



# Power Distribution Panel

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## Distribute 12V power programmatically with current feedback

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### Features

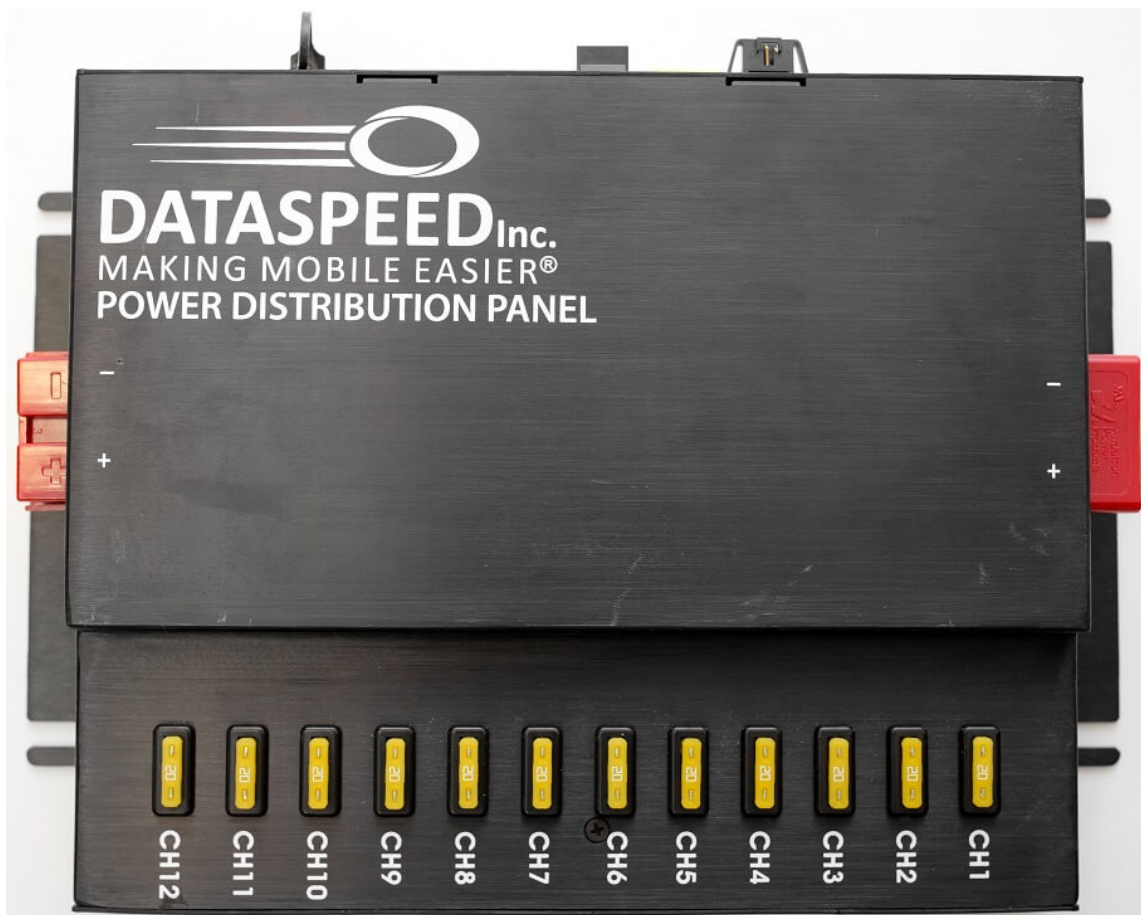
- 12 channels at 20A each
- Programmable startup and shutdown scripts
- Over-current feedback and diagnostics
- CAN, Ethernet, and USB communication
- Chain two units together for 24 channels

### Applications

- Driverless car research
- Advanced Driver Assist (ADAS) research

### Description

The Dataspeed Inc. Power Distribution System enables computer control of 12 fused power channels with programmable startup and shutdown sequences. Industry standard CAN, Ethernet, and USB communication interfaces.



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# Power Distribution Panel

## DISCLAIMER:

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## 1 Connector Pin Description

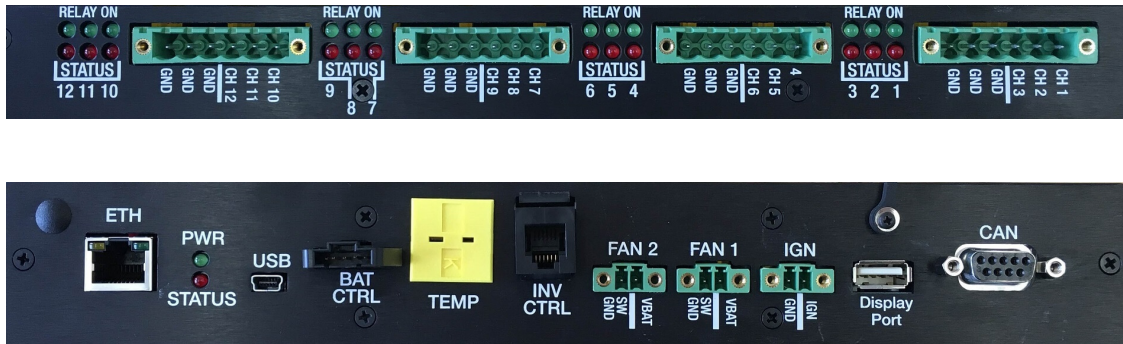


Table 1: Connector Description

Label	Manufacture	Mating P/N	Description
POWER	Anderson	6810G3-BK 1319G6	Power connector
CHx/GND	Phoenix	1805343	Channel outputs
CAN		DB9 Male	CAN and Ignition 1-2
Display Port		USB	Input for display
IGN	Phoenix	1827703	Ignition 3
FAN1 & FAN2	Phoenix	1827703	Fans
INV CTRL		RJ-11	Control lines to 110V AC power inverter
TEMP		Type-K	External Temperature thermocouple
BAT CTRL	Molex	50579405	Not used
USB		USB mini	USB mini
ETH		RJ45	Ethernet

## 1.1 CAN/DB9 Connector

The CAN/DB9 connector is used for CAN communication and to provide power.

Table 2: CAN/DB9 connector pin description.

Pin	Symbol	Description
1	NC	No Connect
2	CANL	CAN Low
3	GND	Ground
4	IGN1	Ignition 1
5	GND	Ground
6	GND	Ground
7	CANH	CAN High
8	IGN2	Ignition 2
9	POUT	Power Out (Switched VBat)

## 1.2 Display Port Connector

The Display Port connector is used to provide power and CAN communication to the touchscreen display. Note: This USB connector does not provide standard USB signals. Connecting a USB device may result in damage to your device.

Table 3: Display Port connector pin description.

Pin	Symbol	Description
1	POUT	Power Out (Switched VBat)
2	CANL	CAN Low
3	CANH	CAN High
4	GND	Ground

## 1.3 Ignition Connector

The Power Distribution System draws less than 0.2mA with ignition off. Applying voltage to any of the 3 ignition pins will power the device on. The startup and shutdown scripts will execute automatically in auto mode.

Table 4: Ignition connector pin description.

Pin	Symbol	Description
1	IGN3	Ignition 3
2	GND	Ground

## 1.4 Fan Connectors

Table 5: Fan connector pin description.

Pin	Symbol	Description
1	VBAT	Protected VBAT
2	SGND	Switched Ground

## 1.5 Inverter Remote

The inverter remote is used to control a Samlex Pure Sine Wave Inverter from the list of supported models below. The higher wattage models with an RJ50 connector require a special connector. Contact Dataspeed for more information.

Table 6: Supported Samlex part numbers

Model	Wattage	Voltage DC	Voltage AC	Connector
PST-600-12	600W	12V	120VAC	RJ11
PST-1000-12	1000W	12V	120VAC	RJ11
PST-1500-12	1500W	12V	120VAC	RJ50
PST-2000-12	2000W	12V	120VAC	RJ50
PST-60S-12E	600W	12V	230VAC	RJ11
PST-100S-12E	1000W	12V	230VAC	RJ11
PST-150S-12E	1500W	12V	230VAC	RJ50
PST-200S-12E	2000W	12V	230VAC	RJ50

## 1.6 Battery Control

This connector is not presently used.

## 1.7 USB Connector

The USB connector is used for introspection and firmware upgrade.

## 1.8 Ethernet Connector

The Ethernet connector supports 10/100 Mbit/s communication. The Ethernet protocol is Lightweight Communications and Marshalling (LCM).

## 2 Electrical Characteristics

Table 7: Electrical Characteristics.

Characteristic	Min	Typ	Max	Units	Conditions
VIGNITION ON	9	12	16	V	
VIGNITION OFF	-0.3	0	2	V	
VPOWER	9	12	16	V	
IPOWER		1500		mA	VPOWER=12V, VIGNITION>9V, all channels on
IPOWER		250		mA	VPOWER=12V, VIGNITION>9V, all channels off
IPOWER			0.2	mA	VPOWER=12V, VIGNITION<2V
ICHANNEL			20	A	Continuous for each channel
ITOTAL			120	A	Total current (device and all channels)
Temperature	-40		+85	°C	

Note: VIGNITION is the maximum of VIGN1,VIGN2,VIGN3

## 3 Mechanical Drawings

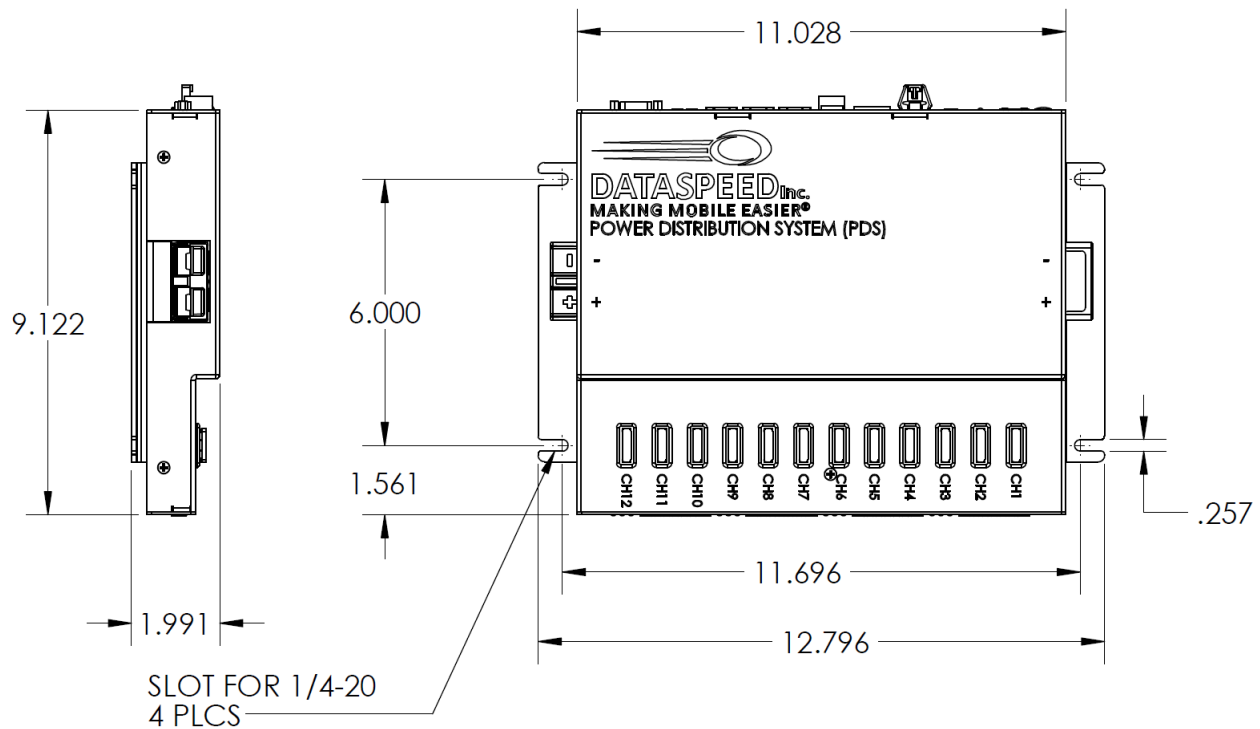


Figure 1: Mechanical Drawing

## 4 LEDs

### 4.1 Main

The power LED (green) indicates that power and ignition have been applied.  
The status LED (red) blinks at a frequency of 1Hz to indicate normal operation.

### 4.2 Channels

Each channel has a green and red LED.  
The green LED is driven with the relay. If this LED is on, the relay is on.  
The red LED indicates a fault status:

Table 8: Red LED status

Solid off	NORMAL	On and load is above 150mA
Solid on	NO LOAD	On and load is below 100mA
1 blink	BAD RELAY	Relay failed to contact
2 blinks	BAD FUSE	Fuse is blown
3 blinks	OVER CURRENT	Channel disabled to protect fuse

## 5 Modes

Mode AUTO uses all communication interfaces and automatically executes startup/shutdown scripts.  
Mode MANUAL uses all communication interfaces and automatically executes the shutdown script.  
Mode VALET only responds to USB. This is a lockout mode. Separate startup and shutdown scripts are executed.

Table 9: Mode Descriptions

Mode	USB	CAN	Ethernet	Bluetooth	Shutdown	Startup
AUTO	X	X	X	X	X	X
MANUAL	X	X	X	X	X	
VALET	X					

## 6 CAN Messages

Table 10: CAN bus configuration.

Parameter	Value	Units
Terminated	Yes	120Ω
BitRate	500	k
t <sub>q</sub>	200	ns
SyncSeg	1	t <sub>q</sub>
PropSeg	3	t <sub>q</sub>
PhaseSeg1	3	t <sub>q</sub>
PhaseSeg2	3	t <sub>q</sub>
SyncJumpWidth	2	t <sub>q</sub>

### 6.1 Request

Message ID: 0x410  
Receive Rate: On Event

Table 11: Request CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	INDEX							
1	15:8	REQUEST							

bit 0-7      **INDEX:** Channel Index  
              0 = Channel 1  
              1 = Channel 2  
              2 = Channel 3  
              ...  
              23 = Channel 24  
              —  
              48 = Inverter 1  
              49 = Inverter 2  
bit 8-15    **REQUEST:** Relay Request  
              0 = Off  
              1 = On  
              2 = Toggle



## 6.2 Mode

Message ID: 0x411  
Receive Rate: On Event

Table 12: Mode CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	MODE							

bit 0-7      **MODE:** Mode Request  
0 = Auto  
1 = Manual  
2 = Valet

## 6.3 Script

Message ID: 0x412  
Receive Rate: On Event

Table 13: Script CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	SCRIPT							

bit 0-7      **SCRIPT:** Script Request  
0 = None  
1 = Startup  
2 = Shutdown

## 6.4 Reserved

Message ID: 0x413  
Receive Rate: On Event

## 6.5 Reserved

Message ID: 0x430  
Transmit Rate: 200ms

## 6.6 Reserved

Message ID: 0x431  
Transmit Rate: On Event

## 6.7 Reserved

Message ID: 0x432  
Transmit Rate: 200ms

## 6.8 Status Master

Message ID: 0x420  
Transmit Rate: 50ms

Table 14: Status CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	INVERTER BITS				RESERVED			
1	15:8	SCRIPT				MODE			
2	23:16	STATUS2				STATUS1			
3	31:24	STATUS4				STATUS3			
4	39:32	STATUS6				STATUS5			
5	47:40	STATUS8				STATUS7			
6	55:48	STATUS10				STATUS9			
7	63:56	STATUS12				STATUS11			

bit 0-3	<b>RESERVED:</b>
bit 4	<b>INV-REQUEST:</b> Inverter request: 0 = Off, 1 = On
bit 5	<b>INV-STATUS:</b> Inverter status: 0 = Off, 1 = On
bit 6	<b>INV-OVERLOAD:</b> Inverter over-load: 0 = No Fault, 1 = Fault
bit 7	<b>INV-OVERTEMP:</b> Inverter over-temperature: 0 = No Fault, 1 = Fault
bit 8-11	<b>MODE:</b> Current mode 0 = Auto 1 = Manual 2 = Valet
bit 15-12	<b>SCRIPT:</b> Running script 0 = None 1 = Startup 2 = Shutdown
bit 19-16	<b>STATUS1:</b> Channel 1 status 0 = Off 1 = On 2 = No Load 3 = Bad Relay 4 = Bad Fuse 5 = Over Current
bit 23-20	<b>STATUS2:</b> Channel 2 status (same as 1)
bit 27-24	<b>STATUS3:</b> Channel 3 status (same as 1)
bit 31-28	<b>STATUS4:</b> Channel 4 status (same as 1)
bit 35-32	<b>STATUS5:</b> Channel 5 status (same as 1)
bit 39-36	<b>STATUS6:</b> Channel 6 status (same as 1)
bit 43-40	<b>STATUS7:</b> Channel 7 status (same as 1)
bit 47-44	<b>STATUS8:</b> Channel 8 status (same as 1)
bit 51-48	<b>STATUS9:</b> Channel 9 status (same as 1)
bit 55-52	<b>STATUS10:</b> Channel 10 status (same as 1)
bit 59-56	<b>STATUS11:</b> Channel 11 status (same as 1)
bit 64-60	<b>STATUS12:</b> Channel 12 status (same as 1)

## 6.9 Status Slave

Message ID: 0x421  
Transmit Rate: 50ms

Table 15: Status CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	INVERTER BITS				RESERVED			
1	15:8	SCRIPT				MODE			
2	23:16	STATUS14				STATUS13			
3	31:24	STATUS16				STATUS15			
4	39:32	STATUS18				STATUS17			
5	47:40	STATUS20				STATUS19			
6	55:48	STATUS22				STATUS21			
7	63:56	STATUS24				STATUS23			

bit 0-3	<b>RESERVED:</b>
bit 4	<b>INV-REQUEST:</b> Inverter request: 0 = Off, 1 = On
bit 5	<b>INV-STATUS:</b> Inverter status: 0 = Off, 1 = On
bit 6	<b>INV-OVERLOAD:</b> Inverter over-load: 0 = No Fault, 1 = Fault
bit 7	<b>INV-OVERTEMP:</b> Inverter over-temperature: 0 = No Fault, 1 = Fault
bit 8-11	<b>MODE:</b> Current mode 0 = Auto 1 = Manual 2 = Valet
bit 15-12	<b>SCRIPT:</b> Running script 0 = None 1 = Startup 2 = Shutdown
bit 19-16	<b>STATUS13:</b> Channel 13 status 0 = Off 1 = On 2 = No Load 3 = Bad Relay 4 = Bad Fuse 5 = Over Current
bit 23-20	<b>STATUS14:</b> Channel 14 status (same as 13)
bit 27-24	<b>STATUS15:</b> Channel 15 status (same as 13)
bit 31-28	<b>STATUS16:</b> Channel 16 status (same as 13)
bit 35-32	<b>STATUS17:</b> Channel 17 status (same as 13)
bit 39-36	<b>STATUS18:</b> Channel 18 status (same as 13)
bit 43-40	<b>STATUS19:</b> Channel 19 status (same as 13)
bit 47-44	<b>STATUS20:</b> Channel 20 status (same as 13)
bit 51-48	<b>STATUS21:</b> Channel 21 status (same as 13)
bit 55-52	<b>STATUS22:</b> Channel 22 status (same as 13)
bit 59-56	<b>STATUS23:</b> Channel 23 status (same as 13)
bit 64-60	<b>STATUS24:</b> Channel 24 status (same as 13)

## 6.10 Status2 Master

Message ID: 0x43C  
Transmit Rate: 50ms

Table 16: Status2 CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	BOARDTEMP							
1	15:8	THERMOCOUPLE							
2	23:16	VOLTAGE<7:0>							
3	31:24	—	—	—	—	VOLTAGE<11:8>			

bit 0-7      **BOARDTEMP:** Internal Board Temperature

0x80 = -20.0°C

0xA8 = 0.0°C

0xA9 = 0.5°C

0x00 = 44.0°C

0x01 = 44.5°C

0x7F = 107.5°C

bit 8-15    **THERMOCOUPLE:** External Thermocouple

0x80 = -20.0°C

0xA8 = 0.0°C

0xA9 = 0.5°C

0x00 = 44.0°C

0x01 = 44.5°C

0x7F = 107.5°C

bit 16-27   **VOLTAGE:** Input Voltage

0x000 = 0.00V

0x001 = 0.01V

0x3FF = 40.95V

bit 28-31   **Unimplemented:** Set to '0'

## 6.11 Status2 Slave

Message ID: 0x43D

Transmit Rate: 50ms

Table 17: Status2 CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	BOARDTEMP							
1	15:8	THERMOCOUPLE							
2	23:16	VOLTAGE<7:0>							
3	31:24	—	—	—	—	VOLTAGE<11:8>			

bit 0-7      **BOARDTEMP:** Internal Board Temperature

0x80 = -20.0°C

0xA8 = 0.0°C

0xA9 = 0.5°C

0x00 = 44.0°C

0x01 = 44.5°C

0x7F = 107.5°C

bit 8-15    **THERMOCOUPLE:** External Thermocouple

0x80 = -20.0°C

0xA8 = 0.0°C

0xA9 = 0.5°C

0x00 = 44.0°C

0x01 = 44.5°C

0x7F = 107.5°C

bit 16-27   **VOLTAGE:** Input Voltage

0x000 = 0.00V

0x001 = 0.01V

0x3FF = 40.95V

bit 28-31   **Unimplemented:** Set to '0'

## 6.12 Current 1 Master

Message ID: 0x424  
Transmit Rate: 50ms

Table 18: Current 1 CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	CURRENT1<7:0>							
1	15:8	CURRENT1<15:8>							
2	23:16	CURRENT2<7:0>							
3	31:24	CURRENT2<15:8>							
4	39:32	CURRENT3<7:0>							
5	47:40	CURRENT3<15:8>							
6	55:48	CURRENT4<7:0>							
7	63:56	CURRENT4<15:8>							

bit 0-15      **CURRENT1:** Channel 1 current

0x8000 = -32.768A

0xFFFF = -0.001A

0x0000 = 0.000A

0x0001 = 0.001A

0x7FFF = 32.767A

bit 31-16    **CURRENT2:** Channel 2 current (same as 1)

bit 47-32    **CURRENT3:** Channel 3 current (same as 1)

bit 63-48    **CURRENT4:** Channel 4 current (same as 1)

## 6.13 Current 1 Slave

Message ID: 0x425

Transmit Rate: 50ms

Table 19: Current 1 CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	CURRENT13<7:0>							
1	15:8	CURRENT13<15:8>							
2	23:16	CURRENT14<7:0>							
3	31:24	CURRENT14<15:8>							
4	39:32	CURRENT15<7:0>							
5	47:40	CURRENT15<15:8>							
6	55:48	CURRENT16<7:0>							
7	63:56	CURRENT16<15:8>							

bit 0-15      **CURRENT13:** Channel 13 current

0x8000 = -32.768A

0xFFFF = -0.001A

0x0000 = 0.000A

0x0001 = 0.001A

0x7FFF = 32.767A

bit 31-16    **CURRENT14:** Channel 14 current (same as 13)

bit 47-32    **CURRENT15:** Channel 15 current (same as 13)

bit 63-48    **CURRENT16:** Channel 16 current (same as 13)

## 6.14 Current 2 Master

Message ID: 0x428

Transmit Rate: 50ms

Table 20: Current 2 CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	CURRENT5<7:0>							
1	15:8	CURRENT5<15:8>							
2	23:16	CURRENT6<7:0>							
3	31:24	CURRENT6<15:8>							
4	39:32	CURRENT7<7:0>							
5	47:40	CURRENT7<15:8>							
6	55:48	CURRENT8<7:0>							
7	63:56	CURRENT8<15:8>							

bit 0-15      **CURRENT5:** Channel 5 current

0x8000 = -32.768A

0xFFFF = -0.001A

0x0000 = 0.000A

0x0001 = 0.001A

0x7FFF = 32.767A

bit 31-16    **CURRENT6:** Channel 6 current (same as 5)

bit 47-32    **CURRENT7:** Channel 7 current (same as 5)

bit 63-48    **CURRENT8:** Channel 8 current (same as 5)



## 6.15 Current 2 Slave

Message ID: 0x429

Transmit Rate: 50ms

Table 21: Current 2 CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	CURRENT17<7:0>							
1	15:8	CURRENT17<15:8>							
2	23:16	CURRENT18<7:0>							
3	31:24	CURRENT18<15:8>							
4	39:32	CURRENT19<7:0>							
5	47:40	CURRENT19<15:8>							
6	55:48	CURRENT20<7:0>							
7	63:56	CURRENT20<15:8>							

bit 0-15      **CURRENT17:** Channel 17 current

0x8000 = -32.768A

0xFFFF = -0.001A

0x0000 = 0.000A

0x0001 = 0.001A

0x7FFF = 32.767A

bit 31-16    **CURRENT18:** Channel 18 current (same as 17)

bit 47-32    **CURRENT19:** Channel 19 current (same as 17)

bit 63-48    **CURRENT20:** Channel 20 current (same as 17)

## 6.16 Current 3 Master

Message ID: 0x42C  
Transmit Rate: 50ms

Table 22: Current 3 CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	CURRENT9<7:0>							
1	15:8	CURRENT9<15:8>							
2	23:16	CURRENT10<7:0>							
3	31:24	CURRENT10<15:8>							
4	39:32	CURRENT11<7:0>							
5	47:40	CURRENT11<15:8>							
6	55:48	CURRENT12<7:0>							
7	63:56	CURRENT12<15:8>							

bit 0-15      **CURRENT9:** Channel 9 current

0x8000 = -32.768A

0xFFFF = -0.001A

0x0000 = 0.000A

0x0001 = 0.001A

0x7FFF = 32.767A

bit 31-16    **CURRENT10:** Channel 10 current (same as 9)

bit 47-32    **CURRENT11:** Channel 11 current (same as 9)

bit 63-48    **CURRENT12:** Channel 12 current (same as 9)

## 6.17 Current 3 Slave

Message ID: 0x42D

Transmit Rate: 50ms

Table 23: Current 3 CAN Message Description.

Byte	Bits	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
0	7:0	CURRENT21<7:0>							
1	15:8	CURRENT21<15:8>							
2	23:16	CURRENT22<7:0>							
3	31:24	CURRENT22<15:8>							
4	39:32	CURRENT23<7:0>							
5	47:40	CURRENT23<15:8>							
6	55:48	CURRENT24<7:0>							
7	63:56	CURRENT24<15:8>							

bit 0-15      **CURRENT21:** Channel 21 current

0x8000 = -32.768A

0xFFFF = -0.001A

0x0000 = 0.000A

0x0001 = 0.001A

0x7FFF = 32.767A

bit 31-16    **CURRENT22:** Channel 22 current (same as 21)

bit 47-32    **CURRENT23:** Channel 23 current (same as 21)

bit 63-48    **CURRENT24:** Channel 24 current (same as 21)

## APPENDIX A: REVISION HISTORY

### Revision A-00 (July 2015)

#### Modifications:

1. Initial release of this document.

### Revision A-01 (September 2015)

#### Modifications:

1. Added CAN messages for multiple units to achieve 24 channels.
2. Added description for each mode.
3. Added section describing LED status codes.

### Revision A-02 (October 2015)

#### Modifications:

1. Changed all CAN IDs to 0x4XX.

### Revision A-03 (December 2015)

#### Modifications:

1. Added inverter to messages.

### Revision A-04 (May 2016)

#### Modifications:

1. Added mechanical drawing.
2. Added connector pictures and part numbers.
3. Changed RESERVED pins on CAN/DB9 connector to ignition pins.

### Revision A-05 (August 2016)

#### Modifications:

1. Updated LED table.
2. Added power usage to electrical specs.
3. Added Status2 CAN message

### Revision A-06 (August 2017)

#### Modifications:

1. Fixed main LED color (power/status).
2. Fixed CAN bus termination value.
3. Added reserved CAN messages.
4. Added connector descriptions for inverter remote and battery control.
5. Added electrical characteristics for each channel

### Revision A-07 (October 2017)

#### Modifications:

1. Split inverter status into 4 individual bits.

**Revision A-08 (January 2018)**

## Modifications:

1. Updated mechanical drawing
2. Added note about multiple ignition voltages