Dauphine Physical ICD

601-0058-000 Rev. C

Dauphine is a command, control, communications (C3), and power distribution platform that evolved from the Clio B product. It is specifically designed to operate in maritime environments.

Table of Contents

Introduction

Dauphine (part number 100-0068-0XX) is a communications and power hub intended to bridge between point-to-point connections and redundant ring networks. The Dauphine model evolved from the Clio Series B (601-0048) by adding more I/O options and integrating a 9-DOF Inertial Measurement Unit/Magnetometer and GPS via the SPI expansion interface. In order to maximize flexibility, most communication pair pins can be CAN, RS485 or PWM.

Much like the Clio Series B, Dauphine has the following capabilities, although not all can be used at once:
- 4x redundant 12~38VDC 12A power inputs with fault detection and backfeed prevention which can be bussed or split as required to allow for multiple voltage rails.
- 11x 12~38VDC 6A individually fused and switched power outputs with electronic circuit breaking.
  - Each output can be configured to turn off during an FTS event using the GPIO control embedded in an onboard FPGA.
  - 2 of the 11 outputs may draw from a 3A maximum auxiliary buck switched power supply.
- 2x 10/100 auto MDI-X internally switched ethernet ports.
- 10x CAN FD busses up to 8Mbps.
- 15x half duplex RS-485 UARTs up to 8Mbps with hardware options to tie the transceiver into receive or transmit only mode.
- 1x 5V full duplex invertible UART up to 1Mbps.
- 1x RS-232 up to 1Mbps.
- 3x isolated 50V/3A general purpose solid state relay switches.
- 2x isolated 50V/3mA general purpose constant current sink inputs.
- 2x +2.8 -2.5 V differential analog inputs with programmable gain.
- 1x 200mA 5V general purpose supply split across 2 supply pins.
- 400MHz ARM Cortex-M7 MCU.
  - Double precision hardware floating point unit.
  - 2MB on chip flash memory.
  - 1MB RAM.
  - 28MB off chip flash memory connected over QSPI.
- Optional expansion board with 3x SPI chip selects and dedicated full duplex UART.
  - Enclosure and boards are designed to allow an SMA connector and coax to the expansion board.

The Dauphine is highly customizable. If there are additional features or clarification needed on functionality, please reach out to allocortech directly. For more information about some of the options available, please refer to the capability mapping tables.

An example vehicle architecture showcasing the versatility of the Dauphine is shown on the next page.

Simple Architecture

For a simplex architecture, a Clio Series B can act as an electronics hub to control and manage the entire vehicle. Primary vehicle command and control can all be run off of a single unit while simultaneously acting as a hub to communicate and power peripheral devices and sensors.
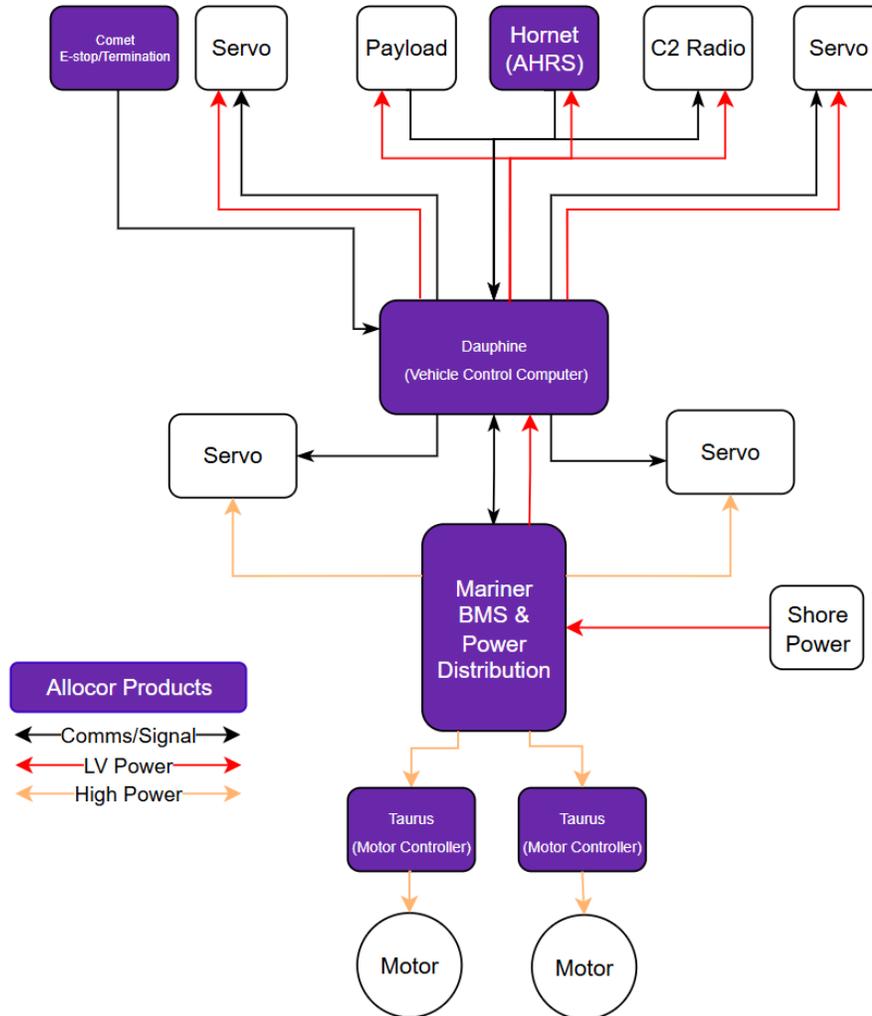
Scope of this Document

This document covers the mechanical and electrical specifications of the allocortech inc Dauphine (part number 100-0068-001 and variants.) The software development interfaces will be covered in other documents.

Version History

Revision	Changes
A	Initial Draft
B	Update typos and mechanical drawings
C	Various updates throughout. Aligned consistencies between Clio and Dauphine Revised power topology details Template Update

List of Abbreviations

4W RS485	Four wire, full duplex, differential serial (aka RS422) with RS485 line levels.
A	Amps
AC	Alternating Current
ADC	Analog to Digital Converter
AUX	Auxiliary
BMS	Battery Management System
C2	Command and Control
CAN	Controller Area Network, serial protocol ISO 11898
CAN FD	Controller Area Network with Flexible Data Rate
DC	Direct Current
DIST	Distribution
EEPROM	Electrically Erasable Programmable Read-Only Memory
EMI	Electromagnetic Interference
ETH	Ethernet
FIFO	First In First Out
FPGA	Field Programmable Gate Array
FTS	Flight Termination System
GND	Power or Digital Ground, isolated from Chassis Ground
GPI	General Purpose Input
GPO	General Purpose Output
GPS	Global Positioning System
IMU	Inertial Measurement Unit
JTAG	Joint Test Action Group
LDO	Low Drop Out
LUT	Look-Up Table, in an FPGA refers to the smallest logic gate
MCU	Microcontroller Unit
MSL	Mean Sea Level
NOR	Not OR
PGA	Programmable Gain Amplifier
PPS	Pulse per Second Time Synchronization
PWM	Pulse Width Modulation
QSPI	Quad SPI, 4 synchronous bidirectional data lines and one clock
RAM	Random Access Memory
RX	Receive
SDK	Software Development Kit
SOA	Safe Operating Area
SPI	Serial Peripheral Interface
TTL	Transistor-Transistor Logic
TX	Transmit
UART	Serial Universal Asynchronous Receiver-Transmitter
V	Voltage
W	Watts

References

Reference	Title, Description, Location
ST AN2606	STM32 Bootloader Manual https://www.st.com/resource/en/application_note/cd00167594.pdf
ST AN3155	USART Protocol Used in the STM32 Bootloader https://www.st.com/resource/en/application_note/cd00264342-usart-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf
ST AN3154	CAN Protocol Used in the STM32 Bootloader https://www.st.com/resource/en/application_note/cd00264321-can-protocol-used-in-the-stm32-bootloader-stmicroelectronics.pdf

Electrical Interface

Connector Pinouts

PWR A/PWR B - Power Inputs
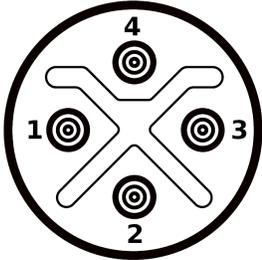
PWR A

Face view of receptacle M12S-04PMMS-SF8B15, S-code, 4 male pins, 12A each.

Mates with M12S-04BFFB-SL7002

Table 1 : PWR A Connector Pinout

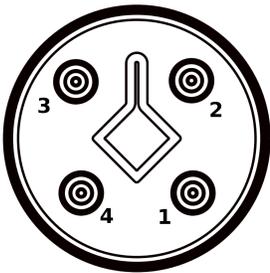| Pin	Name	Primary Function	Alt. Function	Notes
1	VIN 0 +	Bus A Supply	-	12A Slow Blow Fuse, 38V Max Continuous
2	VIN 0 -	Bus A Return	-	
3	VIN 1 +	Bus A Supply	-	12A Slow Blow Fuse, 38V Max Continuous
4	VIN 1 -	Bus A Return	-	

PWR B

Face view of receptacle M12T-04PMMS-SF8B15, T-code, 4 male pins, 12A each.

Mates with M12T-04BFFB-SL7002

Table 2 : PWR B Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	VIN 2 +	Bus B Supply	-	12A Slow Blow Fuse, 38V Max Continuous
2	VIN 2 -	Bus B Return	-	
3	VIN 3 +	Bus C Supply	-	12A Slow Blow Fuse, 38V Max Continuous
4	VIN 3 -	Bus C Return	-	

CAN 0/CAN 1 - CAN Bus
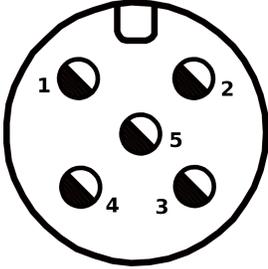
CAN 0 and CAN 1

Face view of receptacle T4141012051-000 , A-code, 5 female pins, 4A each.

Mates with T4111002051-000
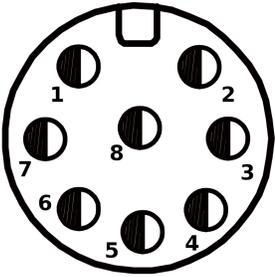
Table 3 : CAN 0 Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis	-	-	
2	LOAD_0 +	LOAD_0 Supply	-	Switchable e-fused output (6A physical fuse)
3	GND	GND	-	
4	TRUNK_0 +	CAN_T0 H	-	Programmable 120 Ohm termination
5	TRUNK_0 -	CAN_T0 L	-	STM32 CAN Bootloader

Table 4 : CAN 1 Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis	-	-	
2	LOAD_1 +	LOAD_1 Supply	-	Switchable e-fused output (6A physical fuse)
3	GND	GND	-	
4	TRUNK_1 +	CAN_T1 H	-	Programmable 120 Ohm termination
5	TRUNK_1 -	CAN_T1 L	-	

D0-D5 - Signal Distribution Connectors

D0, D1, D4, D5

Face view of receptacle T4141012081-000 , A-code, 8 female pins, 2A each.

Mates with T4111002081-000

Table 5 : D0 Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis	-	-	
2	LOAD_9 +	LOAD_9 Supply	-	Switchable e-fused output (6A physical fuse)
3	GND	GND	-	
4	DIST_0 +	CAN_D0 H	Eth 1 RX -	
5	DIST_0 -	CAN_D0 L	Eth 1 RX +	
6	DIST_8	RS485_D8 N	*Eth 1 TX +	*AUX0_IN Additional Configuration Option to internally connect to IO_PORT_A pin 15
7	DIST_8	RS485_D8 P	*Eth 1 TX -	*AUX0_OUT Additional Configuration Option to internally connect to IO_PORT_A pin 16
8	LOAD_0 +	LOAD_0 Supply	-	Switchable e-fused output (6A physical fuse)

Table 6 : D1 Connector Pinout

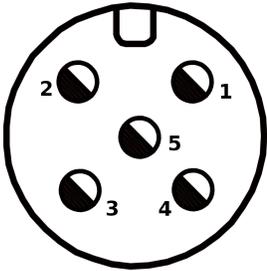| Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis			
2	LOAD_10 +	LOAD_10 Supply	-	Switchable e-fused output (6A physical fuse)
3	GND	GND	-	
4	DIST_1 +	RS485_D1 P	CAN_D1 H	
5	DIST_1 -	RS485_D1 N	CAN_D1 L	
6	DIST_7 +	RS485_D7 P	*CAN_D7 H	*AUX1_IN Additional Configuration Option to internally connect to IO_PORT_B pin 15
7	DIST_7 -	RS485_D7 N	*CAN_D7 L	*AUX1_OUT Additional Configuration Option to internally connect to IO_PORT_B pin 16
8	LOAD_1 +	LOAD 1 Supply	-	Switchable e-fused output (6A physical fuse)

Table 7 : D4 Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis			
2	LOAD_4 +	LOAD_4 Supply	-	Switchable e-fused output (6A physical fuse)
3	GND	GND	-	
4	DIST_4 +	RS485_D4 P	CAN_D4 H	
5	DIST_4 -	RS485_D4 N	CAN_D4 L	
6	SPARE_0	-	*AUX2_IN	*When selected, internally connected to IO_PORT_A pin 17
7	GPO 2 -	GPO_2 Return	*AUX2_OUT	*When selected, internally connected to IO_PORT_A pin 18
8	GPO 2 +	GPO_2 Output	-	

Table 8 : D5 Connector Pinout

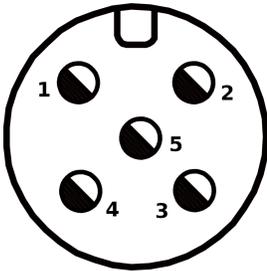| Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis			
2	LOAD_5 +	LOAD_5 Supply	-	Switchable e-fused output (6A physical fuse)
3	GND	GND	-	Signal Ground
4	DIST_5 +	RS485_D5 P	CAN_D5 H	
5	DIST_5 -	RS485_D5 N	CAN_D5 L	
6	SPARE_1	-	*AUX3_IN	*When selected, internally connected to IO_PORT_B pin 17
7	GPO 0 -	GPO_0 Return	*AUX3_OUT	*When selected, internally connected to IO_PORT_B pin 18
8	GPO 0 +	GPO_0 Output	-	

D2

Face view of receptacle T4140012051-000 , A-code, 5 male pins, 4A each.

Mates with T4110002051-000

Table 9 : D2 Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis	-	-	
2	GPI 0 +	GPI_0 High	-	
3	GPI 0 -	GPI_0 Low	GND	Factory option for GND tie
4	DIST_2 +	RS485_D2 P	CAN_D2 H	
5	DIST_2 -	RS485_D2 N	CAN_D2 L	

D3

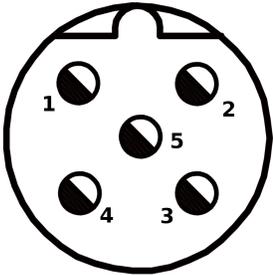Face view of receptacle T4141012051-000 , A-code, 5 female pins, 4A each.

Mates with T4111002051-000

Table 10 : D3 Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis	-	-	
2	LOAD_3 +	LOAD_3 Supply	-	Switchable e-fused output (6A physical fuse)
3	GND	GND	-	
4	DIST_3 +	RS485_D3 P	CAN_D3 H	
5	DIST_3 -	RS485_D3 N	CAN_D3 L	

RS-485 and RS-232

Face view of receptacle T4141412051-000, B-code, 5 female pins, 4A each.

Mates with T4111402051-000
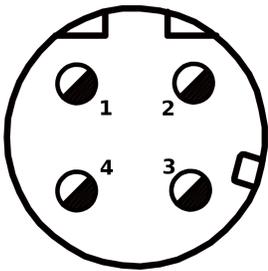
Table 11 : RS-485 Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis	-	-	
2	LOAD_2 +	LOAD_2 Supply	-	Switchable e-fused output (6A physical fuse)
3	GND	GND	-	
4	TRUNK_2 +	RS485_T2 P	-	Programmable 120 Ohm termination
5	TRUNK_2 -	RS485_T2 N	-	

Table 12 : RS-232 Connector Pinout

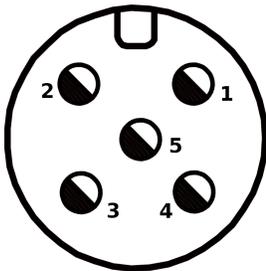| Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis	-	-	
2	LOAD_8 +	LOAD_8 Supply	-	Switchable e-fused output (6A physical fuse)
3	GND	GND	-	
4	DIST_11 +	RS485_D11 P	RS232_D11 TX	
5	DIST_11 -	RS485_D11 N	RS232_D11 RX	

ETH - Ethernet Connector

ETH

Face view of receptacle T4141512041-000, D-code, 4 female pins, 4A each.

Mates with Eonvic M12 4 Pin D-Code to RJ45 or Automation Systems Interconnect ASI ASI-M12-RJ45-11101 M12 4 Position D-Coded Male to RJ45

Table 13 : Ethernet Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	Eth 0 TX +	Ethernet 0	-	
2	Eth 0 RX +	Ethernet 0	-	
3	Eth 0 TX -	Ethernet 0	-	
4	Eth 0 RX -	Ethernet 0	-	

N2K - N2K Connector

N2K

Face view of receptacle T4140012051-000 , A-code, 5 male pins, 4A each.
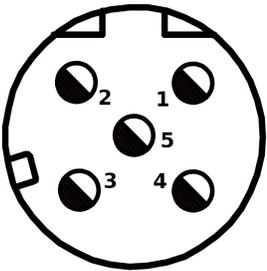
Mates with T4110002051-000

Table 14 : N2K Connector Pinout

| Pin	Name	Primary Function	Alt. Function	Notes
1	Chassis	-	-	
2	TRUNK_3 +	RS485_T3 P	No Connection	
3	TRUNK_3 -	RS485_T3 N	No Connection	
4	DIST_6 +	RS485_D6 P	CAN_D6 H	
5	DIST_6 -	RS485_D6 N	CAN_D6 L	

MAINT - Maintenance Connector

MAINT

Face view of receptacle T4140512051-000 , D-code, 5 male pins, 4A each.

Mates with T4110502051-000

Table 15 : MAINT Connector Pinout

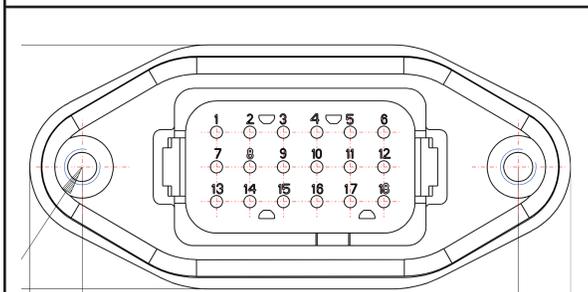| Pin	Name	Primary Function	Alt. Function	Notes
1	Recovery	MCU Boot Mode	-	Short to ground to enter STM32 bootloader mode. Use CAN_T0 or RS485_D10 to load code.
2	DIST_10 -	*2.5V TTL Bias	RS485_D10 N	Leave floating when using TTL_D10. *May also be configured as an additional GND
3	DIST_10 +	TTL_D10 RX	RS485_D10 P	
4	TTL/5V	TTL_D10 TX	200mA 5V	STM32 UART bootloader 5V TTL TX, invertible
5	GND	TTL/5V Return	-	Has TVS Diode to TTL_D10

IO_PORT_A/IO_PORT_B - Input/Output Expansion Connectors
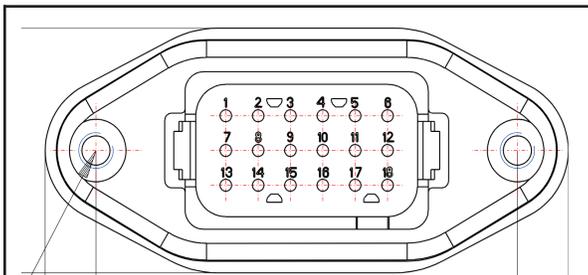
IO_PORT_A

Face view of receptacle AT16-18PA-PM15 , A-code, 18 male pins, 13A each.

Mates with AT16-18SA-SR02

IO_PORT_B

Face view of receptacle AT16-18PA-PM15 , B-code, 18 male pins, 13A each.

Mates with AT16-18SB-SR02

Table 16 : IO_PORT_A Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	FTS Analog +	3A Current Loop	28V Voltage Loop	
2	TRUNK_4 +	RS485_T4 P	-	Usable as FTS / E-Stop GPIO
3	DIST_9 +	RS485_D9 P	-	
4	LOAD_6 +	LOAD_6 Supply	-	Switchable e-fused output (6A physical fuse)
5	VBus A	-	-	6A (fast) fused power from Bus A
6	LOAD_8 +	LOAD_8 Supply	-	Switchable e-fused output (6A physical fuse)
7	FTS Analog -	3A Current Loop	28V Voltage Loop	
8	GPI 1 +	GPI_1 High	-	
9	DIST_9 -	RS485_D9 N	*GND	GND option internally biases D9_N to 50%
10	GND		-	
11	GPO 1 +	GPO_1 Output	-	
12	GND	GND	5V	
13	GND		-	
14	GPO 1 -	GPO_1 Return	GND	Factory option for GND tie
15	GND	GND	*AUX0_IN	*When selected, internally connected to D0 pin 6
16	GND	GND	*AUX0_OUT	*When selected, internally connected to D0 pin 7
17	GPI 1 -	GPI_1 Low	*AUX2_IN	*When selected, internally connected to D4 pin 6
18	TRUNK_4 -	*RS485_T4 N	**AUX2_OUT	*Optionally GND, which internally biases T4_N to 50% *When selected, internally connected to D4 pin 7

Table 17 : IO_PORT_B Connector Pinout

Pin	Name	Primary Function	Alt. Function	Notes
1	Analog 0 +	Analog 0 +	-	
2	Analog 1 +	Analog 1 +	-	
3	DIST_7 +	RS485_D7 P	CAN_D7 H	
4	DIST_8	RS485_D8 P	Eth 1 TX -	
5	VBus B	-	-	6A (fast) fused power from Bus B
6	LOAD_7 +	LOAD_7 Supply	-	Switchable e-fused output (6A physical fuse)
7	Analog 0 -	Analog 0 -	GND	Factory option for GND tie
8	Analog 1 -	Analog 1 -	GND	Factory option for GND tie
9	DIST_7 -	*RS485_D7 N	CAN_D7 L	*Optionally GND, which internally biases D7_N to 50%
10	DIST_8	*RS485_D8 N	Eth 1 TX +	*Optionally GND, which internally biases D8_N to 50%
11	GPO 0 +	GPO_0 Output	-	
12	GND	GND	5V	
13	GPO 0 -	GPO_0 Return	GND	Factory option for GND tie
14	GPI 0 +	GPI_0 High	-	
15	GPI 0 -	GPI_0 Low	*AUX1_IN	*When selected, internally connected to D1 pin 6
16	GND	GND	*AUX1_OUT	*When selected, internally connected to D1 pin 7
17	GND	GND	*AUX3_IN	*When selected, internally connected to D5 pin 6
18	GND	GND	*AUX3_OUT	*When selected, internally connected to D5 pin 7

Chassis Bond Stud

For enhanced bonding between the Dauphine Unit and vehicle chassis, a M3 bonding stud can be installed in the baseplate with a countersunk M3 screw with the intent of allowing a low resistance connection.

Electrical Characteristics

Absolute Maximums

Parameter	Min	Max	Unit
Input Voltage on VIN 0-3[1]		60	V
Total Current through Single VIN		12	A
Total Combined Current through all four VIN inputs		48	A
Output Current to LOAD 0-10		6	A
GPI Voltage between +/-	-8.5	60	V
GPI Isolation to GND		60	V
GPO Voltage between +/-		60	V
GPO Current between +/- (AC or DC)[2] @ 25°C		3	A
GPO Isolation to GND		60	V
RS485 / CAN / PWM Common Mode (Continuous)	-25	25	V
RS485 / CAN / PWM Common Mode (Transient)	-58	58	V
RS485 / CAN / PWM Differential (Continuous)	-5	10	V
RS485 / CAN / PWM Differential (Transient)	-17	17	V
FTS Analog Differential Voltage (Voltage Mode, Continuous)	-13	60	V
FTS Analog Current (Current Mode, Continuous)		5	A
Auxiliary Analog Inputs to GND (Continuous)	-16	16	V

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[1] Assumes 48V nominal system. Baseline Dauphine implements 36V rated fuses which can be updated to allow 60V max operation.
[2] The full safe operating area (SOA) curve for the GPO optoisolator is given in the Isolated Outputs section.

Power Topology

The Dauphine Unit can provide up to 48A continuous power to 11 outputs with ratings ranging from 2 to 4A continuous. at bus voltage and two 5V (200mA combined max) outputs. Power is broken into three power buses (A, B, and C) which can operate independently or be tied together. The A bus, in addition to powering the switched loads, also powers the processor, transceivers, and 3A auxiliary buck switched mode power supply.

The four power inputs on the Dauphine Unit are protected by slow blow 12A fuses, transient protection diodes, and an ideal diode preventing power from flowing backwards. Each input monitors the supply voltage and the return current. This monitoring allows detection of blown fuses, broken wires, and potentially ground loops.

The eleven 2 to 4A outputs are current-monitored by the MCU and are all individually fused with fast blow 6A fuses. It is expected that power supplied to the remote device is returned to the Dauphine Unit on the designated pin. Failure to do so may trip Dauphine's ground fault detection feature. Soft start functionality is expected to be present on the remote load if a current draw above 3.5A occurs at startup.

If used, the auxiliary power supply can regulate from within a volt (-1V) of the A bus voltage down to 5V in 10mV steps and can supply up to 3A of current across temperature.

The Dauphine Unit nominally operates from 12 to 24VDC (36VDC maximum), with a factory option to shift the range up from 24 to 48VDC nominal (60VVDC maximum)..

The worst case power draw for the internal logic is estimated to be no more than 15W if all but one transceiver is operating nominally and one transceiver is driving a shorted bus.

The Dauphine Unit is not rated for any specific hold up time in the case of complete power loss although it is capable of several hundred microseconds depending on the load (consult allocor for application specific estimates).

The Dauphine chassis is capacitively and resistively (1 Mega Ohm) coupled to power return for EMI and voltage transients, it is expected that the power sources have a low resistance connection between chassis and return.
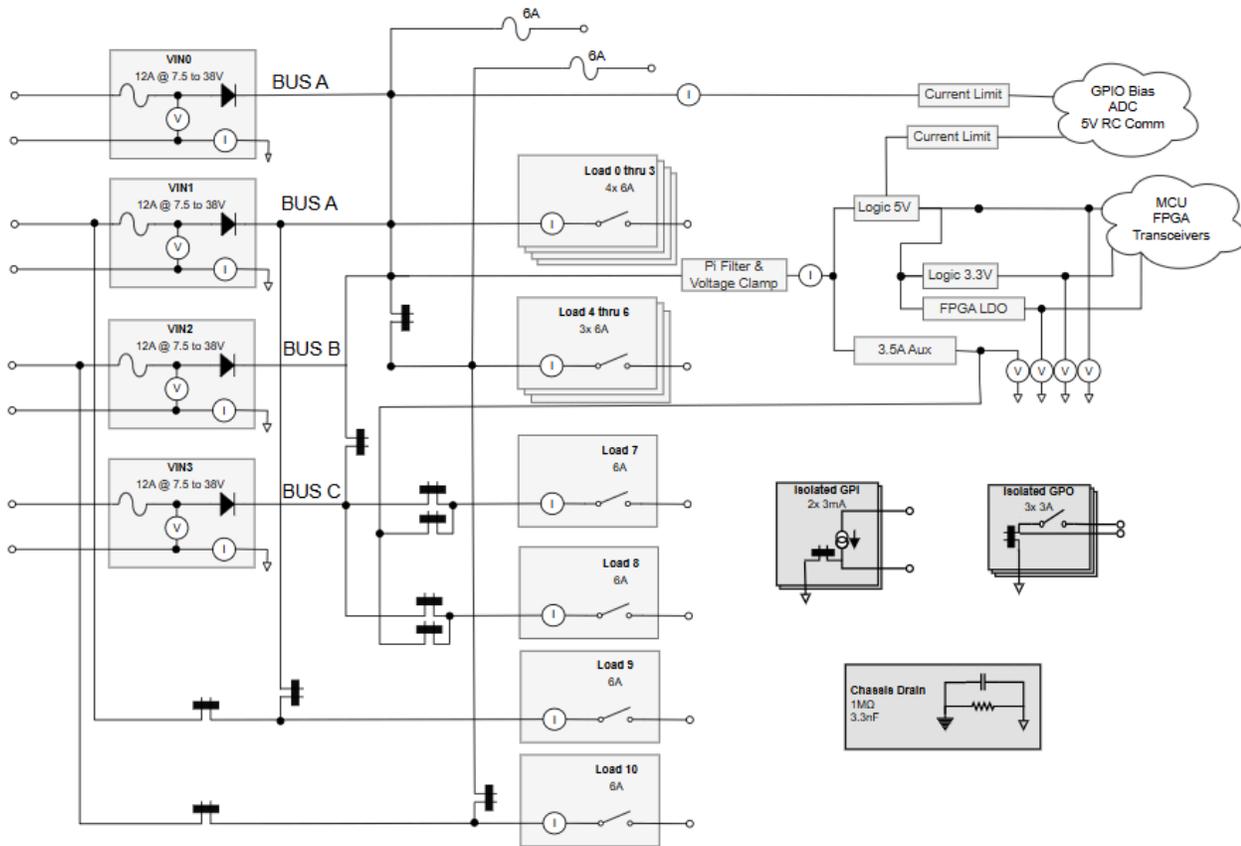
Input and Output Voltage Note:

The original Dauphine design utilized fuses rated to 36V however these can be replaced to allow for up to 60V input.

M12 connector voltage specifications vary with "Code" type, particularly with mating cables, voltage ratings may vary and specify rated voltages as low as 30V. Dauphine side connectors are rated to 60V or greater.

Capability Mapping

There are several categories of serial communications present on the Dauphine Unit. Any interface conceptually designed to be used as a safety critical trunking interface is dedicated and brought directly to the MCU. All other communications go through some form of external peripheral controller and are usually overlaid with other compatible communications busses so that many protocols can be served by a single set of hardware.

Pair #*	CAN	485	232	5V TTL	PWM	Eth	ADC	Note
TRUNK_0	MCU							STM32 bootloader
TRUNK_1	MCU							
TRUNK_2		MCU						
TRUNK_3		MCU						
TRUNK_4		FPGA			Y			FTS GPIO
TRUNK_5							FPGA	FTS Analog
TRUNK_6						Eth 0		
TRUNK_7						Eth 0		
DIST_0	SPI					Eth 1		
DIST_1	SPI	FPGA			FPGA			
DIST_2	SPI	FPGA			FPGA			
DIST_3	SPI	FPGA			FPGA			
DIST_4	SPI	FPGA			FPGA			
DIST_5	SPI	FPGA			FPGA			
DIST_6	SPI	FPGA			FPGA			
DIST_7	SPI	FPGA			FPGA			
DIST_8		FPGA			FPGA	Eth 1		
DIST_9		FPGA			FPGA			
DIST_10		MCU		MCU / RX				STM32 bootloader No termination
DIST_11		FPGA	FPGA		FPGA			
Aux5V_0				MCU / TX				DIST_10 or always on
Aux5V_1								Always on
GPI_0					FPGA			PWM Capture or arbitrary in
GPI_1					FPGA			
GPO_0					FPGA			PWM Generation or arbitrary output
GPO_1					FPGA			
GPO_2					FPGA			

* Note: Pair# here match software registry port names

Differential and Single Ended Options

Several of the differential pairs can be modified in hardware to operate in single ended mode. The pairs with this capability are TRUNK_4, DIST_7, DIST_8, and DIST_9. Each pair with this capability requires hardware modification to convert between differential and single ended modes, and the schematic below is specifically for TRUNK_4.
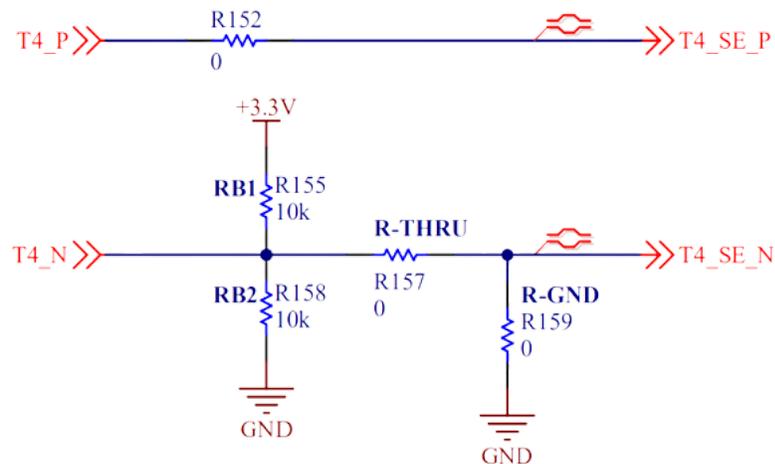
To operate as a differential pair, R-THRU must be installed, and RB1, RB2, and R-GND must be removed. For single ended operation, the opposite must be done. R-THRU must be removed, and RB1, RB2, and R-GND must be installed.

CAN

The Dauphine Unit can expose up to ten CAN-FD busses capable of operation up to 8Mbps. Two of the buses are native to the MCU. The remaining eight CAN buses are produced by SPI CAN controllers attached in pairs to dedicated SPI controllers. The two MCU connected CAN busses are connected to each CAN connector.

All CAN buses use Microchip MCP2542 transceivers which feature 13kV ESD protection (IEC 61000-4-2) and +/- 58VDC common mode protection. Trunk CAN lines are further protected with a common mode choke and have programmable, or optionally factory fixed, 120 Ohm termination. Distribution CAN lines have factory installed 120 Ohm termination resistors.

UARTs

Trunk RS-485

Dauphine has three half duplex RS-485 pairs, all with hardware duplex control and capable of operation up to 8Mbps. Two of these pairs are controlled by the MCU and are powered with 5V for maximum differential voltage swing. The third is controlled by the FPGA, and is powered from 3.3V. All transceivers are fault tolerant to differential shorts, have high

common mode range, are further protected with common mode chokes and all have programmable, or optionally factory fixed, 120 Ohm termination.

If required, all trunk transceivers can be factory modified to operate in receive only mode.

In the first hardware production, a TI THVD2450 was used. In current production runs a Maxim MAX14775EATA+.

RS-485

There are eleven half duplex RS-485 pairs, all with hardware duplex control and capable of operation up to 8Mbps. Ten of these eleven are connected to the FPGA. The eleventh UART is the STM32 bootloader UART which is connected to the MCU. All transceivers on the distribution are powered from 3.3V, are fault tolerant to differential shorts, have high common mode range, and have fixed termination options, except for the RS-232 capable pair which has programmable termination, and the TTL capable pair which has no termination.

In the first hardware production, a Maxim MAX14775 was used. In future production runs, this or an equivalent part will be sourced.

RS-232 (Dist 11)

Using an LTC2873, the Dauphine Unit is able to offer a combined RS-232 and RS-485 port. This device turns the differential pair into TX and RX as well as offering a programmable resistor in RS-485 mode.

5V TTL (Dist 10)
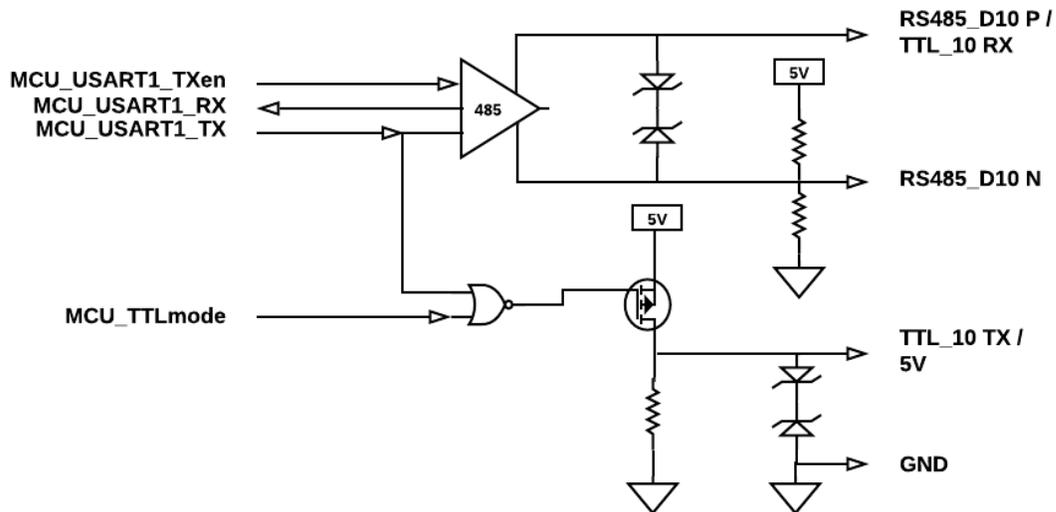
A single 5V TTL UART is provided for devices such as RC receivers and other low voltage sensors that have short communication runs and are not safety critical. This UART operates by weakly biasing the negative side of a RS485 transceiver at 2.5V. The RX is then expected to exceed 2.5V by at least 200mV; notionally from GND to +5 but GND to +3.3V is also acceptable. The transmit side is operated by using a high side FET and strong pull down from 5V to GND. This port is software invertible, meaning that mark and space can be either 5V or GND.

When this port is operating in TTL mode, the maximum baud rate is 56kbps. Improvements to the biasing network can be made to improve the performance of this port up to 115.2kbps at the expense of additional power draw when operating in 5V supply mode.

Ethernet

Dauphine offers up to two external 10/100 Auto-MDIX magnetically coupled ethernet ports. These ports are controlled by an internal three port managed switch with the third port directly attached to the native MCU media access controller.

Discrete Digital Inputs / Outputs

Isolated Inputs

Two isolated, dual port inputs are provided. These are approximately 3mA constant current sinks that have a guaranteed turn off below 1.6V and a guaranteed turn on at or above 3.3V. These voltages are referenced to the Low side return. Logic High can be up to 50V relative to Low. Note that High and Low can not exceed 50V referenced from Dauphine's power return.

If the device connecting to the Dauphine Unit does not provide a logic reference, connect Low to the remote device's power return at the remote location. If sufficient signal margin is available with respect to ground differences between Dauphine and the remote driver, a factory option to tie the Low side to GND inside the enclosure is available.
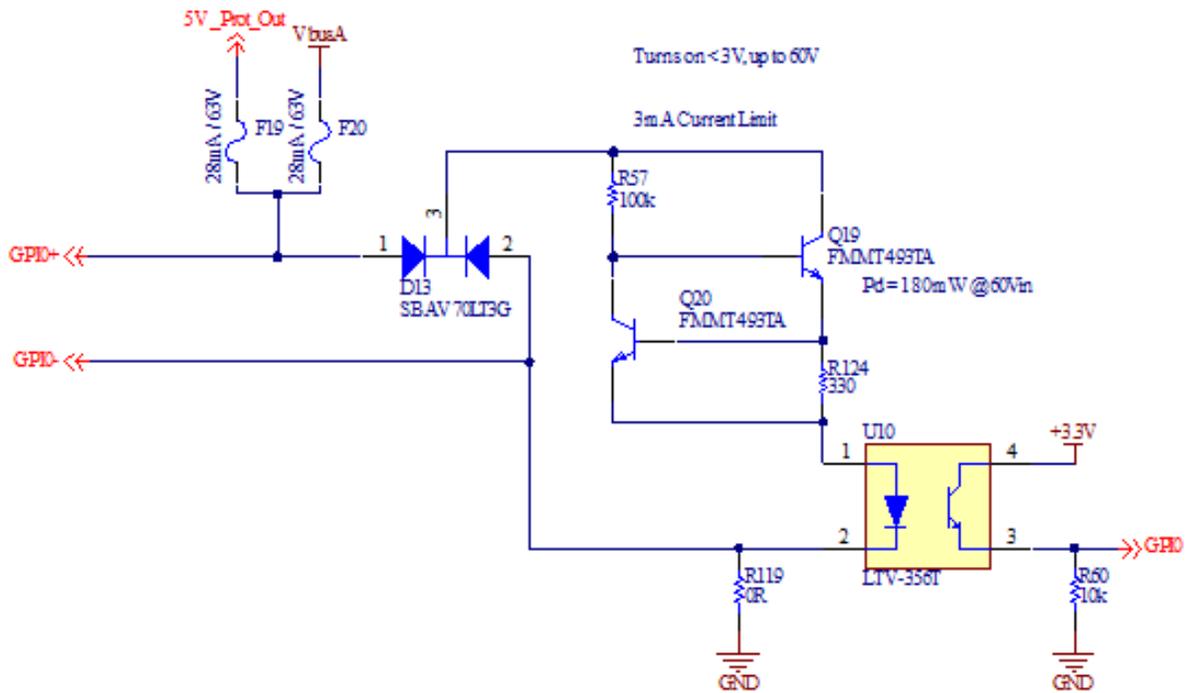

Isolated GPI

Isolated Outputs

Three isolated relay connections are provided. These can handle up to 50V relative to Dauphine's power return and 3A of AC or DC current. As a factory option, one leg of each GPO may be tied to the internal power ground.

These outputs must be derated for the operating temperature. At the peak operating temperature of the Dauphine Unit (70°C) the derated current limit is 1.5A.
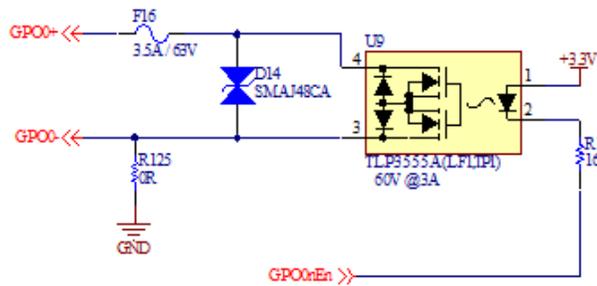
Isolated GPO
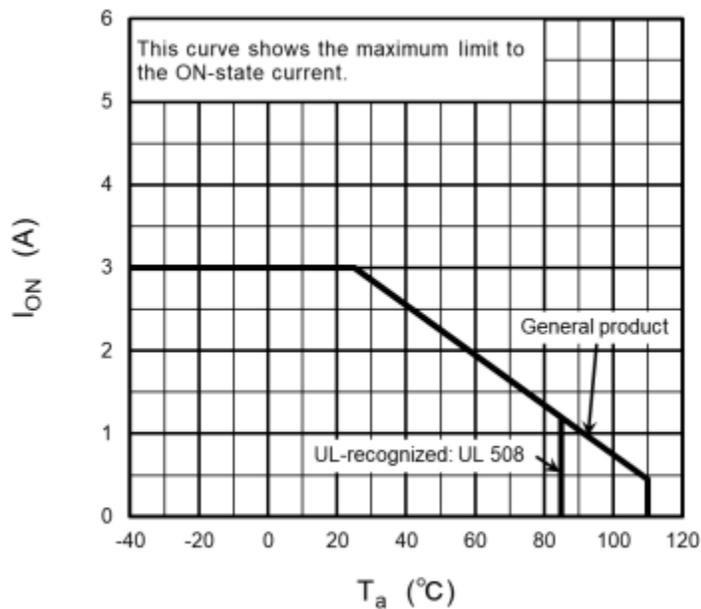
Safe Operating Area of TLP3555A Optoisolator

UARTs as Differential GPIO

All UARTs connected to the FPGA can be repurposed as differential GPIO using RS485 signal levels in software. If configured as an output; the output state when the FTS is triggered is software configurable.

UARTs as PWM Outputs

All UARTs connected to the FPGA can be repurposed as pulse width modulated outputs with 16 bit output/compare registers off a 64MHz clock with a 16 bit integer divider. The output state when the FTS is triggered is software configurable.

Additional functionality such as PWM capture, or specialty protocols that overlay communications channels on top of the PWM signal are available on request with specialized FPGA firmware builds.

Differential Analog Inputs

Two differential analog inputs are provided. These are -2.5V to +2.8V inputs sampled with a 16 bit ADC and have a 50Hz low pass filter applied. There is a programmable gain stage between the input and ADC which ranges from 0.2 to 157 V/V.

If needed, the analog source can be powered with an internally generated 5V source which is shared with the remote control UART. If the combined load on this supply exceeds 200mA the supply will enter a continuous retry mode.
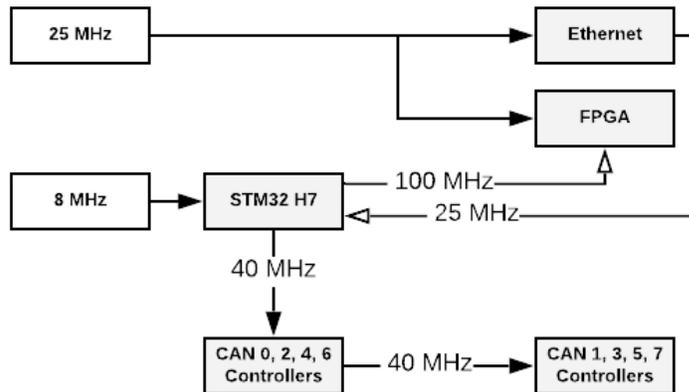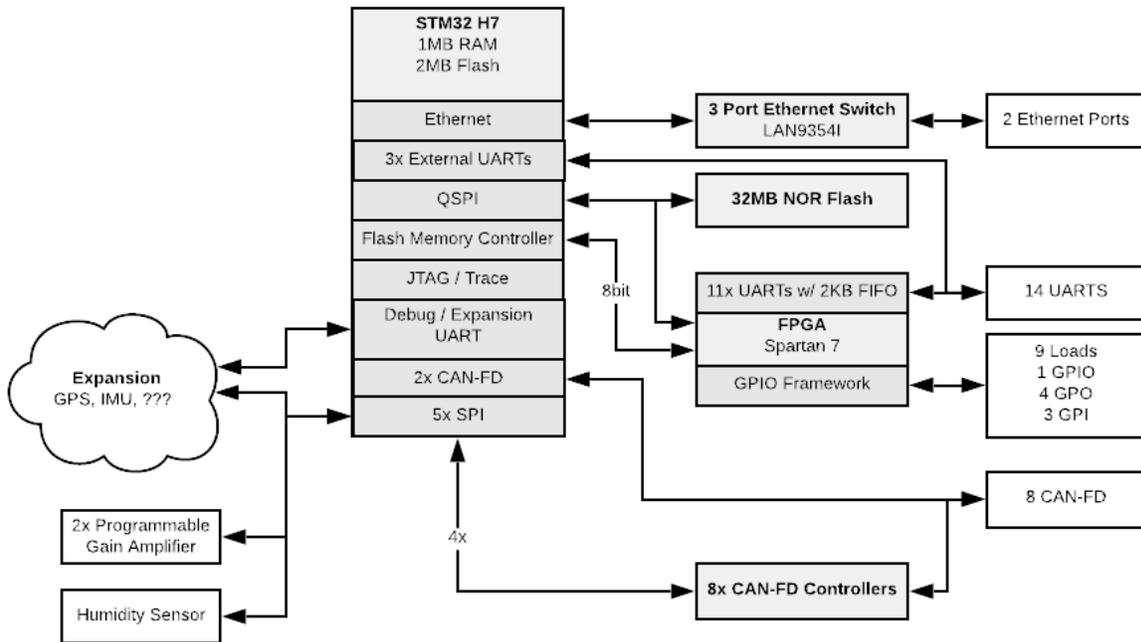
Note that the inputs cannot go below -16V or above +16V referenced to "5V Return", aka GND. No other protection is applied.
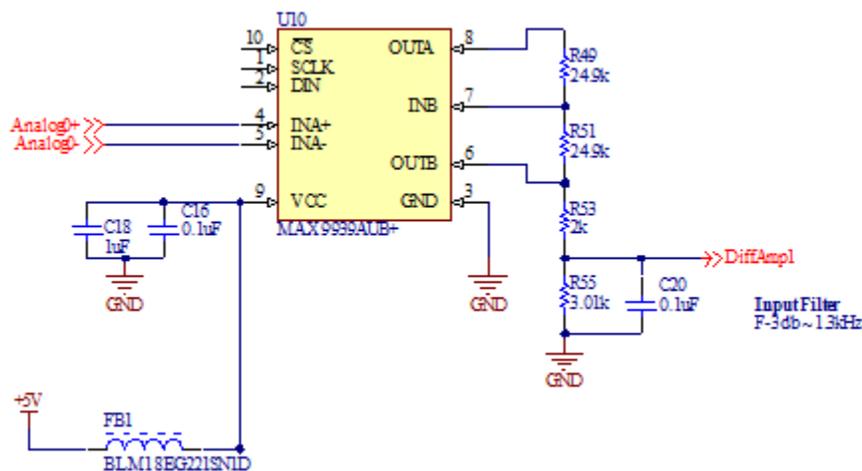
SPI Controlled PGA Network for Differential Analog

Compute Complex

MCU

A mixture of STM32H753 and STM32H743 processors have been used in the various production runs of the Dauphine variant due to parts availability issues. If hardware accelerated cryptography (H753) is desired, contact Allocortech to ensure the shipped product is compliant.

The STM32H7x3 series of MCU are capable of operating up to 400MHz and have 2MB of flash and 1MB of RAM.

FPGA

Attached to the STM32H7 via 8-bit parallel bus is a Xilinx Spartan 7 with at least 25k LUTs. This FPGA is used to control the distribution UARTs, load channels, GPIO, and flight termination analog signal.

Although the FPGA is not capable of offloading general purpose calculations from the MCU due to the bandwidth of the parallel bus, it is able to offload communications packet processing if desired.

In future revisions of the product, the FPGA may also be responsible for distribution CAN instead of using the MCP2518FD SPI controller.

NOR Flash / QSPI

Attached to both the processor and FPGA via QSPI is a 32MB NOR Flash. The first 4MB of this flash is dedicated to the FPGA firmware, but the remaining 28MB are available to the user, which could be used for anything ranging from storing reference models, flight plans or generally running desired applications. The QSPI flash is mapped into the MCU address space for cached and prefetch capable read operations.

Expansion Connector

Dauphine provides a user expansion header on the bottom side of the logic board. This header exposes a dedicated SPI bus with 7 GPIO capable of being chip select or interrupt lines and a full duplex UART. Power is provided at 5 and 3.3V. For further information about expansion card capabilities, see Appendix A.
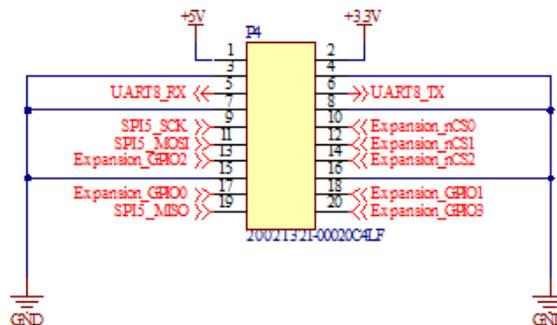
Status LED

A tri-color daylight-visible status LED is provided, exposed through a light pipe on the top of the enclosure, for user specified informational or debugging purposes.

Allocor's standard bootloader will blink the LED green at 1Hz to indicate it's in bootloader mode. Other typical color coding includes blinking RED for errors.

In other instances users have utilized the LED to color code Clio positions or software loads with a solid color of the users choosing. Ex. Blue for Main, White for a forward Unit, Purple for rear.

Bootloading and Vehicle Personality

STMicroelectronics provides the STM32H7 with a serial bootrom, accessible on boot if the MCU Recovery pin is shorted to ground. When the processor is in this mode, communication with the bootrom is possible over Dist 10 (with either RS-485 or TTL) or Trunk 0 (CAN.) See ST AN2606, ST AN3155, and ST AN3154 for further information about interacting with the bootrom.

With the allocortech reference booty bootloader, or a customer supplied bootloader, loading of the MCU internal flash and the FPGA firmware to the QSPI flash is possible over any UART, CAN, or Ethernet connection.

Also attached to the MCU recovery pin is a 112 byte 1-wire EEPROM which allocortech uses to store device revision information and small amounts of configuration. Additional 1-wire devices can be chained in the harness to store end user information as desired.
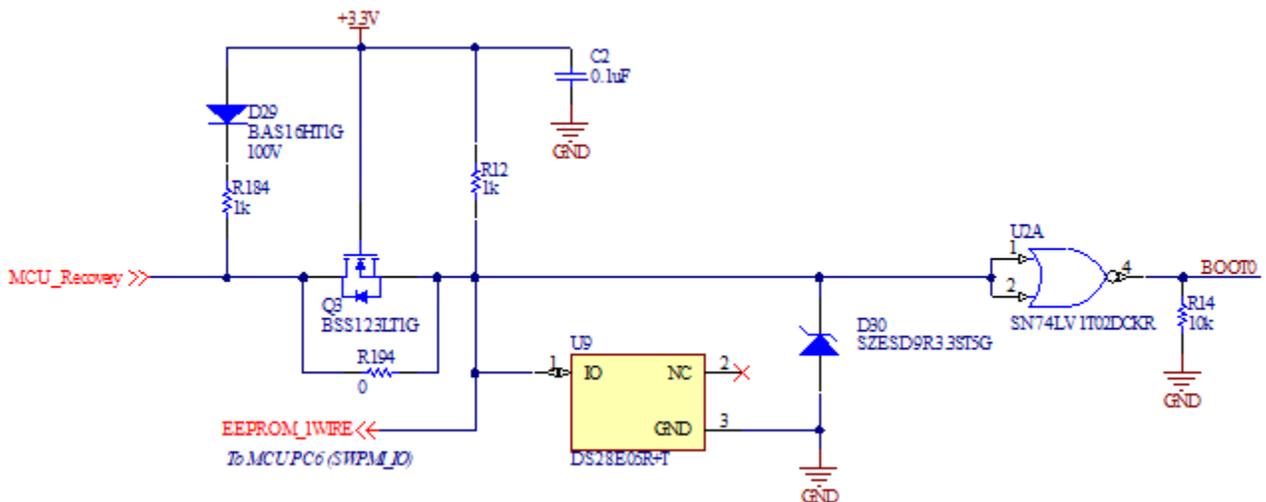
**Recovery and 1-Wire EEPROM Network**

Safety Critical Considerations

FTS / E-Stop Override

An analog input which feeds the FPGA XADC is provided. This analog input is factory selectable as either a current sense or voltage sense input. Notionally this analog input is used as a signal to the FPGA to set all load and GPO signals to a software selectable state, but can be repurposed by the user as desired. When operated as a Flight Termination system/E-stop, once configured the operation is independent of MCU operation.

If this input is unused, the pins should be left floating at the connector.
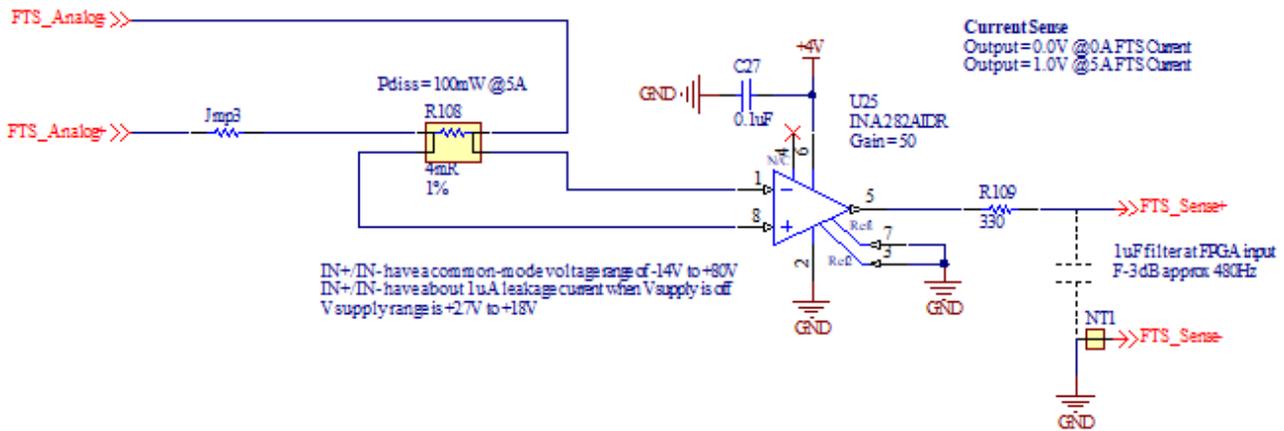

FTS/E-Stop Current Sense
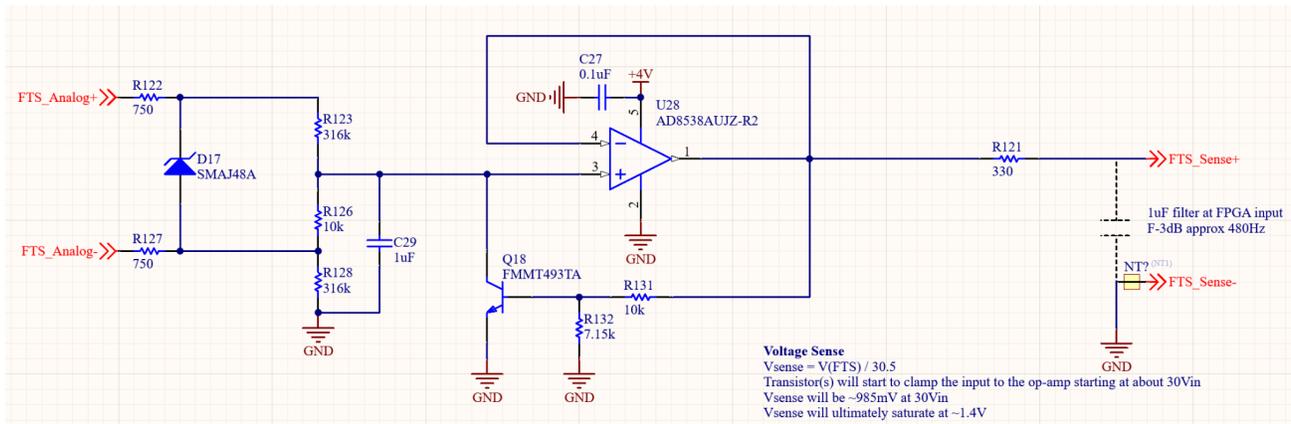
FTS/E-Stop Voltage Sense

MCU Code Coverage

For the purposes of code coverage and on-target debugging, a 4-bit ARM Trace and JTAG connector is present. The JTAG chain includes the FPGA. The pinout chosen is compatible with common trace capable debuggers like those provided by Lauterbach, but adapters can easily be made if required.

Allocortech produces a JTAG adapter board for general purpose embedded debugging, please contact allocortech for more information about part number 120-0061.
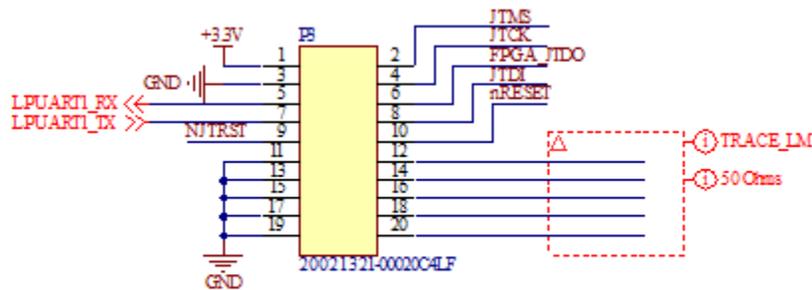
Trace Connector

For use with non-trace capable debuggers, allocortech has produced a common adapter board for the 10-pin ST Link V2, 14-pin STLink V3 (including the UART), 6-pin Digilent JTAG 2, and other common debuggers. Users should contact allocortech for more information.

Hardware in the Loop Emulation

As a special order factory option, the Dauphine Unit may be fitted with features to facilitate Hardware in the Loop (HIL) testing. These features include raising the effective sensitivity of all current measurements so that heavy loads may be simulated in a HIL environment without heavy cabling and power supply requirements.

Health Monitoring

The Dauphine Unit contains several sensors designed to monitor the health of the unit including thermistors, input power return current monitoring, and voltage monitoring of all rails

Hardware Monitor

For use in dual-dual or fail stop control schemes, an additional processor can be added to the Dauphine Unit by use of an interposer circuit board between the logic board and connector boards. Such a processor can be used to monitor all the serial and GPIO signals and override or cut power to the main processor as required.
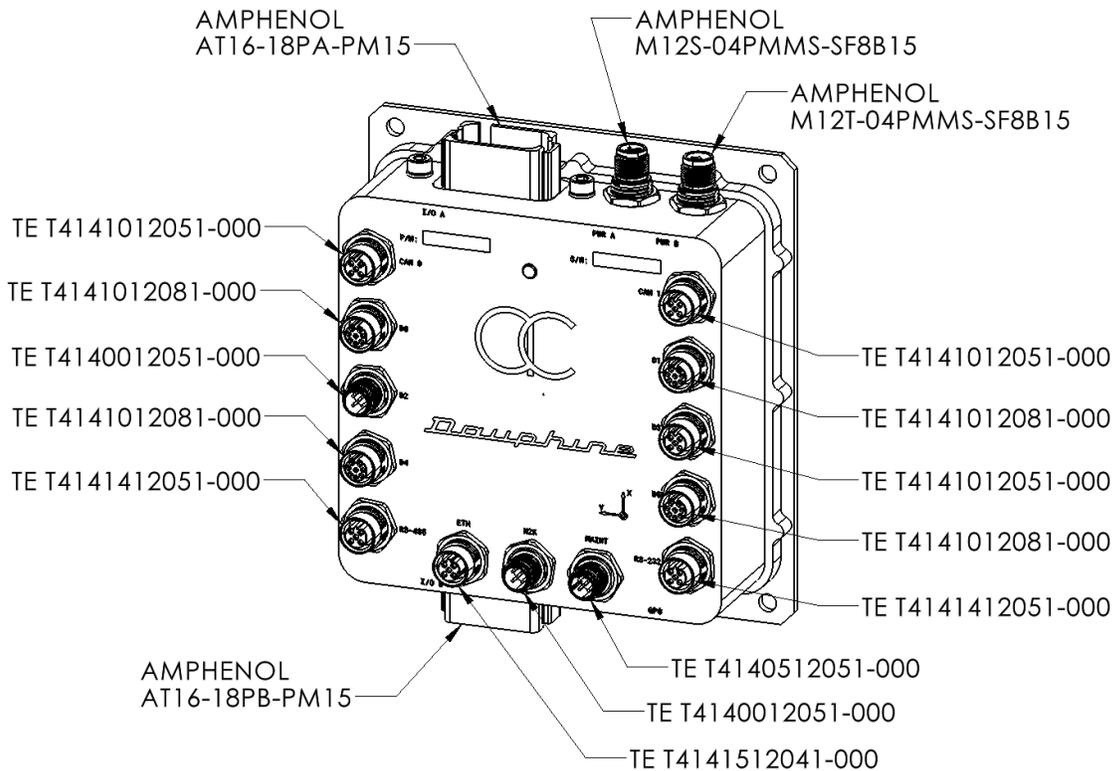
Lightning or Other Signal Conditioning / Protection

The Dauphine Unit is implemented as a logic board containing the MCU, FPGA, and transceivers, and a connector board that performs signal conditioning. If stronger signal or power line protection is required, allocortech can produce and test a custom connector board on request.
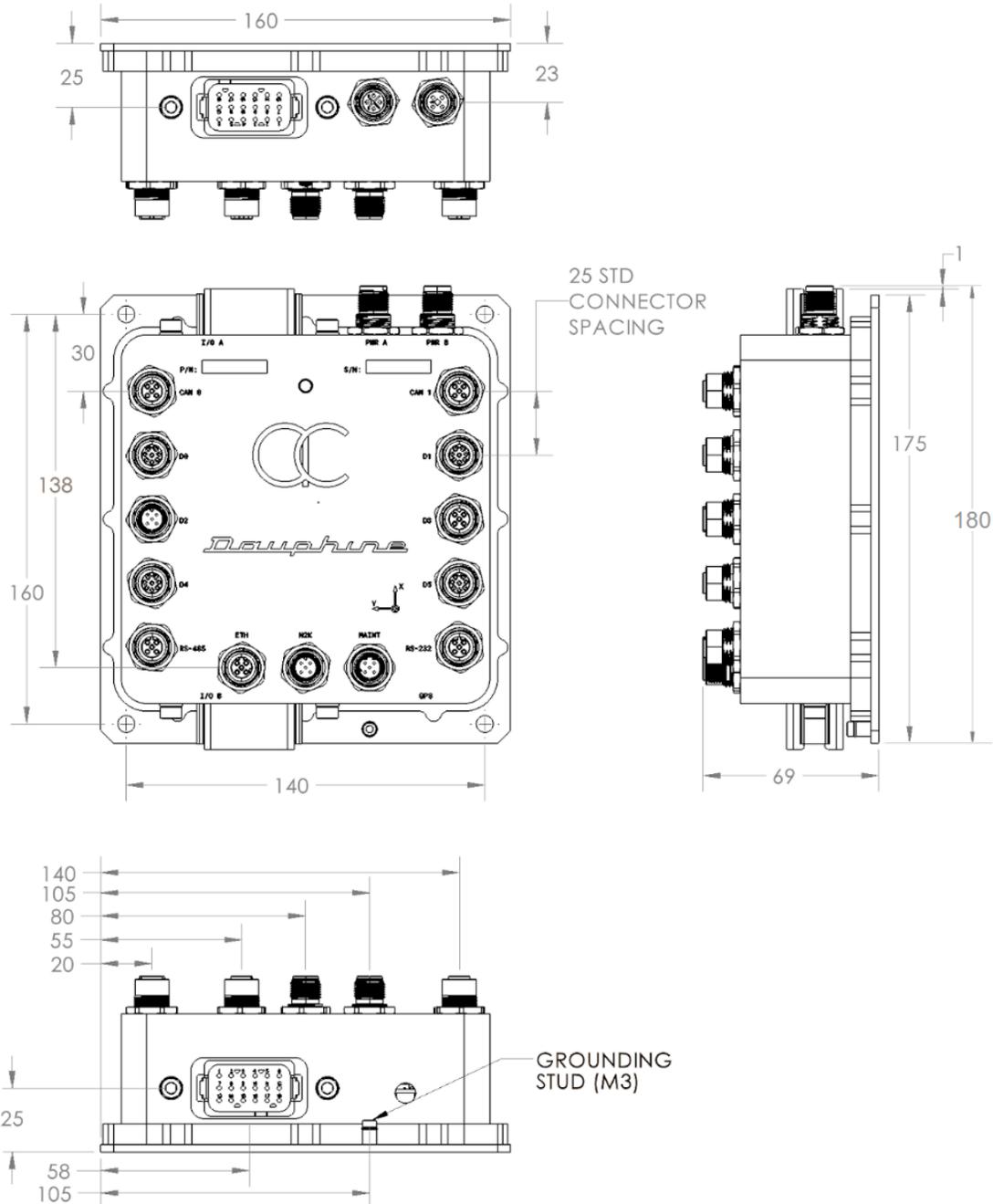
Mechanical Interface

Dauphine is housed in a custom enclosure (box and lid) machined from aluminum 6061-T6 stock with thirteen M12 connectors installed on the top surface of the box, two M12 power connectors installed on one side and two AT Series rectangular connectors installed on opposite sides. The lid has four holes for mounting the unit and a grounding stud.

AMPHENOL
AT16-18PA-PM15

AMPHENOL
M12S-04PMMS-SF8B15

AMPHENOL
M12T-04PMMS-SF8B15

TE T4141012051-000

TE T4141012081-000

TE T4140012051-000

TE T4141012081-000

TE T4141412051-000

TE T4141012051-000

TE T4141012081-000

TE T4141012051-000

TE T4141012081-000

TE T4141412051-000

AMPHENOL
AT16-18PB-PM15

TE T4140512051-000

TE T4140012051-000

TE T4141512041-000

Dimensions

Measurements given in millimeters.

160

25

23

25 STD
CONNECTOR
SPACING

30

138

160

140

1

175

180

69

I/O A

P/N:

S/N:

CAN 0

CAN 1

D0

D1

D2

D3

D4

D5

RS-485

ETH

N2K

MAINT

RS-232

I/O B

GPS

Dauphine

140
105
80
55
20

GROUNDING
STUD (M3)

25

58
105

Weight

With aluminum enclosure and connectors: 1100 g

Environmental

The below specifications are design goals, and have not been fully qualified through environmental qualification testing.

Grounding and Bonding

As standard, a 3.3nF Y capacitor and 1MΩ drain resistor couple Dauphine's power ground to its enclosure for EMI rejection through shields and the aircraft bonding network. These values can be customized on request.

The coupling components provide a nominal 350V isolation between chassis and any pin.

To avoid excessive static charge buildup between chassis and the power grounds during flight, it is recommended that a low resistance connection bond be provided between the chassis and power supply returns at the aircraft power supply.

Temperature

Operating: -40°C to 70°C.

Storage: -40° to 85°C.

Vibration and Shock

Designed to meet DO-160 Category R

Humidity and Water Ingress

Units are sealed and conformal coated to withstand condensing humidity and falling water per IP67.

Corrosion

Anodized Type III, and clear chromate used for corrosion protection on enclosure. M12 connectors are typically brass with nickel plating.. Estimated 168+ hours salt fog resistant.

Part Numbers

Generation

To generate a part number suffix for Dauphine, complete the configuration table located under the documentation tab at
https://www.allocor.tech/tools/product-variants/?product=clio-dauphine

Appendix A - Expansion Board Option

The Inertial Navigation System (INS) Expansion Board is an optional expansion onto the Dauphine system. The INS board includes an inertial measurement unit (IMU), a magnetometer, a barometric pressure sensor, a differential pressure sensor, and a GNSS (Global Navigation Satellite System). Optionally, a VectorNav VN-300 Inertial Measurement Unit (IMU) and Attitude Heading Reference System (AHRS) can replace the GPS. The VectorNav solution offers dual GNSS ports.
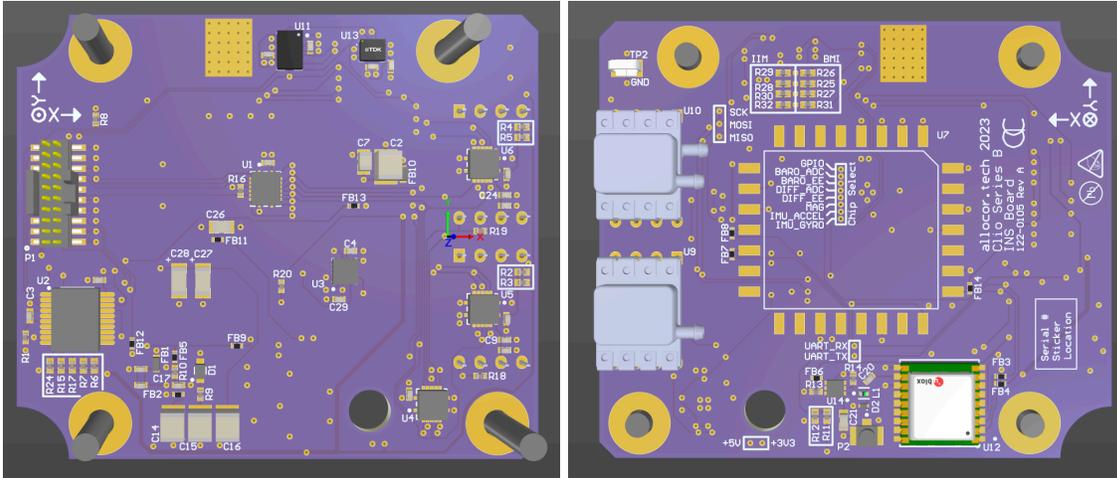
The expansion board connects to the Dauphine inside the enclosure using a Samtec FTSH-110-01-L-DV-K 20 position header. The expansion board is powered and controlled by the Dauphine, and because of this, the INS expansion board cannot be operated without being connected to a Dauphine.

Inertial Measurement Unit (IMU)

Although two IMUs can be placed on the PCB, only one can be used. The option resistors must be configured for either one or the other, and not both.

IMU 1: Bosch BMI088

The BMI088 is an IMU sold by Bosch which includes a 16-bit, three axis accelerometer and a 16-bit, three axis gyroscope. The accelerometer can be configured for a range of +/- 3, 6, 12, or 24g and the gyroscope can be configured for a range of +/- 125, 250, 500, 1000, or 2000 °/s. The coordinate system for this device follows the coordinate system marked on the Dauphine enclosure. The table below describes the offset from the origin marked on the Dauphine to the Bosch IMU origin. Tolerances on positions are +/- 0.05 inches.

	X	Y	Z
Inch	+0.62	+1.22	-1.14
Millimeter	+15.76	+31.02	-28.95

IMU 2: InvenSense IIM42652

The IIM42652 is an IMU sold by TDK InvenSense which includes a 16-bit, three axis accelerometer and a 16-bit, three axis gyroscope. The accelerometer can be configured for a range of +/- 2, 4, 8, or 16g and the gyroscope can be configured for a range of +/- 15.625, 31.25, 62.5, 125, 250, 500, 1000, or 2000 °/s. The coordinate system for this device follows the coordinate system marked on the Dauphine enclosure. The table below describes the offset from the origin marked on the Dauphine to the InvenSense IMU origin. Tolerances on positions are +/- 0.05 inches.

	X	Y	Z
Inch	+1.01	+1.22	-1.14
Millimeter	+25.76	+31.02	-28.95

Magnetometer (Memsic MMC5983)

The MMC5983 is a 3 axis magnetometer sold by Memsic. It has an 18-bit output with a heading accuracy of up to 0.5 degrees. The device has a maximum output data rate of 1000Hz. The magnetometer does not follow the right hand rule with its coordinate system and thus the coordinate system of the magnetometer does not correspond to the marked coordinate system of the Dauphine enclosure. The magnetometer coordinate system relates to the Dauphine coordinate system as described in the table below.

Dauphine	Magnetometer
+X	+X
+Y	+Y
+Z	-Z

Global Navigation Satellite System

The IMU board can optionally socket one of the following GNSS:

- u-blox MAX-M10 series (https://www.u-blox.com/en/product/max-m10-series)
- VectorNav VN-100, VN-200, or VN-300 (https://www.vectornav.com/)

Up to 100mA of 3.3V or 5.0V antenna power can be injected for active antennas.

10 seconds of hold up is provided to the GNSS module.