Lafayette Formula Electric Vehicle/LFEV-Y5

# CAN Bus Interface Control Document

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## Purpose of Interface Control

Instructions: Provide the purpose of the Interface Control document. For example: This Interface Control Document (ICD) documents and tracks the necessary information required to effectively define the <Project Name> system’s interface as well as any rules for communicating with them in order to give the development team guidance on architecture of the system to be developed. The purpose of this ICD is to clearly communicate all possible inputs and outputs from the system for all potential actions whether they are internal to the system or transparent to system users. This Interface Control is created during the Planning and Design Phases of the project. Its intended audience is the project manager, project team, development team, and stakeholders interested in interfacing with the system. This ICD helps ensure compatibility between system segments and components.

The intended audience of the Lafayette Formula Electric Vehicle CAN Bus Interface Control Document (ICD) is all project stakeholders, including the project sponsor, senior leadership, and the project team. This documentation should help to keep all users of the CAN bus informed and able to interface with each other effectively.

## Introduction

Instructions: Provide identifying information for the source and target systems participating in the interface. A separate paragraph should be included for each system that comprises the interface, providing sufficient description to definitively identify the systems participating in the interface. Also describe any security or privacy considerations associated with use of the ICD.

This ICD describes the relationship between the Tractive System Interface (TSI), the Tractive System Voltage (TSV), the Grounded Low Voltage (GLV), the Cooling and the Vehicle Supervisory Control and Data Acquisition (VSCADA) systems.

All systems operate at ???. To communicate on the network each device needs a unique arbitration number. This is used to prevent packet collisions. Data is expected to flow into the VSCADA system from all of the other subsystems. VSCADA may poll any subsystem to ask for information.

This ICD specifies the interface requirements the participating systems must meet. It describes the concept of operations for the interface, defines the message structure and protocols that govern the interchange of data, and identifies the communication paths along which the project team expects data to flow.

The TSV system should provide????

The TSI system should provide?????

The GLV system should provide???/

The Cooling System should provide?????

The VSCADA system should query each system. It will parse the packet and extract appropriate data to be able to log telemetry from the other sub systems.

Traffic expected?????/Traffic size (8 bytes of data per packet)

For each interface, the ICD provides the following information:

* A description of the data exchange format and protocol for exchange
* A general description of the interface
* Assumptions where appropriate
* Estimated size and frequency of data exchange

## Overview

Instructions: Briefly describe the purpose of each interface to another external system at a functional level and the data exchanged between the interfaces. Further information on the functionality and architecture of the participating systems is given in the subsequent sections. In particular, each system should be briefly summarized with special emphasis on the functionality related to the interface. The hardware and software components of each system are also identified.

All subsystems will interface with the VSCADA system in a similar method. The VSCADA system will make a 2 byte request. The first byte will be used as a method of addressing the subsystems. This will be identical to the arbitration number given to each subsystem. The second byte will be a reference to a register. This will be unique in each subsystem. These registers may be read only or read write registers depending on what information they contain.

The TSV

The TSI

The GLV

The Cooling

## Assumptions/Constraints/Risks

### Assumptions

Instructions: Describe any assumptions or dependencies regarding the interfaces of the system. These may concern such issues as: related software or hardware, operating systems, or end-user characteristics.

### Constraints

Instructions: Describe any limitations or constraints that have a significant impact on the system interfaces. Such constraints may be imposed by any of the following (the list is not exhaustive):

* Hardware or software environment
* End-user environment
* Availability of resources
* Interoperability requirements
* Interface/protocol requirements
* Data repository and distribution requirements

### Risks

Instructions: Describe any risks associated with the system interfaces and proposed mitigation strategies.

## General Interface Requirements

### Interface Overview

Instructions: Describe the functionality and architecture of the interfacing systems as they relate to the proposed interface. Briefly summarize the system, placing special emphasis on functionality, including identification of key hardware and software components, as they relate to the interface. If more than one external system is to be part of the interface being defined, then include additional sections at this level for each additional external system.

### Functional Allocation

Instructions: Briefly describe what operations are performed on each system involved in the interface and how the end users will interact with the interface being defined. If the end user does not interact directly with the interface being defined, describe the events that trigger the movement of information using the interface being defined.

### Data Transfer

Instructions: Briefly describe how data will be moved among component systems of the interface being defined. Include descriptions and diagrams of how connectivity among the systems will be implemented and of the type of messaging or packaging of data that will be used to transfer data among the systems. If more than one interface between these two systems is defined by this ICD, each should be identified in this section. A separate subsection may be included for each interface.

### Transactions

Instructions: Briefly describe the types of transactions that will be used to move data among the component systems of the interface being defined. If multiple types of transactions will be used for different portions of the interface, a separate section may be included for each interface.

### Security and Integrity

Instructions: If the interface defined has security and integrity requirements, briefly describe how access security will be implemented and how data transmission security will be implemented for the interface being defined. Include a description of the transmission medium to be used and whether it is a public or a secure line. Include a brief description of how data will be protected during transmission and how data integrity will be guaranteed. Include a description of how the two systems can be certain they are communicating with each other and not with another system masquerading as one of them. Describe how an individual on one system can be audited and held accountable for resulting actions on the other component of the interface. Normally, this section should be an overview of how security and integrity will be implemented.

An interface that is completely self-contained, such as movement of data between systems resident in the same computer room, may not have any security requirements. In this case it should be so stated with an explanation of why the interface has no security and integrity requirements.

## Detailed Interface Requirements

Instructions: This section specifies the requirements for one or more interfaces between two systems. This includes explicit definition of the content and format of every message or file that may pass between the two systems, and the conditions under which each message or file is to be sent. If an interface between the two systems is to be implemented incrementally, identify the implementation phase in which each message will be available. The structure in the “Requirements for <Given Interface>” section should be replicated for each defined interface between the two participating systems.

The template contained in the section named Requirements for <Given Interface> (including subsections) provides a generic approach to interface requirements definition. The specific interface definition should include only subsections relevant to the interface being defined, and liberty may be taken in the organization of subsections under the section named the section named Requirements for <Given Interface>. Where types of information not specified in the section named Requirements for <Given Interface> are required to clearly define the interface, additional subsections should be added. Other readily available documents (such as data dictionaries, standards for commercial protocols, and standards for user interfaces) may be referenced instead of stating the information here. It may be useful to include copies of such documentation as appendices to the ICD. Where possible, the use of tables and figures is encouraged to enhance the understandability of the interface definition. In defining interface requirements, clearly state which of the interfacing systems the requirement is being imposed upon.

### Requirements for CAN Bus

Instructions: Briefly summarize the interface for the name given above. Indicate what data protocol, communication methods, and processing priority are used by the interface. Data protocols may include messages and custom ASCII files. Communication methods may include electronic networks or magnetic media.

#### Assumptions

Instructions: Identify any assumptions that specify organizational responsibilities for specific activities or decisions, or that defines specific constraints. Assumptions might include:

* Data acceptance constraints
* Responsibility for establishing and managing the communication protocol
* Responsibility for providing and/or accepting file feeds for test and production processing
* Allowable file sizes
* Responsibility for decisions on acceptance of test results

#### General Processing Steps

Instructions: Describe the daily, weekly, monthly, etc., and threshold processing. Discuss the process to be used to confirm successful file transmission. Identify steps to be taken if all records in a file are received and the steps to be taken if all records are not received. Identify the reports to be used to document the results of daily, weekly, monthly, etc., processing. Describe any special processing that will be performed if a certain percentage (threshold) of the records is rejected.

#### Interface Processing Time Requirements

Instructions: If information is required to be formatted and communicated as the data is created, as a batch of data is created by operator action, or in accordance with some periodic schedule, indicate processing priority. Requirements for specific messages or files to be delivered to the communications medium within a set interval of time should be included in Subsection named “Message Format (or Record Layout) and Required Protocols”. State the priority that the interfacing entities must assign to the interface. Priority may be stated as performance or response time requirements defining how quickly incoming traffic or data requests must be processed by the interfacing system to meet the requirements of the interface. Considerable latitude should be given in defining performance requirements to account for differences in hardware and transaction volumes at different installation sites of the interfacing systems. Response time requirements, which are impacted by resources and beyond the control of the interfacing systems (i.e., communication networks) are beyond the scope of an ICD.

#### Message Format (or Record Layout) and Required Protocols

Instructions: Specify the explicit definitions of and the conditions under which each message is to be sent. Describe the definition, characteristics, and attributes of the command; also, document query and response descriptions.

##### File Layout

Instructions: This section should contain diagrams and short descriptions of both the header and detail layouts. This information may be included in an appendix to the document that is referenced here.

##### Data Assembly Characteristics

Instructions: Define the content and format of every message, file, or other data element assembly (records, arrays, displays, reports, etc.) specified in Subsection named “Message Format (or Record Layout) and Required Protocols”. In defining interfaces where data is moved among systems, define the packaging of data to be utilized. The origin, structure, and processing of such packets will be dependent on the techniques used to implement the interface. Define required characteristics of data element assemblies that the interfacing entities must provide, store, send, access, receive, etc. When relevant to the packaging technique used, the following information should be provided:

* Names/identifiers
* Project-unique identifier
* Non-technical (natural language) name
* Technical name (e.g., record or data structure name in code or database)
* Abbreviations or synonymous names
* Structure of data element assembly (e.g., field name, type, length, valid values, etc.)
* Visual and auditory characteristics of displays and other outputs (e.g., colors, layouts, fonts, icons, and other display elements, beeps, lights) where relevant
* Relationships among different types of data element assemblies used for the interface
* Priority, timing, frequency, volume, sequencing, and other constraints (e.g., whether the assembly may be updated and whether business rules apply)
* Sources (setting/sending entities) and recipients (using/receiving entities).

##### Field/Element Definition

Instructions: Define the characteristics of individual data elements that comprise the data packets defined in Subsection named “Data Assembly Characteristics”. Sections “Data Assembly Characteristics” and “Field/Element Definition” may be combined into one section in which the data packets and their component data elements are defined in a single table. Data element definitions should include only features relevant to the interface being defined and may include such features as:

* Names/identifiers
* Project-unique identifier
* Priority, timing, frequency, volume, sequencing, and other constraints (e.g., whether the data element may be updated and whether business rules apply)
* Non-technical (natural language) name
* Technical name (e.g., variable or field name in code or database)
* Abbreviation or synonymous names
* Data type (alphanumeric, integer, etc.)
* Size and format (e.g., length and punctuation of a character string)
* Units of measurement (e.g., meters, dollars, nanoseconds)
* Range or enumeration of possible values (e.g., 0-99)
* Accuracy (how correct) and precision (number of significant digits)
* Security and privacy constraints
* Sources (setting/sending entities) and recipients (using/receiving entities)
* Validation rule(s)

If there is a need to reformat data before they are transmitted or after incoming data is received, include descriptions of the tools and/or methods for the reformatting process.

#### Communication Methods

Instructions: Communication requirements include all aspects of the presentation, session, network, and data layers of the communication stack to which both systems participating in the interface must conform. Document the specifications for hand-shaking protocols between the two systems. Include the content and format of the information to be included in the hand-shake messages, the timing for exchanging these messages, and the steps to be taken when errors are identified. The following subsections should be included in this discussion as appropriate to the interface being defined and may be supplemented by additional information as appropriate.

##### Interface Initiation

Instructions: Define the sequence of events by which the connections between the participating systems will be initiated. Include the minimum and maximum number of conceptions that may be supported by the interface. Also include availability requirements for the interface (e.g., 24 hours a day, 7 days a week) that are dependent on the interfacing systems. Availability requirements beyond the control of the interfacing systems (e.g., network availability) are beyond the scope of an ICD.

##### Flow Control

Instructions: Specify the sequence numbering, legality checks, error control, and recovery procedures that will be used to manage the interface. Include any acknowledgement (ACK/NAK) messages related to these procedures. Address the format(s) for error reports exchanged between the systems and their disposition (e.g., retained in a file, sent to a printer, flag/alarm sent to the operator, etc.)

#### Security Requirements

Instructions: Specify the security features that are required to be implemented within the message or file structure or in the communications processes. Specify the security of the communication methods used (Include safety/security/privacy considerations, such as encryption, user authentication, compartmentalization, and auditing). For interactive interfaces, security features may include identification, authentication, encryption, and auditing. Simple message broadcast or ASCII file transfer interfaces are likely to rely on features provided by communication services. Do not specify the requirements for features that are not provided by the systems to which the ICD applies. Specifically state if the interface relies solely on physical security or on the security of the networks and firewalls through which the systems are connected.

### Requirements for the CAN Bus

Instructions: All of the applicable characteristics described in section “Requirements for <Given Interface>” should be replicated for each defined interface between the two participating systems. There is no limit on the number of unique interfaces that can be defined in a single ICD. In general, all interfaces defined should involve the same two systems.

If there is only one defined interface between the two participating systems, delete this section.

## Qualification Methods

Instructions: This section defines a set of qualification methods to be used to verify that the requirements for the interfaces defined in Section “Detailed Interface Requirements” have been met. Qualification methods include:

* Demonstration - The operation of interfacing entities that relies on observable functional operation not requiring the use of instrumentation, special test equipment, or subsequent analysis
* Test - The operation of interfacing entities using instrumentation or special test equipment to collect data for later analysis
* Analysis - The processing of accumulated data obtained from other qualification methods (e.g., reduction, interpretation, or extrapolation of test results)
* Inspection - The visual examination of interfacing entities, documentation, etc.
* Special Qualification Methods - Any special qualification methods for the interfacing entities (e.g., special tools, techniques, procedures, facilities, and acceptance limits)

Appendix A: Interface Controls

Instructions: Utilize appendices to facilitate ease of use and maintenance of the ICD document. Each appendix should be referenced in the main body of the document where that information would normally have been provided.

Include a detailed description of the required interface controls below.

Table - OSI Application Layer

| Interface Type | Interface From | Interface To | Description of Interface | Other Information |
| --- | --- | --- | --- | --- |
| <Interface Type> | <Interface From> | <Interface To> | <Interface Description> | <Other Information> |

Table - OSI Presentation Layer

| Interface Type | Interface From | Interface To | Description of Interface | Other Information |
| --- | --- | --- | --- | --- |
| <Interface Type> | <Interface From> | <Interface To> | <Interface Description> | <Other Information> |

Table - OSI Session Layer

| Interface Type | Interface From | Interface To | Description of Interface | Other Information |
| --- | --- | --- | --- | --- |
| <Interface Type> | <Interface From> | <Interface To> | <Interface Description> | <Other Information> |

Table - OSI Transport Layer

| Interface Type | Interface From | Interface To | Description of Interface | Other Information |
| --- | --- | --- | --- | --- |
| <Interface Type> | <Interface From> | <Interface To> | <Interface Description> | <Other Information> |

Table - OSI Network Layer

| Interface Type | Interface From | Interface To | Description of Interface | Other Information |
| --- | --- | --- | --- | --- |
| <Interface Type> | <Interface From> | <Interface To> | <Interface Description> | <Other Information> |

Table - OSI Data Layer

| Interface Type | Interface From | Interface To | Description of Interface | Other Information |
| --- | --- | --- | --- | --- |
| <Interface Type> | <Interface From> | <Interface To> | <Interface Description> | <Other Information> |

Table - OSI Physical Layer

| Interface Type | Interface From | Interface To | Description of Interface | Other Information |
| --- | --- | --- | --- | --- |
| <Interface Type> | <Interface From> | <Interface To> | <Interface Description> | <Other Information> |

Appendix B: Record of Changes

Instructions: Provide information on how the development and distribution of the Interface Control Document will be controlled and tracked. Use the table below to provide the version number, the date of the version, the author/owner of the version, and a brief description of the reason for creating the revised version.

Table - Record of Changes

| Version Number | Date | Author/Owner | Description of Change |
| --- | --- | --- | --- |
| 0.1 | 2017-02-02 | Greg Flynn | Created template for ICD |
| <X.X> | <YYYY-MM-DD> | TBA | <Description of Change> |
| <X.X> | <YYYY-MM-DD > | TBA | <Description of Change> |
| <X.X> | <YYYY-MM-DD > | TBA | <Description of Change> |
| <X.X> | <YYYY-MM-DD > | TBA | <Description of Change> |

Appendix C: Acronyms

Table - Acronyms

| Acronym | Literal Translation |
| --- | --- |
| LFEV | Lafayette Formula Electric Vehicle |
| TSI | Tractive System Interface |
| TSV | Tractive System Voltage |
| VSCADA | Vehicle Supervisory Control And Data Acquisition |
| CAN Bus | Controller Area Network bus |

Appendix D: Glossary

Instructions: Provide clear and concise definitions for terms used in this document that may be unfamiliar to readers of the document. Terms are to be listed in alphabetical order.

Table - Glossary

| Term | Acronym | Definition |
| --- | --- | --- |
| <Term> | <Acronym> | <Definition> |
| <Term> | <Acronym> | <Definition> |
| <Term> | <Acronym> | <Definition> |
| <Term> | <Acronym> | <Definition> |
| <Term> | <Acronym> | <Definition> |

Appendix E: Referenced Documents

Instructions: Summarize the relationship of this document to other relevant documents. Provide identifying information for all documents used to arrive at and/or referenced within this document (e.g., related and/or companion documents, prerequisite documents, relevant technical documentation, etc.).

Table - Referenced Documents

| Document Name | Document Location and/or URL | Issuance Date |
| --- | --- | --- |
| <Document Name> | <Document Location and/or URL> | <MM/DD/YYYY> |
| <Document Name> | <Document Location and/or URL> | <MM/DD/YYYY> |
| <Document Name> | <Document Location and/or URL> | <MM/DD/YYYY> |
| <Document Name> | <Document Location and/or URL> | <MM/DD/YYYY> |
| <Document Name> | <Document Location and/or URL> | <MM/DD/YYYY> |

Appendix F: Approvals

The undersigned acknowledge that they have reviewed the ICD and agree with the information presented within this document. Changes to this ICD will be coordinated with, and approved by, the undersigned, or their designated representatives.

Instructions: List the individuals whose signatures are desired. Examples of such individuals are Systems Engineer, Team Leader, Project Leader (if identified), and any appropriate stakeholders. Add additional lines for signature as necessary.

Table - Approvals

| Document Approved By | Date Approved |
| --- | --- |
| Name: <Name>, <Job Title> | Date |
| Name: <Name>, <Job Title> | Date |
| Name: <Name>, <Job Title> | Date |
| Name: <Name>, <Job Title> | Date |

Appendix G: Notes to the Author/Template Instructions

This document is a template for creating an Interface Control Document for a given investment or project. The final document should be delivered in an electronically searchable format. The Interface Control Document should stand on its own with all elements explained and acronyms spelled out for reader/reviewers, including reviewers outside of LFEV-Y5 who may not be familiar with the project.

This template includes instructions, boilerplate text, and fields. The developer should note that:

* Each section provides instructions or describes the intent, assumptions, and context for content included in that section. Instructional text appears in blue italicized font throughout this template.
* Instructional text in each section should be replaced with information specific to the particular investment.
* Some text and tables are provided as boilerplate examples of wording and formats that may be used or modified as appropriate.

When using this template, follow these steps:

1. Table captions and descriptions are to be placed left-aligned, above the table.
2. Modify any boilerplate text, as appropriate, to your specific investment.
3. Do not delete any headings. If the heading is not applicable to the investment, enter “Not Applicable” under the heading.
4. Delete this “Notes to the Author/Template Instructions” page and all instructions to the author before finalizing the initial draft of the document.

Appendix H: Additional Appendices

Instructions: Utilize additional appendices to facilitate ease of use and maintenance of the document.