E-trike Battery System

Version 0.0.1

Interface Control Document

February 2015

*****IN-PROGRESS DRAFT DOCUMENT*****

Revision History

Date	Version	Description	Author
2015-02-23	0.0.1	Initial file creation for systems unit 6	Jone Lay

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1. Introduction

The battery system is responsible for supplying power to the electric assist trike, supplying 5V of power to auxiliary systems, and recharging from an wall AC power source. A trained user will interact with the battery system to perform each of these functions. A main power disable toggle switch will be prominently accessible from the exterior of the battery system enclosure. An auxiliary power enable push-button switch will also be accessible form the exterior of the enclosure. The battery system will connect to the trike electronics through a cable with a circular connector, and it will connect to auxiliary systems through a separate cable.

1.1. Purpose

This Interface Control Document presents the electrical, software, and mechanical interface requirements between the battery system and the electric drive, accessory electronics system, and AC power system. It describes the concept of operations for the interface, defines the electrical operating parameters, defines the communication protocols, and identifies the interconnections between subsystems in the device.

1.2. Scope

This Interface Control Document specifies the interfaces between the battery system, the electric drive system, the accessory electronics system, and AC power system. This document provides details on the functional, performance, operational and design requirements for the interface between the battery system, the electric drive system, the accessory electronics system, and AC power system.

1.3. System Identification

This Interface Control Document describes the interface between the battery system, the electric drive system, the accessory electronics system, and AC power system.

The battery system includes the lithium-ion cells, the battery-management system PCB, a mechanical enclosure, and an AC charger.

The electric drive system connects electrical power between the battery system and the trike traction motor. It is composed of a motor controller, a motor, a throttle, a torque sensor, a wheel speed sensor, and a pedal speed sensor. The motor controller includes an ARM M4 microcontroller with a CANbus communication interface.

The accessory electronics system powers and controls the trike headlights, taillights, and LED flag. The accessory electronics system receives power from the battery system, and does not interact with the electric drive system.

The AC power system is defined as a standard 120VAC power outlet, connected to a 15 Amp circuit breaker.

1.3.1. Battery System

The battery system includes the lithium-ion cells, the battery-management system PCB, a mechanical enclosure, and an AC charger.

System	Details
Identification number	1.0
Title	Battery system
Abbreviation	Batt
Version number	0.1
Release number	-
Point of Contact	-

1.3.2. Electric Drive system

The electric drive system connects electrical power between the battery system and the trike traction motor. It is composed of a motor controller, a motor, a throttle, a torque sensor, a wheel speed sensor, and a pedal speed sensor. The motor controller includes an ARM M4 microcontroller with a CANbus communication interface.

System	Details
Identification number	2.0
Title	Electric Drive System
Abbreviation	drive
Version number	
Release number	
Point of Contact	

1.3.3. Accessory Electronics System

The accessory electronics system powers and controls the trike headlights, taillights, and LED flag. The accessory electronics system receives power from the battery system, and does not interact with the electric drive system.

System	Details
Identification number	2.0
Title	Electric Drive System
Abbreviation	accessory

Version number	
Release number	
Point of Contact	

1.3.4. AC Power System

The AC power system is defined as a standard 120VAC power outlet, connected to a 15 Amp circuit breaker.

System	Details
Identification number	2.0
Title	Electric Drive System
Abbreviation	ac
Version number	
Release number	
Point of Contact	

1.4. Operational Agreement

This Interface Control Document provides the specification for interfaces between the battery system, the electric drive system, the accessory electronics system, and AC power system.

2. Electrical Interface

The primary functions of the battery system are realized through the electrical interfaces. These interfaces include power, safety, and communication elements.

2.1. Power

The battery system has four power ports: the battery pack, the charger, the load, and the auxiliary system. The

The power system operational parameters are as follows

Parameter	Min	Nominal	Max	Unit
Electric drive supply voltage	33	45.3	51.6	V
Charger voltage	33	41.3	51.6	V
Charger current	0	8	9.45	A
Balance current, per cell	0	2.1	2.5	A
Auxiliary supply voltage	33	45.3	51.6	V
Auxiliary supply current	0	2	3	A

2.2. Connectors

The Battery System will make use of a circular connector to interface with the electric drive system.

The Battery System will make use of a Neutrik NL2FX connector to interface with the auxiliary electronics system. The following pins will be used by the auxiliary connector:

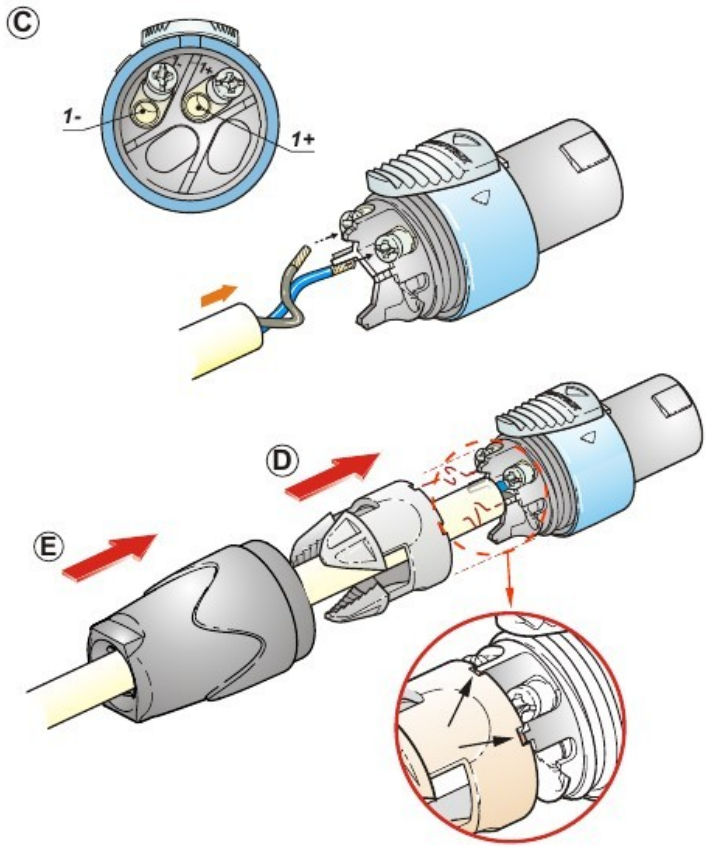

Figure 2: NL2FX connector assembly
Source: NL2FX datasheet

Pin 1: GND

Pin 2: 5V power

The Battery System will make use of a 3-pin XLR connector to interface with the charger, as part of the AC power system.

Figure 3: XLR connector assembly
Source: ebikes.ca

2.3. Logic Power Regulation

The Battery system includes a step-down switching converter to provide regulated 3.3 Volt power to the logic systems. The logic power regulation shall disable itself when any of the following conditions are met:

Parameter	Value	Unit
Under-voltage cut-off hysteresis	0.035	V
Under-voltage cut-off threshold	32.13	V

2.4. Quiescent Power Consumption

The Battery System electronics will meet the following power consumption metrics

Parameter	Value	Unit
Total quiescent discharge power (stop mode)	1.9	mW
Voltage divider power loss	0.02	mW

2.5. Manual Interlock

The Battery System will enter a failsafe mode when the interlock toggle switch is active.

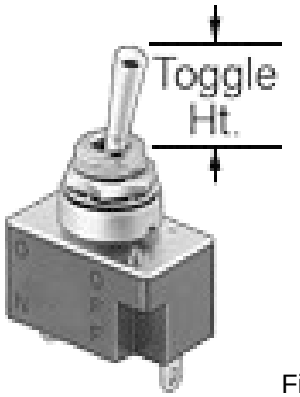

Figure 4: Interlock toggle switch
Source: mcmaster.com

3. CANbus Interface

The Battery System communicates with the drive system via a CANbus interface.

3.1. Physical Layer

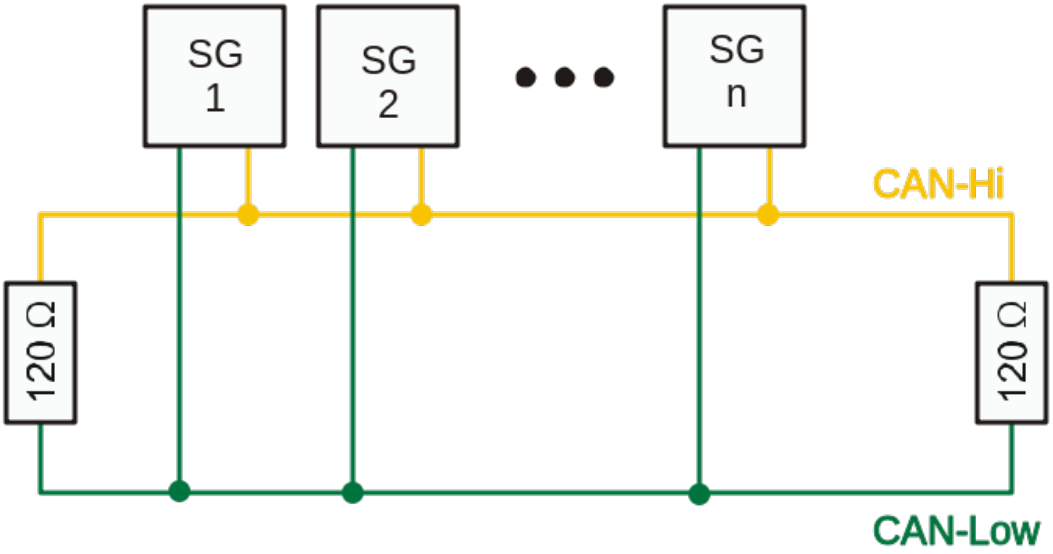

Figure 5: CANbus signal termination, ISO 11898-2
Source: wikimedia commons CAN_ISO11898-2_Network.png

The CANbus interface meets the specifications defined by the ISO 11898-2 standard.

3.2. Base Frame Format

The CANbus communication link shall encode and decode packets following the base frame format described in CAN 2.0 B.

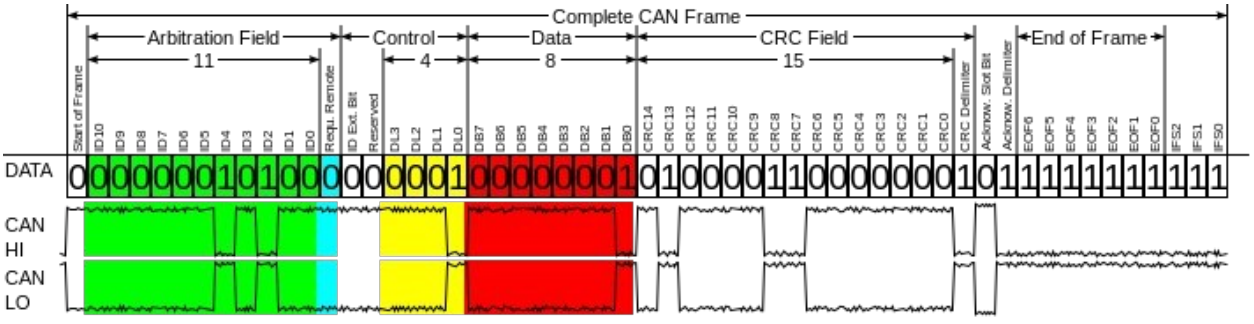

Figure 6: CANbus base frame format
Source: "CAN-Bus-frame in base format without stuffbits". Licensed under CC BY-SA 3.0 via Wikimedia Commons

3.3. Application Layer

The CANbus interface meets the device and communication profiles listed in the CiA 301 specification.

3.4. Addressing

The addressing of devices on the CANbus network will prioritize for electrical safety functions. The BMS PCB shall have priority over the motor controller, and the motor controller shall have priority over the accessory electronics system.

4. Mechanical Interface

The battery system enclosure mounts onto a cargo rack of the trike. The battery system enclosure is removable for daily charging and storage.

4.1. Enclosure Mounting

The battery system mount will be detachable from the trike cargo rack without requiring tools.

4.2. Shock and Vibration

The battery system enclosure mount will meet the following shock and vibration specifications.

5. Interface Controls

Type	Source	Destination	Description
Power			
Charger Power	AC charger	BMS PCB	Charger connector, Pin 1
Battery Power	Battery pack	BMS PCB	BMS PCB solder point, JP4
Drive Power	BMS PCB	Electric Drive	BMS PCB solder point, JP7
Auxiliary Power	BMS PCB	Auxiliary Electronics	BMS PCB connector, JP15 Pin 12
Communication			
CANbus High	CANbus network	CANbus network	BMS PCB connector, JP15 Pin 2
CANbus Low	CANbus network	CANbus network	BMS PCB connector, JP15 Pin 3
CANbus Active	CANbus network	CANbus network	BMS PCB connector, JP15 Pin 1
Mechanical			
Enclosure mount	Battery system	Trike cargo rack	Machined aluminum quick release

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February 2015	0.0.1	Initial file creation, assignment for unit 6	Jone Lay