |  |  |

*[■ Note*

*- Requirements for assembly instruction*

*- Requirements for test/validation activities during production phase*

*- Requirements for documentation of driver's manual*

*- Requirements for decommissioning and disposal instruction]*

|  |
| --- |
| The below chapters can be added when it is needed.  - Quality management req.,  - Process management req.  - Documentation req., |

# System Interfaces Requirements

## External Interface

*[■ Contents: Identifies the external interface between the developed system and other elements (using the ‘2.1 System Context' Context diagram or wiring diagram)]*

|  |
| --- |
|  |

Figure 7.1 Wiring diagram example

*[■ Contents: Describe the requirements for the identified external interface in a table or sub section. If there is a special customer request, the system interface can be also be described.]*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SyRS\_ID | Interface\_ID | Requirements | CRS\_ID | Allocation |
|  | *EI1* | *FAN motor in cooling system should be controlled by BMC based on PWM control signal*  *- Valid PWM range: 10% ~ 90%*  *- Frequency: 500Hz (within 1% tolerance)* | *Customer RFQ* |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

*[■ Note: External wiring diagrams are consistent with “system scope".]*

# Functional Safety Requirements

*[■ Note: It can be omitted for projects that do not perform IS 26262 (Functional Safety).*

*Functional safety related contents can be provided as separate documents.]*

## Technical Safety Requirements: Safety Function Name

*[■ Contents: Describe technical safety requirements for each safety function defined in FSC]*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SyRS\_ID | Safety Requirement | CRS\_ID | Time Constraints  (FTTI) | Upper Safety Requirements  (By Configuration Mgt. Tool) | Allocation |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

*[■ Note:*

*- Time constraints means the time constraints of each TSR related to FTTI and emergency operation.*

*- TSR must be derived based on FSC and consistency must be maintained in terms of ASIL, Safe state, FTTI and Emergency operation]*

## Requirements for Hardware Architectural Metrics and Residual Risk for Random H/W Failures

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| SyRS\_ID | Target | *Value* | *CRS\_ID* | *Allocation* |
|  | Target Value of SPFM | *Higher than 90% for ASIL B* |  |  |
|  | Target Value of LFM | *Higher than 60% for ASIL B* |  |  |
|  | Target Value of Residual Risk for Random H/W failures w.r.t Safety Goal Violation | *Smaller than 100 FIT for ASIL B* |  |  |