FORT Platform

Early Access Integration Guide

Production User Manual coming soon

Introduction

This document is intended to facilitate integration of the FORT Platform into a customer's product. This includes the FORT Endpoint Controller (EPC), FORT Remote Control (FRC), and FORT Manager web and mobile apps. Unless otherwise noted, the features described in this document are available as of the date of the latest revision.

1. Key Features

- Wireless communications
  - Frequency bands include Bluetooth 2.4GHz, WiFi 2.4GHz, ISM 902-928MHz (NA)*, ISM 868MHz (EU)*
- CANopen, Ethernet x2
- Safety I/O: 3x Dual-Channel Inputs, 3x Dual-Channel Outputs (OSSD, High Side, Low Side or Complementary*)
- 9 VDC to 36 VDC power input
- Processors/OS:
  - Safety Core (Dual safety processors)
  - HW Based Security
- -40°C to +85°C operation
- IP67 rated product
- Mechanical:
  - Aluminum enclosure, up to 4x RP-TNC antenna connectors, 2x M12 Ethernet connectors, <2lbs, dimensions 228mm x 138mm x 45mm

*** May not be available for early access firmware, contact a sales representative for information on availability**

2. Specifications

2.1. Recommended Operating Conditions

Parameter	Minimum	Typical	Maximum	Unit
Operational Temperature	-40		+85	°C
PVin High Operating Voltage	9	12/24	36	V
PVin Operating Current Draw			5	A
Input Voltage Maximum			36	V
Input "High" Voltage	95% of PVin*			V
Input "Low" Voltage			5% of PVin*	V

Table 1 – Recommended Operating Conditions

*- subject to change before release

2.2. I/O Connector Pinout

An image of the connector can be seen in Figure 1 and a list of the connector pinout is detailed in Table 2. In Table 2, all wire colors apply to the 100-0256 Integration Cable. All white cables have their pin number printed directly on the cable. The suggested mating connector to this port is a TE 770680-1.

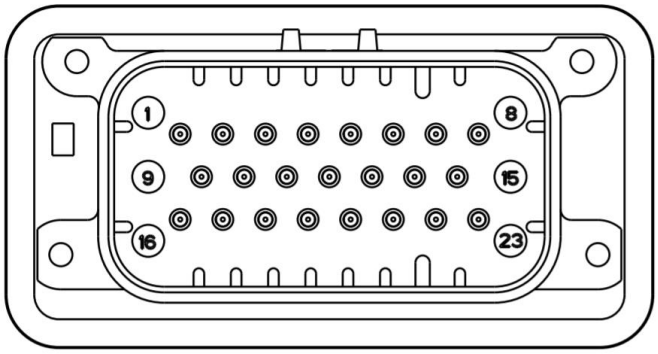

Figure 1 - EPC I/O connector pinout (TE 1-776228-1)

Pin #	Name	Description	Wire Color
1	IN5_CONN	Channel 1, Input 3	White
2	IN4_CONN	Channel 1, Input 2	White
3	IN3_CONN	Channel 1, Input 1	White
4	IN2_CONN	Channel 0, Input 3	White
5	IN1_CONN	Channel 0, Input 2	White
6	IN0_CONN	Channel 0, Input 1	White
7	PVin_RTN	Voltage Negative Polarity	White
8	PVin_RTN	Voltage Negative Polarity	White
9	CH_GND	Chassis to Ground Connection	White
10	Reserved	Do not connect	
11	CAN1_L	CAN Low, Twisted with 12	Green
12	CAN1_H	CAN Hi, Twisted with 11	Yellow
13	CAN1_SHIELD	CAN Bus Shielding	
14	PVin_IN	Voltage Positive Polarity	White
15	PVin_IN	Voltage Positive Polarity	White
16	OUT5_CONN	Channel 1, Output 3	White
17	OUT4_CONN	Channel 1, Output 2	White
18	OUT3_CONN	Channel 1, Output 1	White
19	Reserved	Do not connect	
20	Reserved	Do not connect	
21	OUT2_CONN	Channel 0, Output 3	White
22	OUT1_CONN	Channel 0, Output 2	White
23	OUT0_CONN	Channel 0, Output 1	White

Table 2 – EPC J1 I/O connector pinout and signal descriptions* - wire colors apply to the 100-0256 Integration Cable

* - Subject to change before release

2.3. Mechanical Drawing

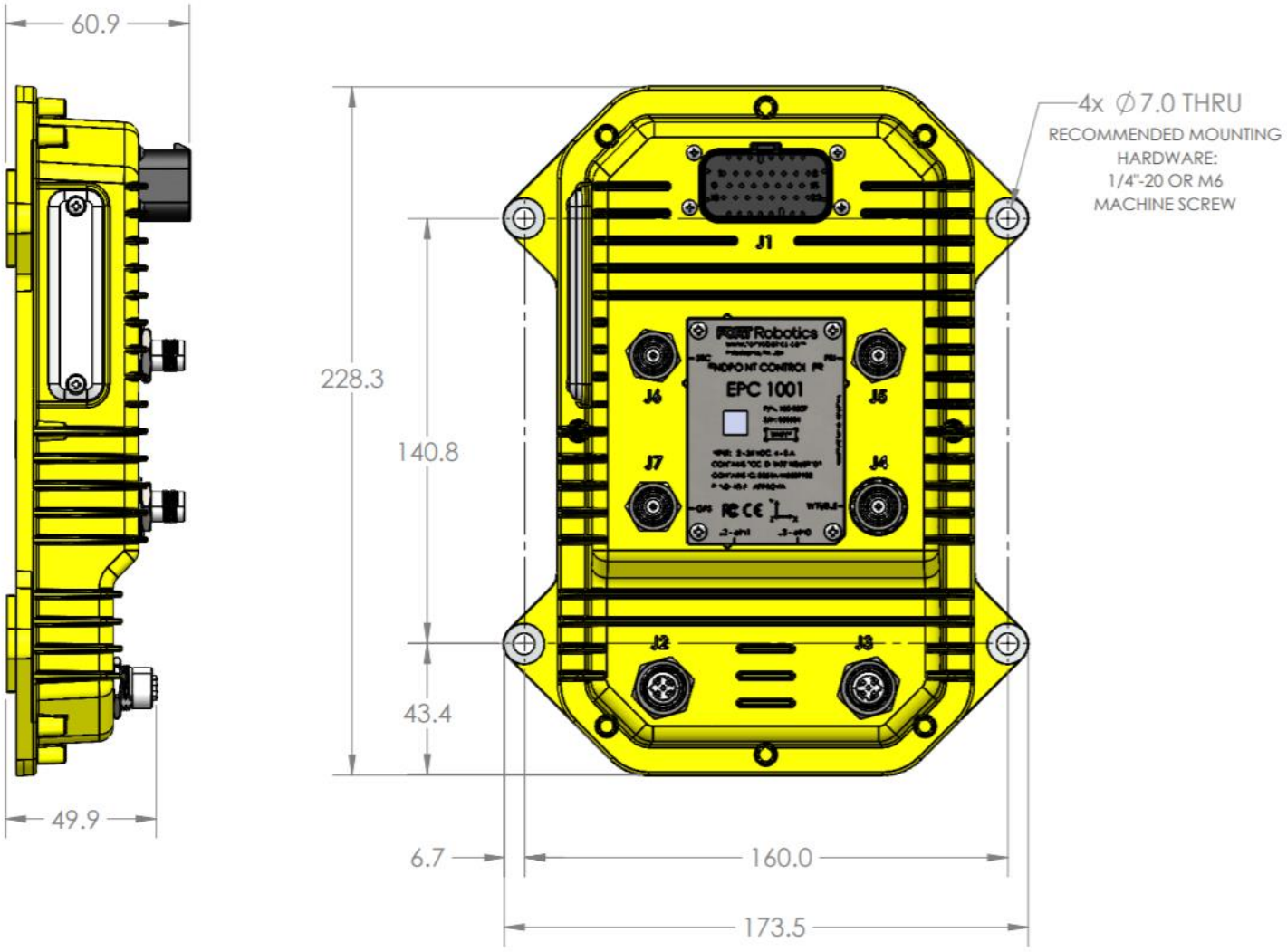

Figure 3 – EPC 1001 Mechanical Drawing (all dimensions in mm)

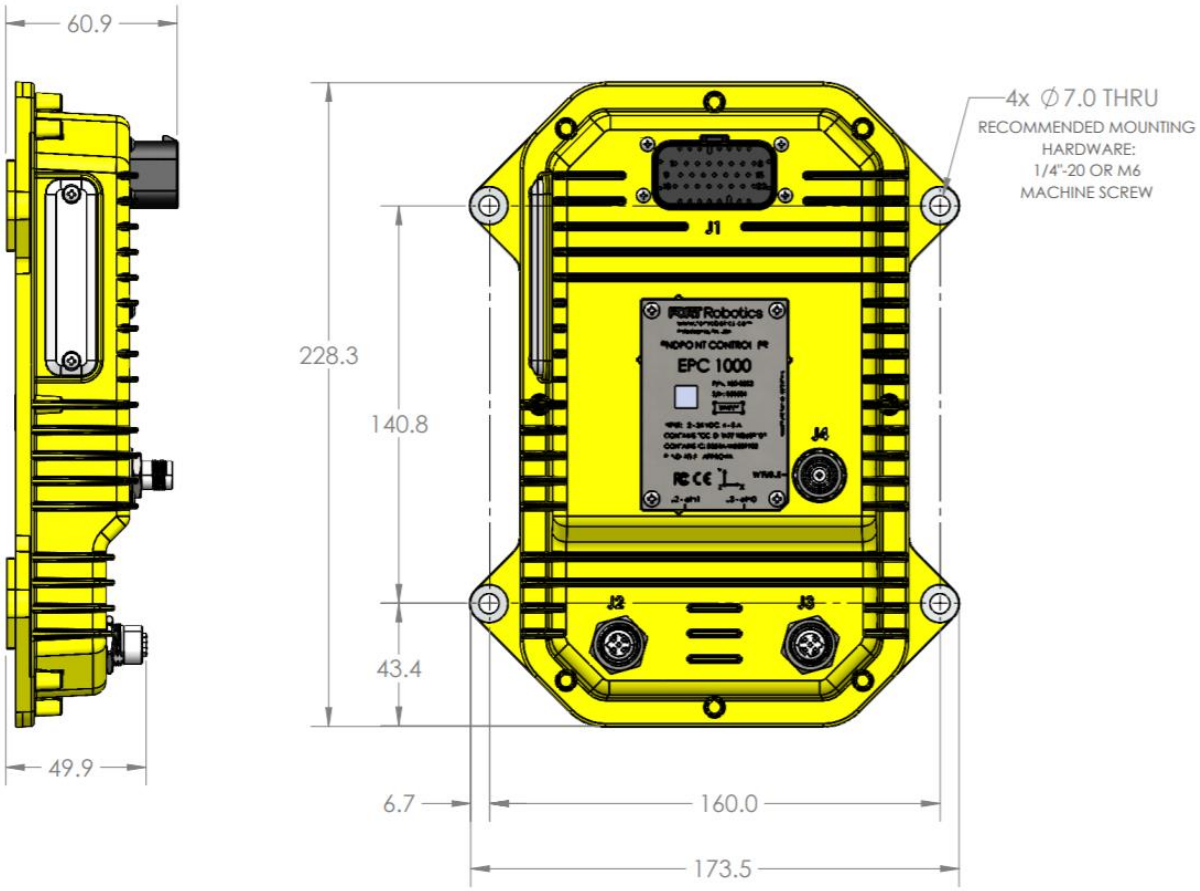

Figure 4 – EPC 1000 (Bluetooth/WIFI only) Mechanical Drawing (all dimensions in mm)

Connector Number	Suggested Mating Connector Type for EPC
J1	TE 770680-1
J2	Ethernet M12 – D Type
J3	Ethernet M12 – D Type
J4	RP-TNC PLUG (MALE) with center SOCKET (FEMALE)
J5	RP-TNC PLUG (MALE) with center SOCKET (FEMALE)
J6	RP-TNC PLUG (MALE) with center SOCKET (FEMALE)
J7	RP-TNC PLUG (MALE) with center SOCKET (FEMALE)
Side Door	MICRO SD
Side Door	RECPT, MINI USB B
Side Door	MICRO-SIM CARD, 6 CONTACTS

Table 3 – Suggested EPC Connector Types

3. Configuration Overview (Early Access phase)

Each EPC is equipped with 3x dual channel inputs and 3x dual channel outputs. Dual channel input 3 and output 3 are reserved for the FORT Remote Controller (FRC). EPC devices can be configured as either an input device or an output device. They can be set to communicate “one-to-one” (see Figure 5 below). Check with your FORT sales representative for release dates for the “one-to-many”, and “many-to-one” configurations (see Figure 5 below).

3.1. One-to-One

In the “one-to-one” EPC configuration, changing the state of input 1 will change the state of output 1 on the output device, and changing the state of input 2 will change the state of output 2 on the output device.

3.2. One-to-Many

In the “one-to-many” EPC configuration, changing the state of input 1 will change the state of output 1 on all output devices, and changing the state of input 2 will change the state of output 2 on all output devices.

3.3. Many-to-One

For the “many-to-one” EPC configuration, changing the state of input 1 on any input device will change the state of output 1 on the output device, and changing the state of input 2 on any input device will change the state of output 2 on the output device.

Figure 5 – Configuration Options

4. EPC to EPC Communication

4.1. IP Based Connection

In the early access phase, EPC devices communicate with each other over an IP based network via the WiFi or Ethernet interface.

4.2. Radio Connection

Currently only Bluetooth communication is available. Radio communication over Bluetooth will only support “one-to-one” configurations. In future phases additional interfaces will be supported, including LTE and ISM band radios.

5. Installation

5.1. Safety

For safety rated applications of the EPC please consult the EPC Safety Manual 400-0024.

5.2. Configured Inputs on Input Devices

The I/O cable described in section 3.1 provides the connections for integrating with most user systems.

The inputs on the EPC can be configured to handle a variety of integration scenarios, including OSSD tolerant +V/Open, GND/Open, and Looping Circuit. Please note that for early access firmware, the Outputs on the Input device will be high (PVin) in preparation for use in a Looping Circuit. If they are not in use, they should be tied off. Examples are depicted below in Figures 6 and 7. GND/Open input configuration will not be available for early access firmware, contact a sales representative for information on availability.

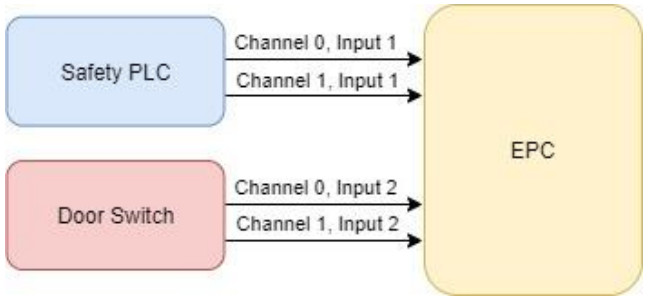

Figure 6 – Dual Channel +V/Open or GND/Open Input Wiring

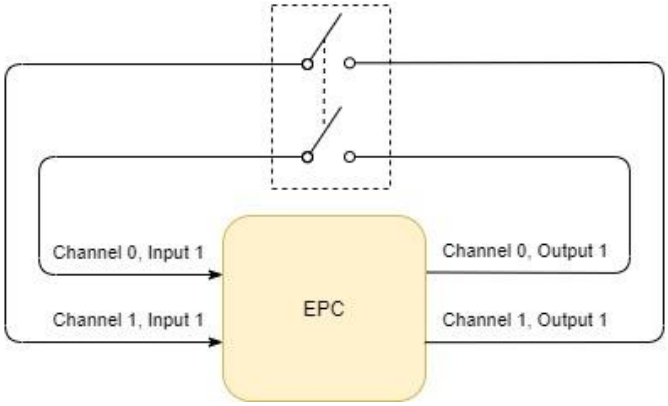

Figure 7 – Dual Channel Looping Circuit

5.3. Configured Outputs on Output Devices

Dual channel outputs are configured as High Side outputs. OSSD output configuration will not be available for early access firmware, contact a sales representative for information on availability. See Figure 8 below for an example of this.

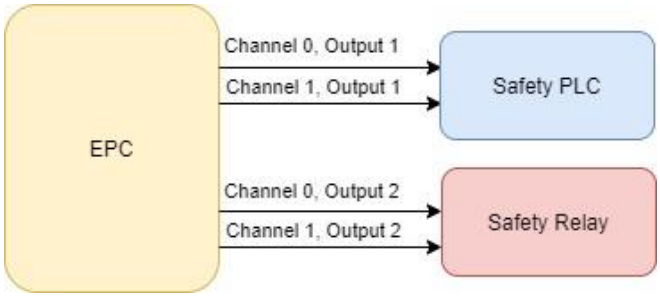

Figure 8– Dual Channel High side and OSSD outputs

5.4. Sample Paired Configuration

Figure 9 shows an example configuration of two EPC devices demonstrating their wiring and communication.

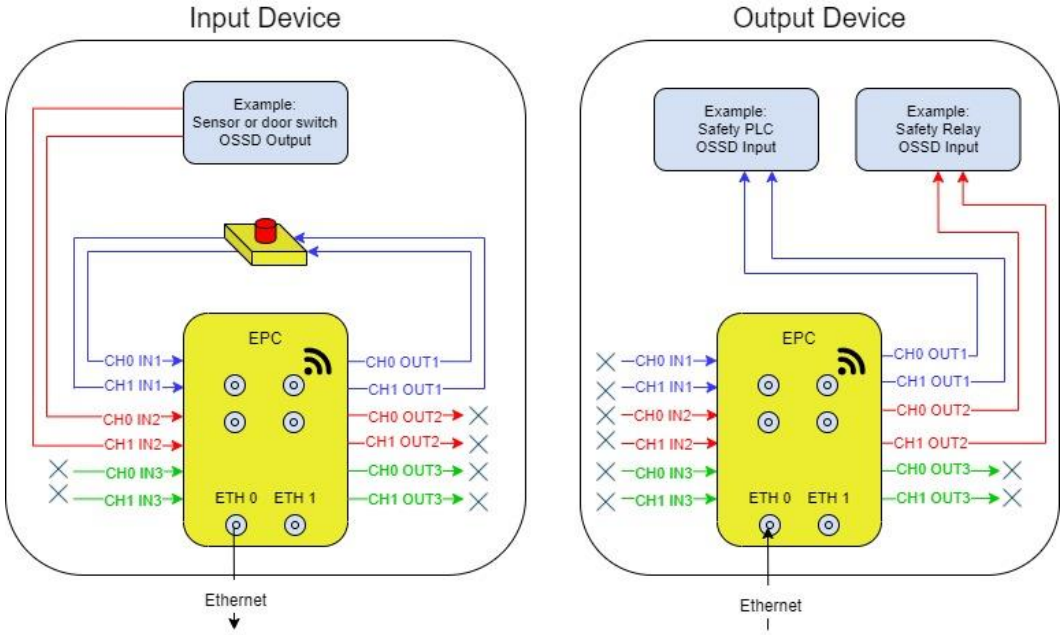

Figure 9 – Sample EPC Paired Configuration

6. FRC to EPC Pairing Processes

6.1. Safety

For safety rated applications of the FRC, please consult the FRC Safety Manual 400-0032.

6.2. FRC Drawing

Figure 10 – FRC Drawing (distances in mm)

6.3. Loading Device Configuration on EPC and FRC

The sections below are a preview of the process for registering and configuring FORT hardware. The FORT Manager web and mobile apps may not be available on early access firmware, contact a sales representative for information on availability. Until the FORT Manager web and mobile apps are available, FORT hardware will be preconfigured prior to shipping based on the customer's desired use case.

6.3.1. Building a Configuration FORT Robotics Configuration App

To begin pairing your devices, first you must open an account and register your FRC and EPC devices with either the FORT Robotics Web Portal Application or the FORT Robotics Mobile App.

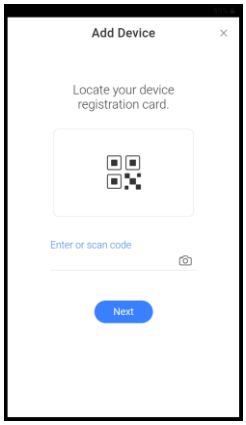

Figure 11 – Registering a Device using FORT Robotics Mobile App

Next, you will need to build a configuration from the list of available devices. This can be done with either the FORT Robotics Web Portal Application or the FORT Robotics Mobile App, as seen below in Figure 12.

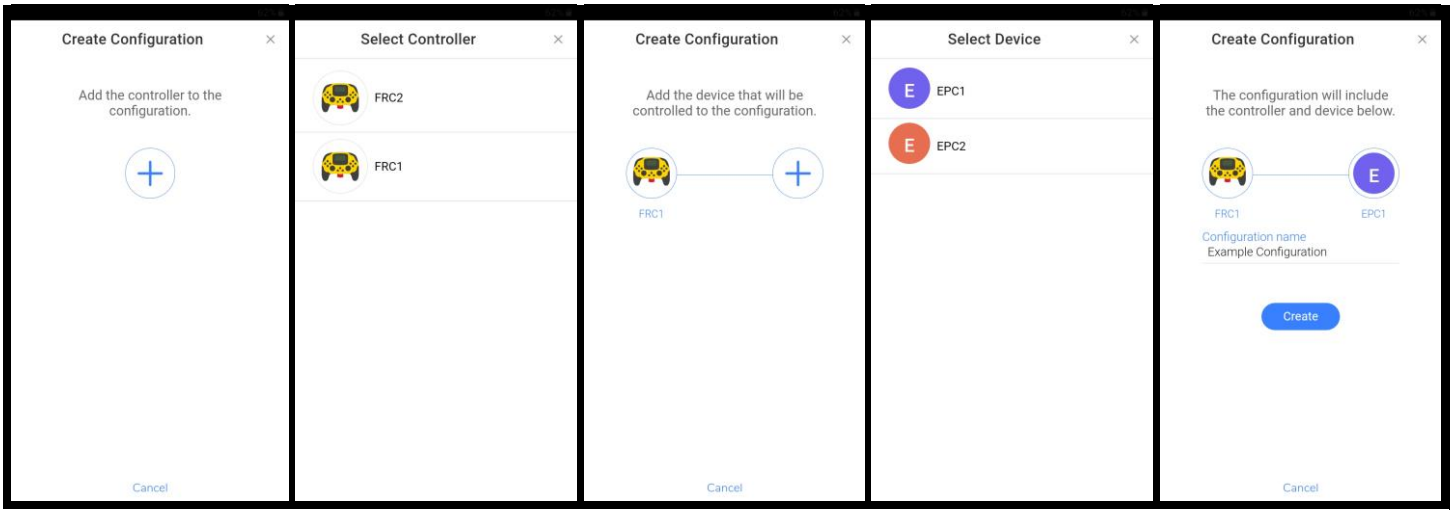

Figure 12 – Building a Configuration using the FORT Robotics Mobile App

6.3.2. Loading Device Configuration to an FRC and an EPC

To configure your FRC and EPC using the FORT Robotics Configuration App you will need both the EPC and FRC in range of your smart device. Prior to configuration, the EPC will need to have no FRC currently connected to it, and the FRC will need to have no EPC connected to it. With both devices powered on, select a configuration and go through the steps on the FORT Robotics Configuration App, as seen below in Figure 13.

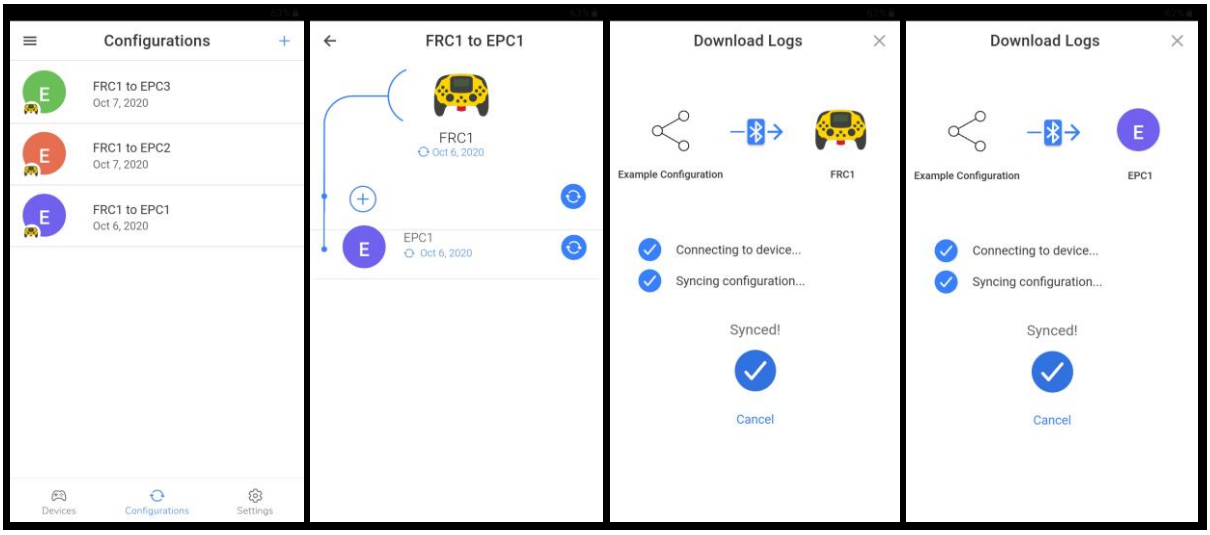

Figure 13 – Loading Device Configuration

6.4. Device Selection and Pairing

Once the Configuration has been loaded onto the FRC and EPC, connecting the two devices can be done independent of the FORT Robotics Web Portal Application or the FORT Robotics Mobile App. The following sections detail the processes required to connect and disconnect your devices.

6.4.1. Connecting an FRC to an EPC

To connect an FRC to an EPC, both devices must be powered up and in range of each other. The FRC cannot have another EPC connected to it. The EPC cannot be connected to another FRC, and the EPC needs to have Dual Channel Input 3 asserted during the connection process. Asserting Input 3 indicates to the EPC that it is ready to accept connection and disconnection requests. Input 3 should only be asserted during the connection or disconnection processes and should remain de-asserted at all other times.

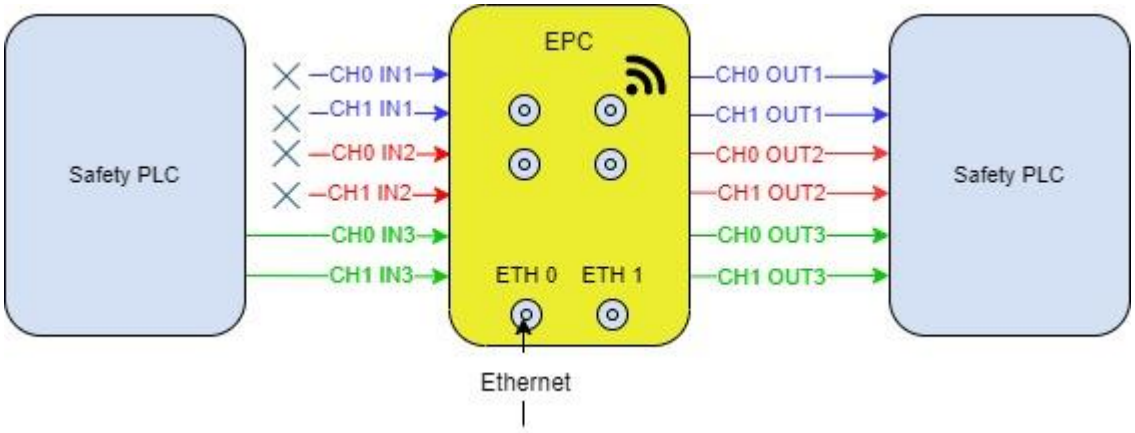

Figure 14 – Input 3 Asserted High During Pairing Process

Then you can send the connection request from the FRC menu option. A confirmation message will appear on the screen of the FRC to ensure an authorized request is being sent out. Once the FRC connects to the EPC, Dual Channel Output 3 will be mapped to the state of the FRC Estop button. At this point the FRC's Estop button will also illuminate. Once the connection process is complete, de-assert Input 3.

Figure 15 – Estop illuminated only while connected

6.4.2. Disconnecting an FRC from an EPC

To disconnect the FRC from an EPC both devices will need to be powered on and within range of each other. First you will need to press the Estop on the FRC to de-assert Output 3. You will need to have Dual Channel Input 3 asserted on the EPC during the disconnecting process. Asserting Input 3 indicates to the EPC that it is ready to accept connection and disconnection requests. Input 3 should only be asserted during the connection or disconnection processes and should remain de-asserted at all other times.

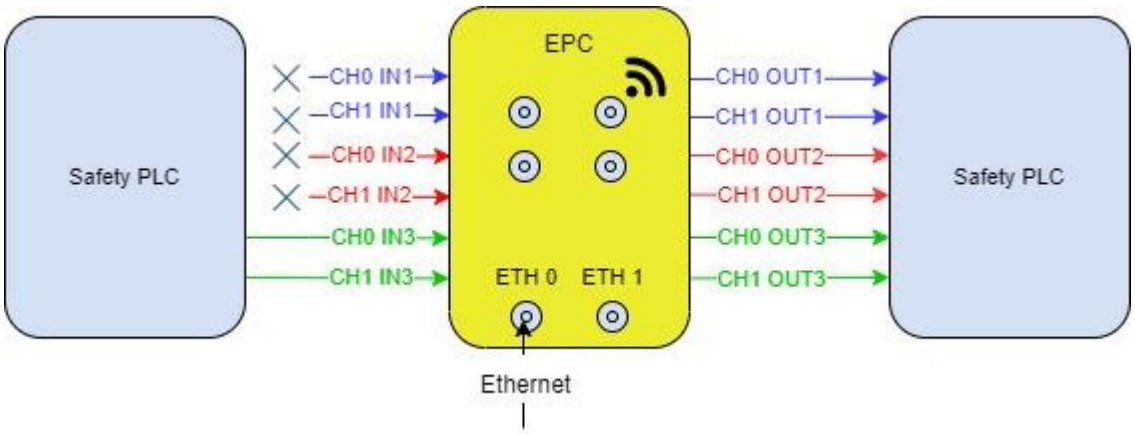

Figure 16 - Input3 Asserted High During Disconnecting Process

Then you can send the disconnection request from the FRC menu option. A confirmation message will appear on the screen of the FRC to ensure an authorized request is being sent out. At this point you will release the Estop button to complete the disconnect process. Once the FRC disconnects from the EPC, Dual Channel Output 3 will assert indicating that it is no longer mapped to the state of the FRC Estop button. At this point the FRC's Estop button will also de-illuminate. Once the disconnection process is complete, de-assert Input 3 until you are ready to connect another FRC.

Figure 17- FRC with De-Illuminated EStop

6.5. Long Term Disconnection of FRC from EPC

In order to more permanently disconnect the FRC from the EPC a new 'blank' configuration must be loaded onto the EPC.

6.6. FRC Joystick and Status Messages

Joystick messages and status messages from the FRC can be accessed via the EPC over CANopen or Ethernet.

7. CANopen Implementation

The FRC-via-EPC CANopen integration provides a CiA 301, 401 Part 1, and 401 Part 2 interoperable network slave. At present, while the integration is intended to be compatible with a CANopen compliant network, the full capability set described in the standards are not yet implemented. An EDS file and sample program to dump CANopen traffic are available on request via our Customer Support Portal: http://support.fortrobotics.com/

7.1. Joystick Data Representation

The device implements a CiA 401 Part 2 compatible representation of a multi-axis joystick. It presents as a Device Type (OD Entry 0x1000) as 0x01 (i.e. “Joystick with digital inputs without digital outputs”). See CiA 401 Part 2 Section 10.2 “Device type”. As per the standard’s representation:

- TPDO1 is used to convey the Boolean values of the FRC’s buttons
- TPDO2 is used to convey the analog values of the 4 axes on the face of the FRC
- TPDO3 is used to convey the analog values of the 2 trigger’s at the rear of the FRC

TPDO1 (0x180 + NodeID) - Buttons

(Each subindex is UINT8)

Object Dictionary Index (hex)	Sub-Index	Bit	Name	Usage
60.00	01	00	memory x-axis	Unused - Fixed 0
60.00	01	01	memory y-axis	Unused - Fixed 0
60.00	01	02	memory z-axis	Unused - Fixed 0
60.00	01	03	ms	Unused
60.00	01	04	ms	Unused
60.00	01	05	ms	Unused
60.00	01	06	ms	Unused
60.00	01	07	ms	Unused
60.00	02	00	b1	Down
60.00	02	01	b2	Right
60.00	02	02	b3	Up
60.00	02	03	b4	Left
60.00	02	04	b5	Pause
60.00	02	05	b6	Unused

60.00	02	06	b7	Unused
60.00	02	07	b8	Unused
60.00	03	00	b9	1 Key
60.00	03	01	b10	2 Key
60.00	03	02	b11	3 Key
60.00	03	03	b12	4 Key
60.00	03	04	b13	Menu
60.00	03	05	b14	Unused
60.00	03	06	b15	Unused
60.00	03	07	b16	Unused

Table 4 - TPDO1 Buttons

TPDO2 (0x280 + NodeID) - Thumbstick Axes

Object Dictionary Index (hex)	Sub-Index	Type	Usage
64.01	01	INT16	Left Stick X
64.01	02	INT16	Left Stick Y
64.01	03	INT16	Right Stick X
64.01	04	INT16	Right Stick Y

Table 5 – TPDO2 Thumbstick Axes

Each value is a full range 16-bit signed integer which is designed to produce a zero-value when the stick is at rest/centered. The axis will show a positive value when pushed up (Y) / right (X) and a negative value when pushed down (Y) / left (X).

TPDO3 (0x380 + NodeID) - Trigger Axes

Object Dictionary Index (hex)	Sub-Index	Type	Usage
64.01	05	INT16	Left Trigger
64.01	06	INT16	Right Trigger

Table 6 – TPDO3 Trigger Axes

Each value is a full range 16-bit signed integer which is designed to produce a zero-value when the trigger is at rest/centered. The axis will show a positive value when pulled up and a negative value when pushed down.

Revision History

Version	Date	Changes
A	11/30/2020	Initial Release
B	12/23/2020	Revise Figure 3 and Figure 4
C	1/13/2021	Remove Orderable Parts Tables, Revised Installation section
D	2/1/2021	Correct typo of CAN Hi pin in pinout table
E	7/14/2021	Revision History moved to top of doc, Added CANopen Implementation Section

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