VEECONNECT
DIGITAL SWITCHING SYSTEM

VeeConnect 12-Channel Electronic Circuit Breaker Unit (ECBU)

Figure 1 – VeeConnect 12-Channel Electronic Circuit Breaker Unit

System Block Diagram

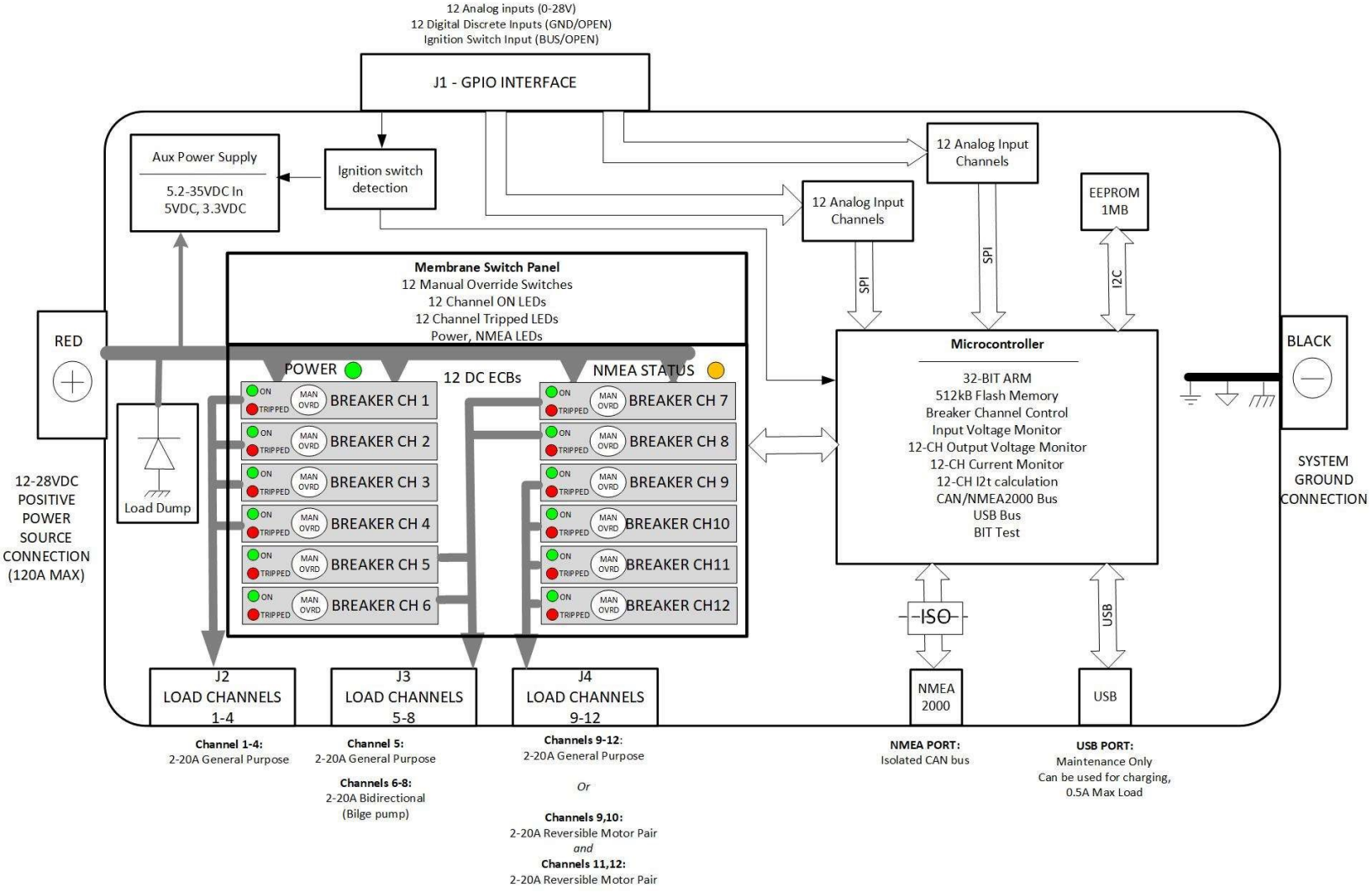


Figure 2 – VeeConnect 12-Channel Electronic Circuit Breaker Unit – Block Diagram

Circuit Breaker Channels

The VeeConnect ECBU is a 12-channel power control unit, with the following features:

- Each ECB channel has a programmable current rating of between 2 to 20A
- Each ECB channel is controllable through the VeeConnect Display
- Each ECB channel is controllable via discrete or analog inputs, configurable through the VeeConnect Display
- Each ECB channel can be manually controlled using the manual buttons on the Membrane Switch Panel
- ECB channels 6, 7 and 8 include reverse-blocking to prevent reverse current from feeding back into the power bus. These channels are the best location for loads that might be connected to the battery at all times, such as a bilge pump
- ECB channels 9, 10, 11, and 12 can operate as autonomous breaker channels, or can be paired as a polarity reversible pair, ideal for DC motor applications such as a hatch motor or anchor lift.
- When used as polarity reversible pairs, ECB channels 9 and 10 can work as a pair, and channels 11 and 12 can work as a pair
- Each ECB channel has trip features, which are a function of I^2t (current^2*time), similar to the behavior of a mechanical or thermal circuit breaker

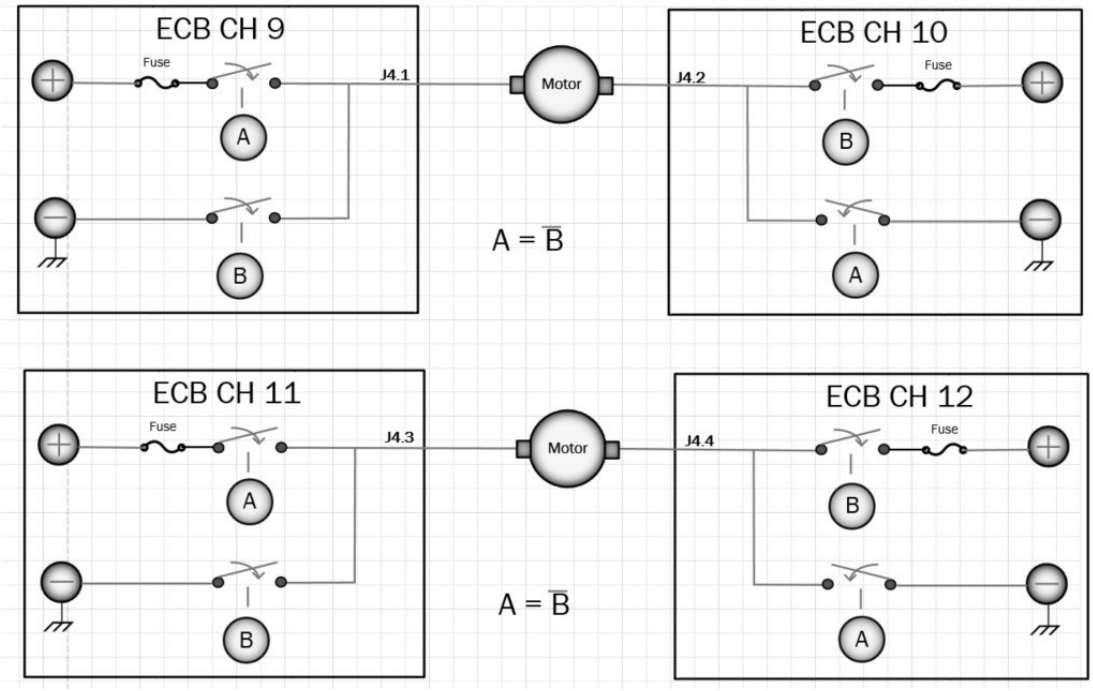
Reversible Motor Breaker Channels

As noted above, ECB channels 9-12 can be operated as reversible motor drive channels. The proper configuration for this type of operation is as shown below. ECB channels 9-10 can form one reversible motor pair, and ECB channels 11-12 can form another. No other ECB channels can be used this way.

CAUTION: There is no current protection in the low-side path to ground. A drive channel must always include both high-side and low-side drivers for circuit breaker protection.

CAUTION: When configured as reversible motor drive channels, the channels should be configured as one of the following to prevent a motor from running continually:

- Discrete input connected to a limit switch to turn the channel off upon reaching the limit
- Set Sequencer Time On to a finite value to turn the channel off after a selected period.


ECB CH 9
Fuse
J4.1
A
B
Motor
A = B
ECB CH 10
J4.2
Fuse
B
A
ECB CH 11
Fuse
J4.3
A
B
Motor
A = B
ECB CH 12
J4.4
Fuse
B
A

Analog Inputs

12 Analog inputs on the J1 connector can range from 0-28VDC, with a bandwidth of <100Hz. See Tables 1 and 2 below. The system response to the analog inputs is configured through the VeeConnect Display.

Discrete Inputs

12 Discrete Inputs on the J1 connector are configured as Open/Ground inputs, with OPEN being the inactive state and GROUND being the active state. The system response to the discrete inputs is configured through the VeeConnect Display.

Battery/Ignition Switch Input

The ECBU has an Ignition Switch Input which is intended to be driven high by the ignition aux power tap. A 12V BUS voltage on this input will wake the ECBU up from low quiescent power mode. Turning the ignition switch off shuts the ECBU system down.

Manual Interface

The ECBU Breaker has a manual interface on the enclosure consisting of:

- A Manual Override Switch that is used to toggle each ECB channel ON and OFF by momentarily pressing the membrane switch.
- A green BREAKER ON indicator, indicating that an ECB is ON. This is a hardware indication, which is controlled without the use of the system firmware.
- A red TRIPPED LED, which indicates that an ECB is TRIPPED or otherwise disabled. This indication IS generated and controlled by the system firmware.
- Green INPUT POWER LED, which indicates that the ECBU is connected to battery power greater than 5.2VDC.
- Green NMEA STATUS LED, which indicates activity on the NMEA 2000 bus.

Digital Communications Interfaces

The system includes the following digital communications interfaces:

- A USB port is provided for maintenance access, for updating the system firmware, for loading configuration databases, and for saving configuration database. This port can also source up to 500mA for charging USB devices.
- A NMEA 2000 port is provided to allow this system to communicate with the VeeConnect Display.

NMEA 2000 – VeeConnect Interface

The ECBU includes a NMEA 2000 interface that is designed to be used with the VeeConnect T5 or T7i Display. The ECBU is configured by the Display via the NMEA 2000 interface, and its configuration is stored by the ECBU.

For further information on VeeConnect Display's, refer to https://www.veeconnect.info

Connector Pin Diagrams

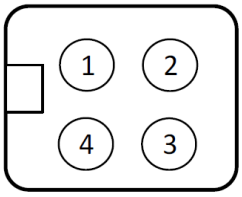
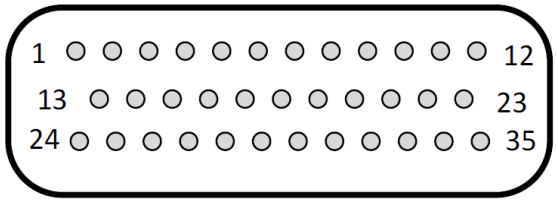
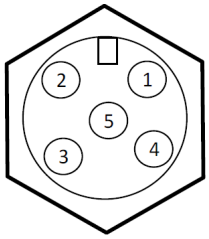
Connector	Pinout (Front View)	Mating Connector Part Number
BREAKER OUTPUTS		TE CONNECTIVITY PN DTP06-4S-E004
GPIO INTERFACE		TE CONNECTIVITY PN 776164-1
NMEA 2000		NMEA 2000 COMPLIANT

Table 1 – Connector Pin Diagrams

Connector Pin Descriptions:

Connector J1 - GPIO INTERFACE (Recommend 16-20AWG wire)

Pin	Function	Pin	Function	Pin	Function
1	GP DISCRETE INPUT #1	13	GP DISCRETE INPUT #2	24	GP DISCRETE INPUT #3
2	GP DISCRETE INPUT #4	14	GP DISCRETE INPUT #5	25	GP DISCRETE INPUT #6
3	POWER GROUND	15	GP DISCRETE INPUT #7	26	POWER GROUND
4	GP DISCRETE INPUT #8	16	GP DISCRETE INPUT #10	27	GP DISCRETE INPUT #9
5	GP DISCRETE INPUT #11	17	NOT CONNECTED	28	GP DISCRETE INPUT #12
6	28V OUTPUT FOR IGNITION SWITCH	18	NOT CONNECTED	29	IGNITION SWITCH INPUT
7	NOT CONNECTED	19	GP ANALOG INPUT #1	30	SIGNAL GROUND
8	GP ANALOG INPUT #2	20	SIGNAL GROUND	31	GP ANALOG INPUT #3
9	NOT CONNECTED	21	GP ANALOG INPUT #4	32	GP ANALOG INPUT #6
10	GP ANALOG INPUT #5	22	GP ANALOG INPUT #7	33	SIGNAL GROUND
11	GP ANALOG INPUT #8	23	GP ANALOG INPUT #10	34	GP ANALOG INPUT #9
12	GP ANALOG INPUT #11			35	GP ANALOG INPUT #12

Table 2 – J1 Input Connector Pinout

Connector J2-J4 - BREAKER CHANNEL OUTPUT (Recommend 10-14AWG wire)

J2 – CHANNELS 1-4		J3 – CHANNELS 5-8		J4 – CHANNELS 9-12	
Pin	Function	Pin	Function	Pin	Function
1	BREAKER CHANNEL 1	1	BREAKER CHANNEL 5	1	BREAKER CHANNEL 9
2	BREAKER CHANNEL 2	2	BREAKER CHANNEL 6	2	BREAKER CHANNEL 10
3	BREAKER CHANNEL 3	3	BREAKER CHANNEL 7	3	BREAKER CHANNEL 11
4	BREAKER CHANNEL 4	4	BREAKER CHANNEL 8	4	BREAKER CHANNEL 12

Table 3 – J2-J4 Breaker Channel Connector Pinouts

Connector J7 - NMEA 2000 CONNECTOR

Pin	Function
1	CABLE SHIELD (SHIELD)
2	OPEN (NET-S)
3	GROUND (NET-C)
4	CAN_HIGH (NET-H)
5	CAN_LO (NET-L)

Table 4 –J7 NMEA 2000 Connector Pinout

Fault Codes

Code	Trip Cause	Comments
FT	Fast Trip	Circuit breaker channel has hard short
I2	I2T Trip	Circuit breaker channel has soft fault
FO	Fail Open	Circuit breaker switch failed open circuit
FS	Fail Short	Circuit breaker switch failed short

ECBU Fault Indications (Red LEDs)

Red LEDs	Indication	Comments
All On	Process Not Running	
ECB Channel x On	FT or I2	ECB channel tripped; ECB channel x LED continuously illuminated
ECB Channel x Flash @2 Hz	FO or FS	ECB channel tripped; channel x LED flashes This condition will usually mean that the breaker is unresponsive to the override switches and the green LED will either remain on or off depending on the fault.
All three of these Analog subsystem faults are reported via unique blink codes using the red LEDs. One or more blink codes are displayed on those LEDs which are not indicating a trip or ECB fault. Blink codes are indicated by some number of fast blinks followed by an off period. The system cycles through the blink code for each fault which is present. If all three faults are present there will be a sequence of xix blinks and three pause, as in: blink - pause - blink blink - pause, blink, blink, blink - pause, which then repeats.		
Single Blink – Pause – Repeat	Voltage Monitor fault	If the voltage monitor inputs cannot be read, the ECB fault detection described in the previous paragraph is disabled. Voltage will continue to be reported on the NMEA bus but it may be incorrect. Blink followed by an off period Analog subsystem fault – vSense
Two Blinks – Pause – Repeat	Current Monitor fault	If the current monitor inputs cannot be read the I2T trip detection is disabled. Current will continue to be reported on the NMEA bus but it may be incorrect. Blinks followed by an off period Analog subsystem fault - iSense
Three Blinks – Pause – Repeat	Analog GPI fault	If the analog GPIs cannot be read, any actions programmed in the Configuration Data Base based on analog GPIs are disabled. Blinks followed by an off period Analog subsystem fault – gpi inputs

Installing ECBU Software

USB Flash Drive Requirements – 512 Byte Sectors

The ECBU software is loaded per the following:

1. Copy Ecbu.bin to the root directory of the USB Flash Drive
2. Install USB Flash Drive
3. Power On ECBU
4. Red LEDs 2 and 3 turn On
5. Red LED 4 turns On when the software is installed
6. Remove USB Flash Drive
7. Cycle power
8. Red LEDs 1 – 12 individually turn On then Off

ECBU Software

The ECBU software provides the control and status interface to to/from each ECBU channel. As described above, each of channels can be configured via the VeeConnect Display and is saved in EEPROM when changes are made.

The software stores specific data during a power down in EEPROM:

- Last State (Off, On, Faulted)
- Run-Time Statistics (Max Temperature, On Time and Max Current)

The ECBU will support the following features:

Soft Start/Stop

A Soft Start can be used for an ECB that needs to gradually reach its initial operating state. For a PWM-enabled ECB, the output will be slowly ramped up, using the ramp time, from 0% to 100% duty cycle. This is used to avoid startup stress and surges (inrush current) by providing the capability to control supplied voltage. For Soft Stop, the ECB output will be ramped down from the current ECB PWM state to 0% using the ramp time.

Coordinated ECB Control

ECBs are typically individually controllable, but may be grouped to form a Coordinated ECB. For a Coordinated ECB, ECBs are configured to operate as Primary and Secondary. The lower number ECB is configured as Primary, and the adjacent ECB(s) are configured as Secondary. For a Coordinated ECB, all ECBs are maintained with a single command.

An ECB can be configured to Trip when an adjacent ECB has tripped.

Sequencer Control

The Sequencer Control provides for programmable control of an individual ECB or Coordinated ECB. This provides for arbitrary ensemble behavior of an individual ECB or Coordinated ECB.

Examples of such behavior include blower timer, and time sequencing (recirculation pumps in live wells).

The Sequencer is triggered when the primary is turned on, and is disabled when the primary is turned off.

Inhibit Fail Short Fault

The software may need to inhibit Fail Short fault reporting for an ECB that is Off, but voltage is detected. This is applicable for ECBs 5 - 7, (e.g., Bilge Pump on a float switch) where voltage may be back feed from an outside source. This prevents a false positive fault report for those items that may have back fed voltage on the line.

Copy Configuration Database to USB Drive

The Display can issue a request message to the ECBU to save its configuration Database to a USB Flash drive.

ECBU Configuration Database

The ECBU configuration database can be modified via the Veethree Display. The default configuration for each of the 12 ECBs is set as follows:

Parameter	Valid Values	Default Value	Comments
Programmed Rating	2 - 20 A	2	
Power-Up Default State	Last State (prior to Power Down) Off On	Last State	
Switch Control	Digital (CAN) Discrete Input Analog Input	Digital (CAN)	
Assigned Discrete Input (DI)/Analog Input (AI)	0 - 12	0	
ECB State when DI/AI Active	Off On	Off	
PWM Enable	Disabled Enabled	Disabled	
AI Trigger Point	0 - 12V	0	
AI Release Point	0 - 12V	0	
ECB String #1	18 ASCII characters	ECB #	
ECB String #2	10 ASCII characters	<Blank>	
ECB String #3	10 ASCII characters	<Blank>	
ECB String #4	10 ASCII characters	<Blank>	
Reversible Motor	False True	False	Channels 9-10, 11-12 support Reversible Motor
Inhibit Fail Short	Not Inhibited Inhibited	Not Inhibited	
Soft Start Enable	Disabled Enabled	Disabled	
Soft Ramp Time	0 - 255	0	0.1 Seconds
Soft Stop Enable	Disabled Enabled	Disabled	
Coordinated ECB Role	Primary Secondary	Primary	
Coordinated ECB Trip	Trip independently Trip as a set	Trip independently	Trip as a set is only valid for ECBs configured as Secondary
Sequencer Control Enable	Disabled On-Stay Off On-Off-Repeat	Disabled	
Sequencer Offset	0 - 255	0	Not set by the Display
Sequencer – Time On	0 - 255	0	Minutes
Sequencer – Time Off	0 - 255	0	Minutes

Also, the following is stored as part of the configuration:

- Device Instance
- Configuration Information (NMEA PGN 126998 Description Data)