AEM Performance Electronics
2205 W 126th Street, Unit A
Hawthorne, CA 90250

Phone (8am-5pm M-F PST): 310-484-2322
Fax: 310-484-0152
sales@aemev.com
tech@aemev.com

AEM EV
VCU300 Product Description

Revision C

AEM Performance Electronics
2205 W 126th Street, Unit A
Hawthorne, CA 90250

Phone (8am-5pm M-F PST): 310-484-2322
Fax: 310-484-0152
sales@aemev.com
tech@aemev.com

Revision History

Revision	Date	Change Description
A	6/20/2020	Initial Release
B	6/22/2020	PDU8-3 channel 3 should be Positive4 Contactor Driver PDU8-3 channel 8 should be Motor Oil Pump 2 Driver Move Postive1 Contactor Driver Lowside from K84 to A11 Add documentation for Orion BMS message 0x6B2
C	7/31/2020	Revise CAN network diagram

Cautions and Warnings

Working on tractive systems (which includes but is not limited to motor(s), inverter(s), high voltage battery packs and high voltage cables) requires special experience and training. AEM EV has implemented fault detection and failsafe logic into its vehicle control units ("VCU"), however this does not mean that your VCU installation will be safe or effective, or that your VCU installation will not interfere with other systems on your vehicle and create a hazardous situation. It is the responsibility of the installer to understand the implications of each stage of tractive system installation and testing and to recognize what might be unique about your application that presents potential hazards or safety issues – and it is the responsibility of the installer to solve or address any such hazards or issues.

The following list includes basic recommended practices. This is not a comprehensive list; as noted below, if you are not well-versed in the appropriate installation and testing procedures, you should refer the installation and calibration to a reputable installation facility or contact AEM EV for a referral in your area.

- When access is required near the battery pack, the cell segments must be separated by using an appropriate maintenance disconnect plug.
- When working on the battery pack or tractive system, safety gloves with side shields and appropriate insulated tools must be used.
- Always wear Class 0 gloves rated at 1000V with leather protectors.
- Only use CAT III rated digital multimeters (DMM) and test leads.
- When working on the battery pack or tractive system, work with one hand while keeping the other behind your back.
- During initial system power up and testing, the vehicle must be raised off the ground and supported appropriately. Wheels and tires should be removed.
- During the VCU firmware upgrade process, battery cell segments must be separated using an appropriate maintenance disconnect plug.
- Do not make calibration changes when the inverter pulse width modulation (PWM) is enabled.

USE THIS VCU WITH EXTREME CAUTION. MISUSE AND/OR IMPROPER INSTALLATION CAN CAUSE SIGNIFICANT DAMAGE TO YOUR VEHICLE AND PROPERTY BELONGING TO YOU OR OTHERS, AS WELL AS PERSONAL INJURY OR DEATH. IF YOU ARE NOT WELL VERSED IN THE INSTALLATION OF TRACTIVE SYSTEMS OR CONFIGURING THE CALIBRATIONS IN THE AEM EV VCU THAT ARE NECESSARY TO CONTROL THE VEHICLE, YOU SHOULD REFER THE INSTALLATION AND VCU

CALIBRATION TO A REPUTABLE INSTALLATION FACILITY, OR CONTACT AEM EV FOR A REFERRAL IN YOUR AREA. IT IS THE RESPONSIBILITY OF THE INSTALLER TO ULTIMATELY CONFIRM THAT THE INSTALLATION AND CALIBRATIONS ARE SAFE FOR ITS INTENDED USE.

ADVANCED ENGINE MANAGEMENT CO., INC. ("AEM") AND ITS AFFILIATES, SHAREHOLDERS, DIRECTORS, OFFICERS, AGENTS, REPRESENTATIVES, SUCCESSORS AND ASSIGNS (COLLECTIVELY, THE "AEM PARTIES") HOLD NO RESPONSIBILITY FOR ANY DAMAGE OR INJURY THAT RESULTS FROM INSTALLATION OR MISUSE OF ANY AEM PRODUCTS. EXCEPT FOR, TO THE EXTENT APPLICABLE TO THE PRODUCTS YOU HAVE PURCHASED, AEM'S 12 MONTH LIMITED WARRANTY (WHICH CAN BE FOUND AT https://www.aemelectronics.com/about-us/warranty-returns), ALL AEM PRODUCTS ARE PROVIDED "AS IS" AND THE AEM PARTIES EXPRESSLY DISCLAIM ALL WARRANTIES, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHERWISE. THE AEM PARTIES SPECIFICALLY DISCLAIM ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND ALL WARRANTIES ARISING FROM COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OR TRADE PRACTICE.
UNDER NO CIRCUMSTANCES SHALL ANY AEM PARTY BE LIABLE TO YOU OR ANY OTHER PERSON OR ENTITY FOR ANY DAMAGES OF ANY AMOUNT OR CHARACTER (INCLUDING, WITHOUT LIMITATION, ANY GENERAL, INDIRECT, SPECIAL, INCIDENTAL, EXEMPLARY, CONSEQUENTIAL OR PUNITIVE DAMAGES) ARISING OUT OF, RELATED TO, OR IN CONNECTION WITH (1) YOUR INSTALLATION OF ANY AEM PRODUCTS OR (2) YOUR MISUSE OF ANY AEM PRODUCTS. IN NO EVENT SHALL ANY AEM PARTY BE LIABLE TO YOU OR ANY OTHER PERSON OR ENTITY FOR ANY LOST OR CORRUPTED DATA, LOST PROFITS, LOST REVENUES, LOSS OF USE, DIMINUTION IN VALUE, LOSS OF OTHER INTANGIBLES OR ANY SPECIAL, INCIDENTAL, INDIRECT, EXEMPLARY, PUNITIVE OR CONSEQUENTIAL DAMAGES, WHETHER ARISING OUT OF BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, REGARDLESS OF WHETHER SUCH DAMAGES WERE FORESEEABLE AND WHETHER OR NOT THE AEM PARTIES WERE ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. SOME JURISDICTIONS MAY NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE EXCLUSIONS SHALL ONLY APPLY TO THE EXTENT PERMISSIBLE UNDER APPLICABLE LAW.

Electrical Safety Insulation Monitoring

The high voltage system in an electric vehicle is designed to be ungrounded (floating) with respect to the vehicle chassis (frame). Insulation faults can cause electric shock, personal injury and even death. An insulation monitoring device (IMD) must be used to protect against these faults. See Bender https://www.benderinc.com/ for more information.

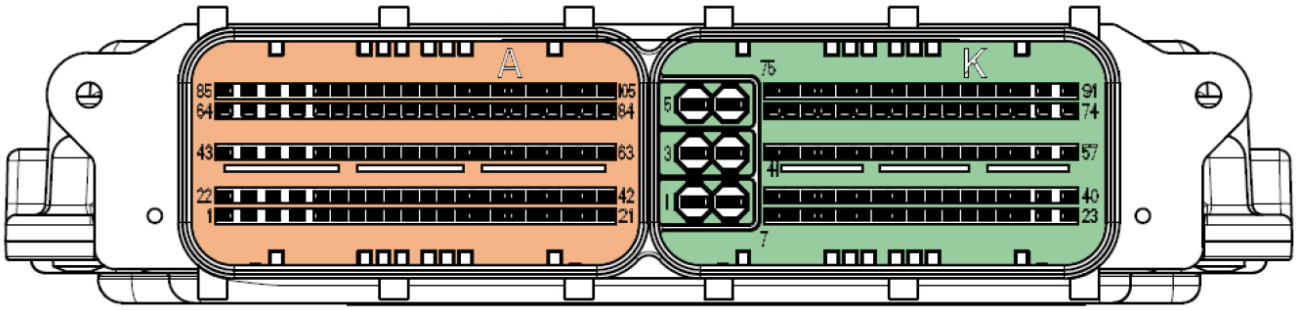
AEM Performance Electronics
2205 W 126th Street, Unit A
Hawthorne, CA 90250

Phone (8am-5pm M-F PST): 310-484-2322
Fax: 310-484-0152
sales@aemev.com
tech@aemev.com

Hardware Overview

AEM Part Number	30-8100
Microprocessor	Infineon Tricore TC1793
Clock Speed	200/260 MHz
Environmental	IP6k9k Compliant
Operating Temperature	-40°C to +105°C
Operating Voltage	9 – 16V 16V is the absolute maximum rating. ***The module is not designed for use with 16V battery systems as they typically require ~18V to charge.***
Overvoltage Protection	38.5V
Current Draw: Off-State Current	8.4 mA
Reverse Polarity Supply Voltage	13.5V for 5 min
Wake Switch Power-on threshold	4.13V minimum
Wake Switch Power-off threshold	3.61V maximum
Load dump protection	Load dump on the 12V supply lines must be less than 36V
Main Relay	A VCU controlled main relay is required. Main relay must be source for loads driven by lowside drivers.
Communication Channels	CAN1, 500k, NOT internally terminated, PC Comms
	CAN2, 500k, Internally Terminated, Peripheral Device Comms
	CAN3, 500k, NOT internally terminated, Peripheral Device Comms and Data Transmit
Internal Logging Memory	**None** - External logging possible with AEM Dash units with logging capability and other compatible 3rd party displays and data loggers.

Hardware Pinout



Pin #	Pin Function	Range	Conditioning	Type	Application Notes
A1	Inverter2 12V Power Relay Driver			Low Side	2.2A max
A2	Inverter3 12V Power Relay Driver			Low Side	2.2A max
A3	Output 9			Low Side	4.0A max, RESERVED
A4	Output 21			Low Side	3.0A max, RESERVED
A5	NOT USED				
A6	NOT USED				
A7	NOT USED				
A8	NOT USED				

Pin #	Pin Function	Range	Conditioning	Type	Application Notes
A9	Inverter4 12V Power Relay Driver			Low Side	2.2A max
A10	Pre-Charge1 Contactor Driver			Low Side	2.2A max
A11	Positive1 Contactor Driver			Low Side	2.2A max
A12	Sensor Return				Analog Sensor Ground
A13	NOT USED				
A14	NOT USED				
A15	Sensor Power1			5V Supply	150mA max *shared with A58, K67, K85*
A16	Enable Switch	0 – 5V	2.15k Pullup	Analog	Switch to ground
A17	Cooling Fan Override Switch	0 – 5V	2.15k Pullup	Analog	Switch to ground
A18	Wheelie Bar Pressure 1	0 – 5V	422k Pulldown	Analog	
A19	Accessory Lighting Switch	0 – 5V	681k Pullup	Analog	Switch to ground
A20	Sensor Power2			5V Supply	150mA max *shared with A21, K66*
A21	Sensor Power2			5V Supply	150mA max *shared with A20, K66*
A22	Output 12			Low Side	4.0A max, RESERVED
A23	HVIL Main Output			Low Side	3.0A max, 100 Hz, 50% DC
A24	Pre-Charge2 Contactor Driver			Low Side	2.2A max
A25	Output 29			Low Side	2.2A max, RESERVED
A26	NOT USED				
A27	NOT USED				
A28	NOT USED				
A29	NOT USED				
A30	NOT USED				
A31	Positive3 Contactor Driver			Low Side	2.2A max
A32	NOT USED				
A33	Cooling Fan 2 Relay Driver			Low Side	2.2A max
A34	NOT USED				
A35	HVIL Main Input			Frequency	300 Hz max
A36	Sensor Ground				Digital Sensor Ground
A37	Negative Contactor Feedback	0 – 5V	681k Pullup	Analog	Switch to ground
A38	Ignition Switch	0 – 5V	681k Pullup	Analog	Switch to ground
A39	Sensor Return				Analog Sensor Ground
A40	Logging Switch	0 – 5V	4.64k Pullup	Analog	Switch to ground
A41	Drive Switch	0 – 5V	681k Pullup	Analog	Switch to ground
A42	Cooling Pump Override Switch	0 – 5V	681k Pullup	Analog	Switch to ground
A43	Output 54			H-Bridge	2.5A max, RESERVED
A44	Output 55			H-Bridge	2.5A max, RESERVED
A45	Output 10			Low Side	3.0A max, RESERVED
A46	Pre-Charge3 Contactor Driver			Low Side	2.2A max
A47	NOT USED				
A48	NOT USED				
A49	NOT USED				

Pin #	Pin Function	Range	Conditioning	Type	Application Notes
A50	NOT USED				
A51	NOT USED				
A52	NOT USED				
A53	NOT USED				
A54	Pre-Charge4 Contactor Driver			Low Side	2.2A max
A55	Park Switch	0 – 5V	681k Pullup	Analog	Switch to ground
A56	Sensor Return				Analog Sensor Ground
A57	Input 33		1.3k Pulldown	Digital	RESERVED
A58	Sensor Power1			5V Supply	150mA max *shared with A15, K67, K85*
A59	Wheelie Bar Pressure 2	0 – 5V	422k Pulldown	Analog	
A60	Sensor Return				Analog Sensor Ground
A61	Sensor Return				Analog Sensor Ground
A62	Input 13	0 – 5V	2.15k PU/31.6k PD	Analog	RESERVED
A63	Sensor Return				Analog Sensor Ground
A64	Output 52			H-Bridge	2.5A max, RESERVED
A65	Output 53			H-Bridge	2.5A max, RESERVED
A66	Output 50			H-Bridge	2.5A max, RESERVED
A67	Output 51			H-Bridge	2.5A max, RESERVED
A68	NOT USED				
A69	NOT USED				
A70	NOT USED				
A71	NOT USED				
A72	NOT USED				
A73	NOT USED				
A74	NOT USED				
A75	High Voltage Safety Light Driver			Low Side	2.2A max
A76	Sensor Ground				Digital Sensor Ground
A77	NOT USED				
A78	NOT USED				
A79	NOT USED				
A80	NOT USED				
A81	Sensor Return				Analog Sensor Ground
A82	Reverse Switch	0 – 5V	681k Pullup	Analog	Switch to ground
A83	Sensor Power3			5V Supply	150mA max *shared with A104, K83*
A84	Input 15	0 – 5V	2.15k PU/31.6k PD	Analog	RESERVED
A85	NOT USED				
A86	NOT USED				
A87	NOT USED				
A88	NOT USED				
A89	NOT USED				
A90	NOT USED				
A91	NOT USED				
A92	NOT USED				

Pin #	Pin Function	Range	Conditioning	Type	Application Notes
A93	HVIL Charge Output			Low Side	3.0A max, 100 Hz, 50% DC
A94	Negative Contactor Driver			Low Side	2.2A max
A95	NOT USED				
A96	Sensor Ground				Digital Sensor Ground
A97	Input 16	0 – 5V	4.64k Pullup	Analog	RESERVED
A98	NOT USED				
A99	NOT USED				
A100	NOT USED				
A101	NOT USED				
A102	Manual Regen 1 Input	0 – 5V	422k Pulldown	Analog	
A103	Manual Regen 2 Input	0 – 5V	422k Pulldown	Analog	
A104	Sensor Power3			5V Supply	150mA max *shared with A83, K83*
A105	Input 19	0 – 5V	2.15k Pullup	Analog	RESERVED
K1	Battery Ground 1				12V Battery Ground
K2	Battery Ground 2				12V Battery Ground
K3	Main Relay Power 1				Must be switch battery power from VCU controlled main relay
K4	Battery Ground 3				12V Battery Ground
K5	Main Relay Power 2				Must be switch battery power from VCU controlled main relay
K6	Main Relay Power 3				Must be switch battery power from VCU controlled main relay
K7	NOT USED				
K8	NOT USED				
K9	NOT USED				
K10	NOT USED				
K11	Neutral Switch	0 – 5V	681k Pullup to Batt	Analog	Switch to ground
K12	BMS Charge Command			Low Side	2.2A max
K13	Coolant Temperature 2	0 – 5V	2.15k Pullup	Analog	
K14	NOT USED				
K15	Sensor Ground				Digital Sensor Ground
K16	Head Light Switch		1.3k Pullup to Batt	Digital	Switch to ground
K17	Trans Brake Switch		1.18k Pullup to 5V	Digital	Switch to ground
K18	HVIL Charge Input		1.47k Pullup to 6V	Digital	33 kHz max
K19	BMS Discharge Command			Low Side	0.6A max
K20	Output 35			Low Side	2.2A max, RESERVED
K21	Output 36			Low Side	0.5A max, RESERVED
K22	NOT USED				
K23	NOT USED				
K24	NOT USED				

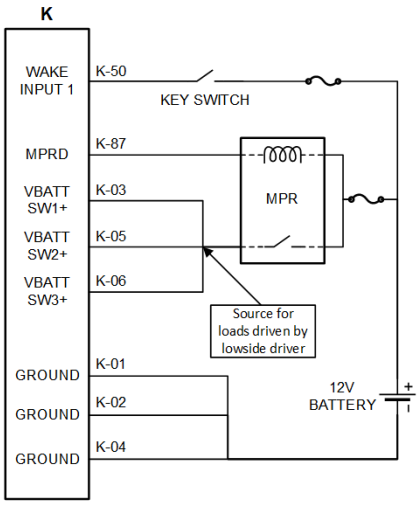
Pin #	Pin Function	Range	Conditioning	Type	Application Notes
K25	NOT USED				
K26	NOT USED				
K27	NOT USED				
K28	Line Lock Switch		1.3k Pullup to Batt	Digital	Switch to ground
K29	Input 43		1.3k Pulldown	Digital	300 Hz max, RESERVED
K30	Brake Switch 1	0 – 5V	2.15k Pullup	Analog	Switch to ground
K31	Sensor Return				Analog Sensor Ground
K32	Sensor Ground				Digital Sensor Ground
K33	Park Lamp Switch		1.3k Pullup to Batt	Digital	Switch to ground
K34	Transmission Pressure	0 – 5V	56.7k Pulldown	Analog	
K35	Brake Pressure	0 – 5V	56.7k Pulldown	Analog	
K36	Output 37			Low Side	2.2A max, RESERVED
K37	Positive4 Contactor Driver			Low Side	2.2A max
K38	Output 38			Low Side	2.2A max, RESERVED
K39	Output 39			Low Side	2.2A max, RESERVED
K40	NOT USED				
K41	Input 31	0 – 5V	None	Analog	RESERVED
K42	Coolant Temperature 1	0 – 5V	2.15k Pullup	Analog	
K43	Sensor Return				Analog Sensor Ground
K44	Sensor Return				Analog Sensor Ground
K45	Start Switch	0 – 5V	681k Pullup	Analog	Switch to ground
K46	Sensor Ground				Digital Sensor Ground
K47	IMD Input		1.3k Pulldown	Digital	
K48	Non-Driven Wheel Speed		2.6k Pullup to 5V	Digital	15 kHz max
K49	Brake Switch 2		1.3k Pulldown	Digital	
K50	Wake Input 1	0 – 12V	2.9k Pulldown	Digital	Switch to Batt, 12V = ON
K51	Input 27	0 – 5V	2.15k Pullup	Analog	RESERVED
K52	Driveshaft Speed/Driven Wheel Speed		1.47k Pullup	Digital	33 kHz max
K53	NOT USED				
K54	Output 40			Low Side	0.6A max, RESERVED
K55	Oil Pump 1 Driver			Low Side	2.2A max
K56	Oil Pump 2 Driver			Low Side	2.2A max
K57	Output 11			Low Side	3.0A max. RESERVED
K58	Transmission Temperature	0 – 5V	2.16k Pullup	Analog	
K59	Output 43			Low Side	0.6A max, RESERVED
K60	CAN2 +				Peripheral Comms
K61	CAN2 -				Peripheral Comms
K62	CAN1 +				PC Comms
K63	CAN1 -				PC Comms
K64	Sensor Return				Analog Sensor Ground
K65	Accel Pedal 1	0 – 5V	215k Pulldown	Analog	
K66	Sensor Power2			5V Supply	150mA max *shared with A20, A21*

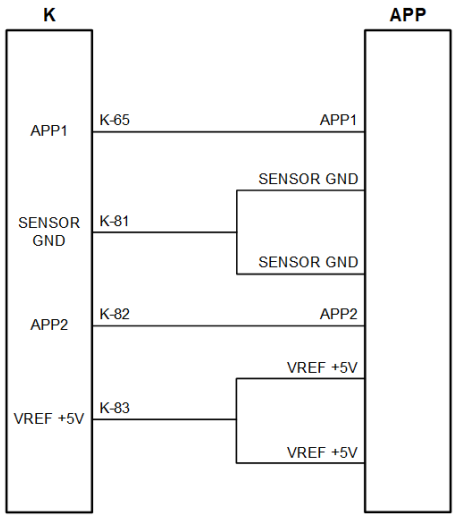
Pin #	Pin Function	Range	Conditioning	Type	Application Notes
K67	Sensor Power1			5V Supply	150mA max *shared with A15, A58, K85*
K68	LIN				RESERVED
K69	Output 44			Low Side	0.6A max, RESERVED
K70	Output 45			Low Side	0.6A max, RESERVED
K71	Output 46			Low Side	2.2A max, RESERVED
K72	Cooling Fan 1 Relay Driver			Low Side	2.2A max
K73	Inverter1 12V Power Relay Driver			Low Side	2.2A max
K74	NOT USED				
K75	Input 32	0 – 5V	None	Analog	RESERVED
K76	Sensor Return				Analog Sensor Ground
K77	CAN3 +				Peripheral Comms and Data Transmit
K78	CAN3 -				Peripheral Comms and Data Transmit
K79	CAN1 +				Internally connected to K62
K80	CAN1 -				Internally connected to K63
K81	Sensor Return				Analog Sensor Ground
K82	Accel Pedal 2	0 – 5V	215k Pulldown	Analog	
K83	Sensor Power3			5V Supply	150mA max *shared with A83, A104*
K84	Output 7			Low Side	2.2A max, RESERVED
K85	Sensor Power1			5V Supply	150mA max *shared with A15, A58, K67*
K86	NOT USED				
K87	Main Relay Driver			Low Side	350 mA max
K88	Positive2 Contactor Driver			Low Side	2.2A max
K89	Cooling Pump Wake			High Side	0.4A max
K90	NOT USED				
K91	NOT USED				

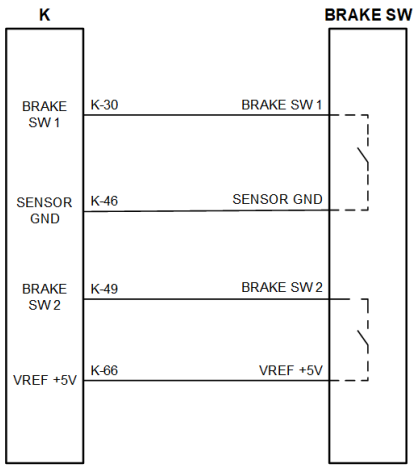
AEM Performance Electronics
2205 W 126th Street, Unit A
Hawthorne, CA 90250

Phone (8am-5pm M-F PST): 310-484-2322
Fax: 310-484-0152
sales@aemev.com
tech@aemev.com

Minimum Required Inputs

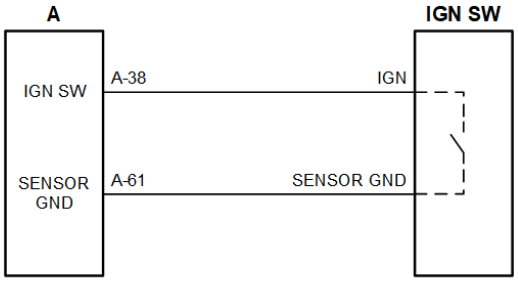


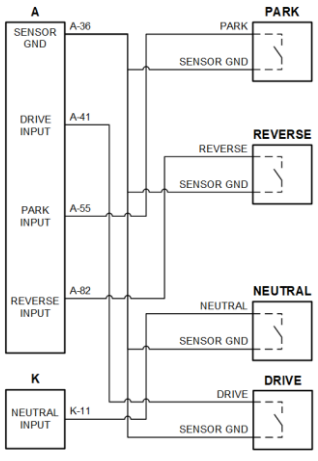




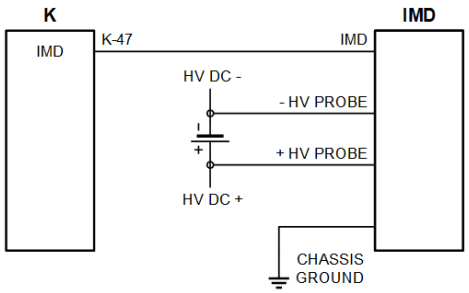
Signal polarity selectable to support both N.O. and N.C. switches

Choice between AND or OR logic





PRND CAN Keypad option for direct drive applications



Firmware Programming Notes

- The VCU must be power cycled after programming to enable CAN 2 and CAN 3.
- Pin K14 must NOT be grounded during firmware programming.

Power and Calibration Storage

The VCU must be connected to switched battery power via a main power relay. The relay primary coil ground must be connected to pin K87. The relay is controlled by the VCU and is NOT user programmable. At key off (Wake Input 1, pin K50 low), the VCU will store calibration data. During this time, the main relay will remain on. Calibration storage may take up to 15 seconds after which the main relay will automatically turn off. Removing all battery power during this time can result in calibration memory corruption. DO NOT REMOVE ALL BATTERY POWER UNTIL THE MAIN RELAY TURNS OFF. Wait at least 30 seconds.

AEM PDU-8 Support

The VCU300 currently supports interfaces with up to four (4) AEM 30-8300 PDU-8 Power Distribution Units. The PDU-8 is a high current, lightweight module that is designed to be mounted near the devices requiring power. Its design philosophy is for multiple units to be part of a vehicle installation and to distribute the power throughout the vehicle rather than having it concentrated in a central area.

The PDU-8 is not a stand-alone device. It is designed to be operated as a satellite unit and controlled via CAN by either an AEM Vehicle Control Unit or a programmable 3rd party device that can generate the required CAN control messages. As such, the PDU-8 module itself is not programmable in any way and only carries out commands issued by other devices. When used with the VCU300, the function assignments are not configurable by the end user.

Specific PDU's are identified by grounding different combinations of configuration pins on the PDU connector. For proper function with the VCU300, the PDU-8 units must be configured as follows.

Unit ID	Config 1, Pin 24	Config 2, Pin 16	Config 3, Pin 10	Tx Msg 1 Address	Tx Msg 2 Address	Rx Msg 1 Address	Rx Msg 2 Address
1	O/C	O/C	O/C	0x000A0610	0x000A0611	0x000A0620	0x000A0630
2	Gnd	O/C	O/C	0x000A0612	0x000A0613	0x000A0621	0x000A0631
3	O/C	Gnd	O/C	0x000A0614	0x000A0615	0x000A0622	0x000A0632
4	Gnd	Gnd	O/C	0x000A0616	0x000A0617	0x000A0623	0x000A0633

AEM PDU-8 / VCU Functional Pin Assignments

Unit ID 1

Pin	PDU Pin Name	VCU Function	Notes
1	High Side Driver 1	Negative Contactor Driver	20 Amp Max
2			
3	CAN-	VCU/PDU comms	Unterminated, VCU CAN2
4	CAN+	VCU/PDU comms	Unterminated, VCU CAN2
5	Ground		
6	High Side Driver 5	Peripheral switched 12V Supply Power (Inverter, Keypad, Dash)	20 Amp Max
7			
8	High Side Driver 2	Pre-Charge1 Contactor Driver	10 Amp Max
9			
10	Config 3	Leave unterminated	
11	Ground		

Pin	PDU Pin Name	VCU Function	Notes
12	High Side Driver 6	High Voltage Safety Light Driver	10 Amp Max
13			
14	High Side Driver 3	Positive1 Contactor Driver	10 Amp Max
15			
16	Config 2	Leave unterminated	
17	Not Used		
18	High Side Driver 7	Pre-Charge1 Contactor Driver	10 Amp Max
19			
20	High Side Driver 4	Cooling Pump 1 Power	20 Amp Max
21			
22	Not Used		
23	Not Used		
24	Config 1	Leave unterminated	
25	High Side Driver 8	Cooling Pump 1 Power	20 Amp Max
26			

Unit ID 2

Pin	PDU Pin Name	VCU Function	Notes
1	High Side Driver 1	Cooling Pump 2 Power	20 Amp Max
2			
3	CAN-	VCU/PDU comms	Unterminated, VCU CAN2
4	CAN+	VCU/PDU comms	Unterminated, VCU CAN2
5	Ground		
6	High Side Driver 5	Pre-Charge3 Contactor Driver	20 Amp Max
7			
8	High Side Driver 2	Pre-Charge2 Contactor Driver	10 Amp Max
9			
10	Config 3	Leave unterminated	
11	Ground		
12	High Side Driver 6	Cooling Pump Wake	10 Amp Max
13			
14	High Side Driver 3	Positive2 Contactor Driver	10 Amp Max
15			
16	Config 2	Leave unterminated	
17	Not Used		
18	High Side Driver 7	Cooling Pump Wake	10 Amp Max
19			
20	High Side Driver 4	Cooling Pump 2 Power	20 Amp Max
21			
22	Not Used		
23	Not Used		
24	Config 1	Ground for Unit ID 2	
25	High Side Driver 8	Positive3 Contactor Driver	20 Amp Max
26			

Unit ID 3

Pin	PDU Pin Name	VCU Function	Notes
1	High Side Driver 1	Cooling Fan 1 Power	20 Amp Max
2			
3	CAN-	VCU/PDU comms	Unterminated, VCU CAN2
4	CAN+	VCU/PDU comms	Unterminated, VCU CAN2
5	Ground		
6	High Side Driver 5	Motor Oil Pump 1	20 Amp Max
7			
8	High Side Driver 2	Pre-Charge4 Contactor Driver	10 Amp Max
9			
10	Config 3	Leave unterminated	
11	Ground		
12	High Side Driver 6	Trans Brake Solenoid Driver	10 Amp Max
13			
14	High Side Driver 3	Positive4 Contactor Driver	10 Amp Max
15			
16	Config 2	Ground for Unit ID 3	
17	Not Used		
18	High Side Driver 7	Line Lock Solenoid Driver	10 Amp Max
19			
20	High Side Driver 4	Cooling Fan 2 Power	20 Amp Max
21			
22	Not Used		
23	Not Used		
24	Config 1	Leave unterminated	
25	High Side Driver 8	Motor Oil Pump 2	20 Amp Max
26			

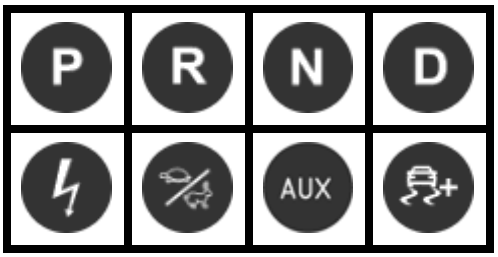
Unit ID 4

Pin	PDU Pin Name	VCU Function	Notes
1	High Side Driver 1	Head Lamps Driver	20 Amp Max
2			
3	CAN-	VCU/PDU comms	Unterminated, VCU CAN2
4	CAN+	VCU/PDU comms	Unterminated, VCU CAN2
5	Ground		
6	High Side Driver 5	Reverse Lamps Driver	20 Amp Max
7			
8	High Side Driver 2	Shift Solenoid Driver	10 Amp Max
9			
10	Config 3	Leave unterminated	
11	Ground		
12	High Side Driver 6	Auxiliary Power From Keypad	10 Amp Max
13			
14	High Side Driver 3	Accessory Lighting Driver	10 Amp Max

Pin	PDU Pin Name	VCU Function	Notes
15			
16	Config 2	Ground for Unit ID 4	
17	Not Used		
18	High Side Driver 7	RESERVED	10 Amp Max
19			
20	High Side Driver 4	Parking Lamps Driver	20 Amp Max
21			
22	Not Used		
23	Not Used		
24	Config 1	Ground for Unit ID 4	
25	High Side Driver 8	Brake Lamps Driver	20 Amp Max
26			

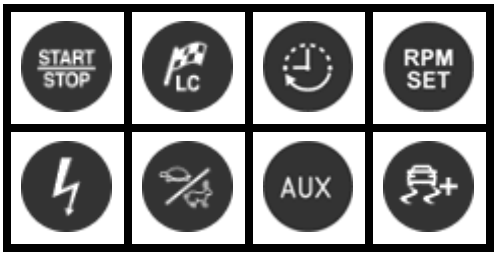
AEM 8-Button CAN Keypad Support

The VCU300 currently supports interfaces with the AEM 8-Button CAN Keypad for direct drive and indirect drive configurations.



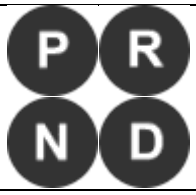
2x4 Keypad (AEM PN 30-8400)

DIRECT DRIVE CONFIG



2x4 Keypad (AEM PN 30-8400)

INDIRECT DRIVE CONFIG

Icon(s)	Function
	Direct Drive Park, Reverse, Neutral, Drive inputs Radio Button functionality
	GREEN = High Voltage Contactors Are Closed YELLOW = Pre-charge in process YELLOW = Discharge in process

	OFF = Contactors Open RED = ERROR – Pre-charge failed, Contactors are open
	Momentary start/stop (long hold)
	Performance Level Loop Toggle 1-4, on while pressed
	Launch TQ Multiplier Loop Toggle
	Launch TQ Time Loop Toggle
	Slip Target (reserved for future use) Loop Toggle
	Aux Function, latch on/off User programmable PDU output
	Launch RPM target Loop toggle

Keypad CAN Configuration:

VCU CAN Channel	CAN3
Baud Rate	500k

Supported Inverter Systems

The VCU300 currently supports all Cascadia Motion PM family inverters. This includes:

PM100 DX PM100 DXR PM100 DZ	PM150 DX PM150 DZ PM150 DZR	PM250 DX PM250 DZ PM250 DZR	PM500 DZ

Support for additional inverters will be added over time. Contact sales@aemev.com for more information.

Inverter CAN Configuration:

VCU CAN Channel	CAN2
Inverter1 Receive CAN ID	0x0C0 (standard)
Inverter2 Receive CAN ID	0x1C0 (standard)
Inverter3 Receive CAN ID	0x2C0 (standard)
Inverter4 Receive CAN ID	0x3C0 (standard)
Baud Rate	500k

Resolver Calibration Process

It is important to correctly complete the resolver calibration process before attempting to run the motor. The resolver calibration process will ensure that the motor and resolver are properly connected to the inverter. A description of this process is beyond the scope of this document. Cascadia Motion provides a detailed document describing this process.

CAN Controlled Cooling Pump Support

The VCU300 supports CAN interface with up to two (2) EMP WP29/32 Brushless Electric Water Pumps. The VCU includes a target motor speed table that allows the user to tailor the flow rate to their individual system requirements. For proper VCU control, the following requirements must be true.

Water Pump CAN Configuration:

VCU CAN Channel	CAN2
Pump1 Receive CAN ID	0x18EF20A3
Pump1 Transmit CAN ID	0x18FF0320
Pump2 Receive CAN ID	0x18EF8BA3
Pump2 Transmit CAN ID	0x18FF038B
Baud Rate	500k

BMS Support

A Battery Management System (BMS) is an electronic system that manages a rechargeable battery pack. When configured properly, it can protect the battery pack from unsafe operating conditions. A BMS can also communicate state variables, limit data and detailed information about individual cells.

When a BMS is used with the VCU300 the following features are possible:

- Inverter Pre-Charge using measured battery pack voltage as a reference
- Torque request deratings based on battery pack discharge/charge current limits, pack high temp, pack low temp, cell voltage min, cell voltage max, pack state of charge % (SOC) and overall pack voltage.

The VCU300 currently supports the following BMS systems:

- Orion BMS2
- Lithium Balance s-BMS

Most BMS systems are highly configurable. For the VCU300 to communicate with the BMS properly, the following CAN configurations are required:

Orion BMS2
VCU CAN channel: CAN 3
Message: 0x6B0
Byte Order: Motorola
Baud Rate: 500k

Signal	Start bit	Length [bit]	Value Type	Factor	Offset	Min	Max
Pack_Current	8	16	Signed	0.1	0	-32768	3276.7

Signal	Start bit	Length [bit]	Value Type	Factor	Offset	Min	Max
Pack_Inst_Voltage	24	16	Unsigned	0.1	0	0	6553.5
Pack_SOC	32	8	Unsigned	0.5	0	0	127.5
MPI2_State	40	1	Unsigned	1	0	0	1
MPI3_State	41	1	Unsigned	1	0	0	1
MPO2_State	43	1	Unsigned	1	0	0	1
MPO3_State	44	1	Unsigned	1	0	0	1
MPO4_State	45	1	Unsigned	1	0	0	1
MP_Enable_State	46	1	Unsigned	1	0	0	1
MPO1_State	47	1	Unsigned	1	0	0	1
Discharge_Relay_State	48	1	Unsigned	1	0	0	1
Charge_Relay_State	49	1	Unsigned	1	0	0	1
Charger_Safety_State	50	1	Unsigned	1	0	0	1
MIL_State	51	1	Unsigned	1	0	0	1
MPI1_State	52	1	Unsigned	1	0	0	1
AlwaysOn_State	53	1	Unsigned	1	0	0	1
Is_Ready_State	54	1	Unsigned	1	0	0	1
Is_Charging_State	55	1	Unsigned	1	0	0	1

Orion BMS2
VCU CAN channel: CAN 3
Message: 0x6B1
Byte Order: Motorola
Baud Rate: 500k

Signal	Start bit	Length [bit]	Value Type	Factor	Offset	Min	Max
Pack_DCL	8	16	Unsigned	1	0	0	65535
Pack_CCL	16	8	Unsigned	1	0	0	255
Pack_High_Temp	32	8	Signed	1	0	-128	127
Pack_Low_Temp	40	8	Signed	1	0	-128	127

Orion BMS2
VCU CAN channel: CAN 3
Message: 0x6B2
Byte Order: Motorola
Baud Rate: 500k

Signal	Start bit	Length [bit]	Value Type	Factor	Offset	Min	Max
Low_Cell_Voltage	8	16	Unsigned	0.0001	0	0	6.5535
High_Cell_Voltage	24	16	Unsigned	0.0001	0	0	6.5535

Lithium Balance sBMS
VCU CAN channel: CAN 3
Message: 0x500
Byte Order: Intel
Baud Rate: 500k

Signal	Start bit	Length [bit]	Value Type	Factor	Offset	Min	Max
BMS_Cell_Voltage_Avg	0	16	Unsigned	0.001	0	0	65.535
BMS_Cell_Voltage_Max	16	16	Unsigned	0.001	0	0	65.535
BMS_Cell_Voltage_Min	32	16	Unsigned	0.001	0	0	65.535
BMS_Cell_Voltage_Delta	48	16	Unsigned	0.001	0	0	65.535

Lithium Balance sBMS
Message: 0x501
Byte Order: Intel
Baud Rate: 500k

Signal	Start bit	Length [bit]	Value Type	Factor	Offset	Min	Max
BMS_Pack_Current	0	16	Signed	0.1	0	-3276.8	3276.7
BMS_Pack_Temp_High	16	8	Signed	1	0	-128	127
BMS_Pack_Temp_Low	24	8	Signed	1	0	-128	127
BMS_Pack_Voltage	32	16	Unsigned	0.1	0	0	6553.5
BMS_Pack-Sum_Cell_Voltage	48	16	Unsigned	1	0	0	65535

Lithium Balance sBMS
Message: 0x502
Byte Order: Intel
Baud Rate: 500k

Signal	Start bit	Length [bit]	Value Type	Factor	Offset	Min	Max
BMS_System_State	0	8	Unsigned	1	0	0	255
BMS_SOC	8	8	Unsigned	1	0	0	255
BMS_SOH	16	8	Unsigned	1	0	0	255

Smart Voltage/Current Sensor Support

The VCU300 supports the IVT-Series Current and Voltage sensors for battery management systems from Isabellenhutte. The IVT series are intelligent, digital voltage and current sensors with a CANbus 2.0 interface.

IVT CAN Configuration:

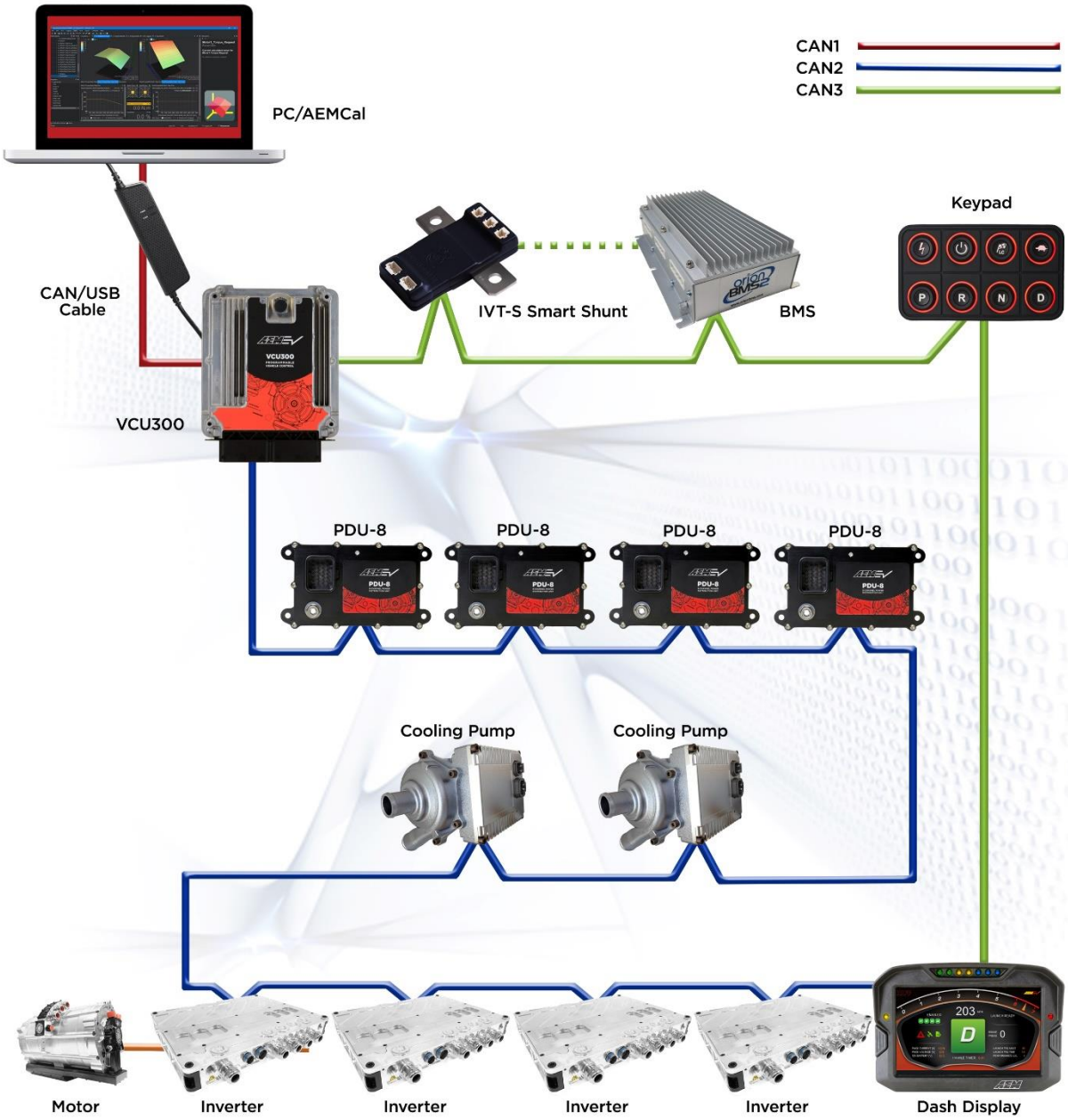
VCU CAN Channel	CAN3
Baud Rate	500k

CAN Network Requirements

The following diagram describes the basic network requirements. Three separate CAN networks are represented. The network channel assignment for each device is not reconfigurable by the end user. The VCU CAN 2 channel is internally terminated. CAN 1 and CAN 3 channels are not terminated at the VCU. All busses must be terminated with a 120 ohm resistor at the physical end. The VCU must be located at a physical end of the CAN 2 bus.

PERFORMANCE EV CONTROL SOLUTIONS

VCU300 CAN Networking



PC Communications with AEMCal

The VCU200 communicates with the PC over the CAN1 network. A CAN to USB converter device is required. For best performance, AEM recommends the Kvaser Leaf Light HS v2 https://www.kvaser.com/product/kvaser-leaf-light-hs-v2/