Display Panel Standard - Construction

DPS-C

User Guide



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Publication History

The following table provides an overview of the changes made to this document over the course of its publication history.

Release Date	Description of Change	
Rev. 003, June 2014	Fixed LED color assignments in section "Telltales" to match standard variant.	
Rev. 002, September 2012	Applied new branding.	
	Reordered chapters; renamed some of them.	
	Added new glossary definitions, revised others.	
	Replaced some graphics.	
	Made minor editorial changes throughout.	
Rev. 001, 2010	First release of this document	

Safety

Do not perform the procedures in this manual unless you are experienced in the handling of electronic equipment.

Contact the manufacturer if there is anything you are not sure about or if you have any questions regarding the product and its handling or maintenance.

The term "manufacturer" refers to Parker Hannifin Corporation.

Safety symbols

The following symbols are used in this document to indicate potentially hazardous situations:



Warning! Risk of damage to equipment or degradation of signal

When you see these symbols, follow the instructions carefully and proceed with caution.

General safety regulations

Work on the hydraulics control electronics may only be carried out by trained personnel who are well-acquainted with the control system, the machine, and its safety regulations.



Follow the manufacturer's regulations when mounting, modifying, repairing, and maintaining equipment. The manufacturer assumes no responsibility for any accidents caused by incorrectly mounted or incorrectly maintained equipment. The manufacturer assumes no responsibility for the system being incorrectly applied, or the system being programmed in a manner that jeopardizes safety.





• Do not use the product if electronic modules, cabling, or connectors are damaged or if the control system shows error functions.



Lectronic control systems in an inappropriate installation and in combination with strong electromagnetic interference fields can, in extreme cases, cause an unintentional change of speed of the output function.

Welding after installation

Complete as much as possible of the welding work on the chassis before the installation of the system. If welding has to be done afterwards, proceed as follows:



• Do not place the welding unit cables near the electrical wires of the control system.

- 1. Disconnect the electrical connections between the system and external equipment.
- 2. Disconnect the negative cable from the battery.
- 3. Disconnect the positive cable from the battery.
- 4. Connect the welder's ground wire as close as possible to the place of the welding.

Construction regulations

The vehicle must be equipped with an emergency stop which disconnects the supply voltage to the control system's electrical units. The emergency stop must be easily accessible to the operator. If possible, the machine must be built so that the supply voltage to the control system's electrical units is disconnected when the operator leaves the operator's station.

Safety during installation



Incorrectly positioned or mounted cabling can be influenced by radio signals, which can interfere with the functions of the system.



Safety during start-up

2 Danger! Risk of death or injury. Do not start the machine's engine before the control system is mounted and its electrical functions have been verified.

Do not start the machine if anyone is near the machine.

Safety during maintenance and fault diagnosis

Before performing any work on the hydraulics control electronics, ensure that

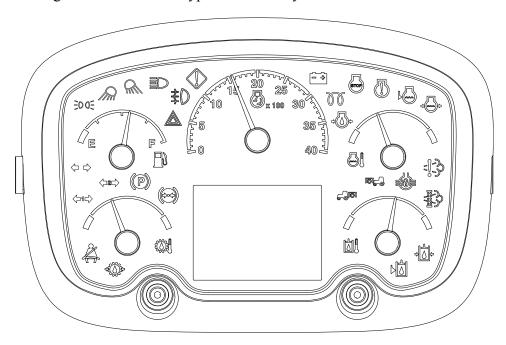
- The machine cannot start moving.
- Functions are positioned safely.
- The machine is turned off.
- The hydraulic system is relieved from any pressure.
- Supply voltage to the control electronics is disconnected.

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1. About the DPS-C

The Display Panel Standard - Construction (DPS-C) is a compact, rugged-use instrument cluster for use in smaller cabs, such as those found in agricultural vehicles and off-road construction equipment. Like its larger cousin the DPS, the DPS-C provides complete vehicle information and is programmable using the Vansco Display Software Developer's Kit (SDK). Information about the SDK is available from your Parker Vansco Account Representative.

The figure below shows a typical DPS-C layout.





The DPS-C comprises a 320 x 240 color, TFT LCD screen with 28 LEDs for the telltales:

- 7 red
- 4 green
- 10 amber
- 1 blue
- 6 tricolor

Although the locations of the LEDs are fixed, the overlay can be customized. Contact your Parker Vansco Account Representative for more information.

The DPS-C monitors up to 24 inputs and four outputs:

- 4 analog inputs
- 18 digital inputs
- 2 frequency inputs
- 2 high-side outputs
- 2 low-side outputs

Five gauges and a buzzer also provide vehicle information. The buzzer can be programmed to signal a particular event, such as a system fault, and to produce a different sound, such as a clicking noise instead of a buzz.

The DPS-C can detect the following faults on the outputs:

- Short circuit
- Overcurrent
- Open load
 - Short-to-battery
 - Short-to-ground

The DPS-C has three communication connectors:

- 2 x 20-pin Molex connectors for interfacing with the inputs, outputs, and the controller area network (CAN)
- 1 x 4-pin Molex connector for the USB interface, typically routed to a panel-mounted USB port, although a separate cable is available to route to a type B port.

If the system becomes unresponsive, a watchdog timer will trigger a microprocessor reset. If the micro supply voltage falls outside of its normal range, a low-voltage reset function will also trigger a reset.



1.1. Diagram conventions

The following symbols are used in the schematic diagrams in this document:

Symbol	Meaning
	General input
	General output
	Frequency input
	Analog input
	Frequency sensor
	Pulse sensor
	Resistive sensor
	General sensor
	Application switch
	Load
<u> </u>	Pull-down resistor

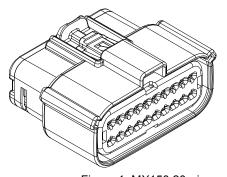


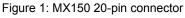
Symbol	Meaning
	Pull-up resistor
\geqslant	
=	Battery
2	Fuse
-	Resistor
<u></u>	Ground
<i>/</i>	Chassis ground

2. Connectors and pinouts

Three Molex MX150 sealed connector shells are molded into the rear cover of the standard unit. Connectors J1 and J2 have 20 pins; the J4 USB connector has four.

Parameter Terminal	
Current rating	15A with 18-gauge wire
Voltage rating	500 VDC maximum
Sealing	IP67
Wire gauge	14 – 22 AWG
Contact resistance	10 mΩ maximum
Mating cycles	100





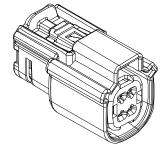


Figure 2: MX150 4-pin connector

Mating Connector Part Numbers				
Connector	Molex part no. with locking clip	Molex part no. without locking clip		
J1 connector (gray), 20-pin, key option B	33472-2007	33472-2002		
J2 connector (black), 20-pin, key option A	33472-2006	33472-2001		
J4 USB connector (black), 4-pin, key option A	33472-0406	33472-0401		



2.1. Pinouts

Pins connect to inputs, outputs, and communication channels. They provide the interface between the vehicle harness and the internal circuitry of the DPS-C.

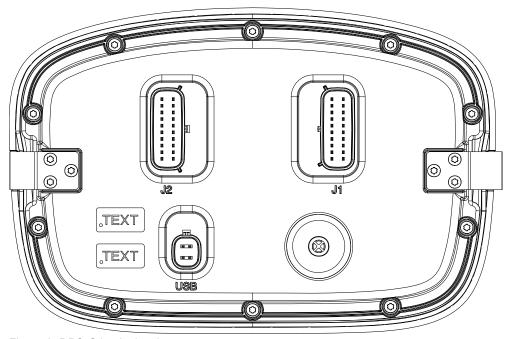


Figure 3: DPS-C back showing connectors

The following tables show the pinouts for each connector:

J2 Connector (Black) Pinout		
Pin	Name	Function
1	INPUT17_D	Digital input (SW)
2	INPUT16_D	Digital input (SW)
3	INPUT15_D	Digital input (SW)
4	INPUT14_D	Digital input (SW)
5	INPUT13_D	Digital input (SW)
6	INPUT12_D	Digital input (SW)
7	INPUT11_D	Digital input (SW)
8	INPUT10_D	Digital input (active low)
9	INPUT9_D	Digital input (active low)
10	INPUT8_D	Digital input (active high)
11	INPUT21_A	Analog input
12	INPUT22_A	Analog input
13	INPUT24_F	Frequency input



J2 Connector (Black) Pinout			
Pin Name Function			
14	OUTPUT3_2A5_LS	2.5 A low-side output	
15	INPUT18_D	Digital input (SW)	
16	INPUT5_D	Digital input (active high)	
17	SENSOR_GROUND	Ground (sensor)	
18	INPUT6_D	Digital input (active high)	
19	INPUT7_D	Digital input (active high)	
20	SENSOR_SUPPLY	+5 V sensor power	

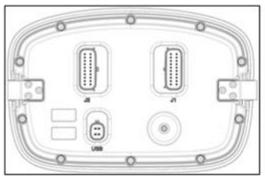
J1 Connector (Gray) Pinout			
Pin	Name	Function	
1	INPUT2_D	Digital input (wake up high)	
2	INPUT1_D	Digital input (wake up high)	
3	CAN2_SHLD	CAN shield	
4	CAN2_LO	CAN low	
5	CAN2_HI	CAN high	
6	CAN1_SHLD	CAN shield	
7	CAN1_LO	CAN low	
8	CAN1_HI	CAN high	
9	GND	Ground	
10	VBATT	Power	
11	INPUT3_D	Digital input (wake up high)	
12	INPUT4_D	Digital input (wake up high)	
13	OUTPUT4_2A5_LS	2.5 A low-side output	
14	INPUT23_F	Frequency input	
15	GND	Ground	
16	INPUT19_A	Analog input	
17	INPUT20_A	Analog input	
18	OUTPUT2_HS	High-side output	
19	OUTPUT1_HS	High-side output	
20	VBATT	Power	

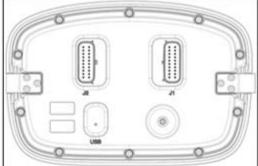
J4 USB Connector Pinout					
Pin Name Function					
1	USB_D-	USB data low			
2	USB_VCC	USB power (5 V from host)			
3	USB_D+	USB data high			
4	USB_GND	USB ground (0 V from host)			



2.2. Connector Configurations

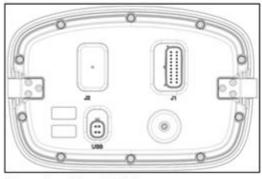
Four connection configurations provide different pinout options.

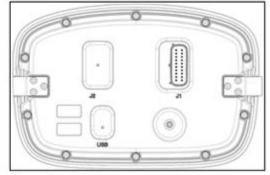




Connectors J1, J2, and USB

Rear Cover with Connectors J1 and J2





Connectors J1 and USB

Connector J1 only

Figure 4: Back cover connection options

3. Power

The DPS-C is powered by a direct battery connection. The instrument cluster is turned on by applying power to one of the four wake-up inputs. The direct battery input is protected against vehicle transients such as load dump and inductive load switching, etc. It is also protected against reverse battery voltage of -42 V through the use of a high-current path that will cause an external fuse to blow.

The DPS-C operates in a 12 V or 24 V system and can operate from 8 V up to 32 V with overvoltage protection at 42 V.

Direct Battery Input (+VBATT)					
Parameter		Min	Nom	Max	Units
Input voltage for normal operation		8	-	32	V
Minimum cranking voltage (see note 1)		5.5	-		V
Overvoltage protection (DC)		-	-	42	V
Reverse battery protection (see note 2)		-	-	-42	V
Maximum continuous current (see note 3)		-	-	TBD	А
Off-state current	Vbatt of 12V	-	-	1	mA
	Vbatt of 24V	-	-	2	mA
Rating of External Fuse (see note 4)		-	-	20	А

Note 1: The unit will operate below 8 V, down to 5.5 V, but the telltales and backlighting LEDs may be dim.

3.1. Logic and output power

The DPS-C has two pins, labeled VBATT, dedicated to providing power for logic and outputs, and two pins, labeled GND, dedicated to grounding the DPS-C.

Note: The power and ground connections are usually paralleled over several pins to minimize voltage drops on higher current applications.

Note 2: A reverse battery condition causes an external fuse to blow.

Note 3: The maximum current is based on the theoretical maximum current for worst-case operating conditions.

Note 4: Based on testing with an ATC-20 automotive fuse.

4. Inputs

The DPS-C has digital, frequency, and analog inputs.

A Damage to equipment! Do not connect inputs directly to unprotected inductive loads such as solenoids or relay coils, as these can produce high voltage spikes that may damage the DPS-C. If an inductive load must be connected to an input, use a protective diode or transorb.

4.1. Digital inputs

All the digital inputs have a 1.2 k resistor that provides the path for the wetting current. The resistor is connected to ground or V_{battery} depending on the active state of the input. The resistor is switched to the biased state with a 20% duty cycle at a frequency of 40 Hz.

The DPS-C has three types of digital inputs, assigned to the following pins:

- Active high with wake-up: inputs 1 through 4
- Hardware configurable: inputs 5 through 10
- Software configurable: inputs 11 through 18

4.1.1. Active-high digital inputs with wake-up

This type of input has a pull-down resistor option only. When the input is active it turns on the power supply pass transistor to power up the unit. These inputs are sensed directly by the microprocessor.

Active-High Input with Wake-Up Parameters							
Parameter Min Nom Max Unit							
High switching threshold	2.00	-	-	V			
Low switching threshold	-	-	0.80	V			
Filter cutoff (3 dB) frequency	-	1600	-	Hz			
Step response time	-	-	2	ms			



4.1.2. Hardware-configurable digital inputs

These inputs can be configured at manufacturing so that the bias resistor is switched to either ground or to V_{battery} .

Hardware-Configurable Parameters							
Parameter Min Nom Max Unit							
High switching threshold	2.43	-	-	V			
Low switching threshold	-	-	0.94	V			
Filter cutoff (3 dB) frequency	-	675	-	Hz			
Step response time	-	-	1	ms			

4.1.3. Software-configurable digital inputs

You can configure the bias resistor to ground or to V_{battery}.

Software-Configurable Parameters							
Parameter Min Nom Max Unit							
High switching threshold	2.43	-	-	V			
Low switching threshold	-	-	0.94	V			
Filter cutoff (3 dB) frequency	-	675	-	Hz			
Step response time	-	-	1	ms			

4.2. Frequency inputs

There are two frequency inputs, with the following pin assignments:

• INPUT23 F (Frequency 1) through INPUT24 F (Frequency 2)

Both inputs have a 10 k pull-up resistor to 6.4 V through a diode. They can measure the signal's frequency, duty cycle, and pulse width. Input 23 (frequency 1) can be used with variable reluctance sensors.

Frequency Input Parameters								
Parameter Min Nom Max Unit								
Input threshold	0.52	-	2.54	V				
Cutoff frequency	-	67 k	-	Hz				
Measurement range	5	-	10000	Hz				
Resolution	-	0.5	-	μs				

4.3. Analog inputs

The DPS-C has four analog inputs with pin assignments as follows:

INPUT19_A (Analog 1) through INPUT22_A (Analog 4).



Configuration options provide two choices for pull-up resistance and two choices for gain. The pull-up resistor is connected to +5 V through a diode.

Analog Inputs Configuration Options							
Analog Input Pull-up 1 Pull-up 2 Gain 1 Gain 2							
Analog 1	2.21 k	475	0.623	1.25			
Analog 2	75.0 k	2.21 k	0.623	1.09			
Analog 3	75.0 k	2.21 k	0.623	1.09			
Analog 4	75.0 k	2.21 k	0.623	1.09			

Analog Input Parameters								
Parameter Min Nom Max Unit								
Measurement range	-	-	5.2	V				
Setting time	-	50	ı	ms				
Voltage measurement offset error	-	-	11	mV				
Voltage measure absolute error	-	-	2	%				

The charts below show the resistance measurement error for the different configurations.

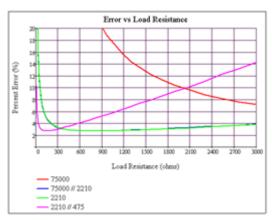




Figure 5: Resistance measurement error

5. DPS-C outputs

The DPS-C has four solid-state FET technology outputs designed for low to medium current and high inrush inductive load switching. Output currents can range up to 2.5 A.

- High-side outputs. HSO1 may be configured for alternator excitation and is limited to 140 mA max.
- Low-side outputs with error detection. These outputs monitor current and can be used for current feedback if a high-side output is used for pulse-width modulation
- Alternator output
- Sensor supply

5.1. High-side outputs

The DPS-C has 2 high-side outputs, with the following pin assignments;

OUTPUT1_2A5_HS (HSO1) through OUTPUT2_2A5_HS (HSO2)

HSO1 has a 100 k pull-up resistor and can detect open loads and provide feedback. HSO2 does not have these capabilities.

High-Side Output Parameters						
Parameter		Min	Nom	Max	Unit	
Output operating voltage range		7	-	32	V	
Output current		-	-	2.5	Α	
On Resistance		-	70	180	mΩ	
Max. voltage applied to output pin		-	-	32	V	
Current limit in short-to-ground condition		9	15	23	А	
Max. PWM frequency		-	-	200	Hz	
PWM resolution (min. pulse width)		-	-	TBD	μs	
Pull-up Resistance (see note 1)	HSO1	-	100 k	-	Ω	
	HSO2	-	N/A	-		



Feedback gain (V _{micro} /V _{pin}) (see note 2)	-	.091	-	V/V
Feedback max readable voltage	ı	ı	33	V

Note 1: Only on HSO1. There is no open load detection on HSO2.

Note 2: Only on HSO1. There is no feedback on HSO2.

High-Side Output Error Detection				
Fault Condition Remark				
Open load (see note)	Error detected if output > 3 V with the output off.			
Short circuit Detected by over temperature.				
Current is limited by driver.				
Software should latch off output on error.				
Note: Only on HSO1. There is	no open load detection on HSO2.			



5.2. Low-side outputs

The DPS-C has two low-side outputs, with the following pin assignments:

OUTPUT3 2A5 LS (LSO 1) through OUTPUT4 2A5 LS (LSO 2)

The outputs have analog feedback for error detection.

Low-Side Output Parameters					
Parameter	Min	Nom	Max	Unit	
Output current	-	-	2.5	Α	
On resistance	-	45	100	mΩ	
Max. voltage applied to pin	-	-	32	V	
Current limit in short-to-ground condition	18	24	30	А	
Max PWM Frequency	-	-	200	Hz	
PWM resolution (min pulse width)	-	-	TBD	μs	
Flyback diode continuous current	-	-	1	А	
Flyback diode non-repetitive surge current	-	-	30	А	
Pull-down resistance	-	10 k	-	Ω	
Pull-up resistance	-	10 k	-	Ω	
Feedback gain (V _{micro} /V _{pin}) (see note)	-	.097	-	V/V	
Feedback max readable voltage	-	-	33	V	
Feedback cut-off (3dB) frequency	-	TBD	-	Hz	

Note: V_{micro} is the voltage at the micro A/D pin, and V_{pin} is at the external connector pin. The tolerance of the V_{pin} measurement using nominal gain is $\pm 0.5 \text{ V}$.

Low-Side Output Error Detection						
Driver State	Error Detected?					
Off	Open	Vsw/2	Yes			
Off	Short-to-battery	Vsw	Yes			
Off	Short-to-ground	0 V	No			
On	Open	0 V	No			
On	Short	>Vsw/2 (see note)	Yes			
Note: An over-te	Note: An over-temperature fault results in driver output cycling.					



5.3. Alternator output

The alternator output supplies a pre-excitation current to the alternator. The output is current-limited with a series resistance, the value of which is different for 12 V and 24 V systems. The switching is done automatically when the battery supply voltage exceeds 16 V.

Alternator Output Parameters								
Parameter	Parameter Min Nom Max Unit							
Current limit @ 13 V supply voltage	-	140	-	mA				
Current limit @ 26 V supply voltage	-	142	-	mA				
Feedback gain (V _{micro} /V _{pin}) (see notes 1 and 2)	-	.097	-	V/V				
Voltage threshold for series resistance change	-	16	-	V				

Note 1: V_{micro} is the voltage at the micro A/D pin, and V_{pin} is at the external connector pin.

Note 2: The tolerance of V_{pin} measurement using nominal gain is +/- 0.5 V.



The alternator output shares a connector pin with high-side output 1 (HSO1). To avoid sending excessive current to the load, do not permit the high-side output to turn on.

5.4. Sensor supply

The DPS-C has one pin, labeled SENSOR SUPPLY, dedicated to providing power to external sensor.



Marning! Do not drive more than 250 mA of current through the SENSOR SUPPLY pin. Doing so will cause the pin to protect itself by dropping the voltage, which will result in a lack of power to the sensors, causing unknown vehicle responses.

SENSOR SUPPLY is a 5 V linear power supply that is capable of continuously providing 250 mA to external sensors.

Sensor Supply Output Parameters				
Parameter	Min	Nom	Max	Unit
Output voltage	4.35	5.0	5.65	V
Current limit	-	250	-	mA
Feedback gain (V _{micro} / V _{pin}) (see note)	-	0.5	-	V/V
<i>Note:</i> V _{micro} is the voltage at the micro A/D pin, and V _{nin} is at the external connector pin.				

6. User Interface

The user interface of the DPS-C consists of the following:

- a 3.5" color display
- 5 gauges
- 28 telltales
- 2 buttons
- a buzzer
- a real-time clock

6.1. TFT LCD Display

The DPS-C has a 3.5" color transflective liquid crystal display for reading system information. The resolution is 320 x 240 pixels. The display has a wide viewing angle and excellent readability, even in direct sunlight.

LCD Parameters					
Parameter	Min	Nom	Max	Units	
Diagonal size	-	3.5	-	inch	
Backlight brightness	-	400	-	Cd/m ²	
Operating temperature	-20		70	С	
Frames per second	-	2	-	Frame/sec	
Resolution	320 x 240			pixels	
Viewing angle	6 o'clock			-	
Color resolution	15			bit	



6.2. Gauges

The DPS-C cluster has five gauges. These gauges are implemented with stepper motors that move the pointer. Four of the gauges can be micro-stepped. Micro-stepping results in pointer movement of 1/12 ° per step. The fifth gauge (lower right) has movement resolution of 1/3 ° per step, which might not be suitable for faster-moving parameters such as RPM or speed.

The velocity and acceleration of the gauges is controlled through software, and can be adjusted to meet the specific requirements of the application.

The gauges are backlit with white LEDs.

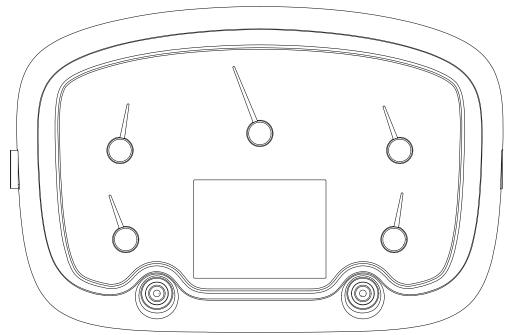


Figure 6: DPS-C gauge locations



6.3. Telltales

There are 28 status LEDs on the DPS-C cluster, positioned as shown in the following figure.

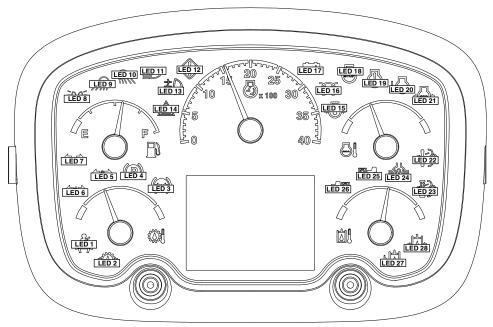


Figure 7: Location of DPS-C leds

The brightness of the telltales can be adjusted through software. This adjustment controls the brightness of all of the telltales together.

The colors of the LEDs are defined as follows:

- Red (LED 1, 3, 4, 14, 15, 18, 22)
- Green (LED 5, 6, 7, 8)
- Amber (LED 2, 9, 10, 13, 16, 19, 20, 21, 27, 28)
- Blue (LED 11)
- Tricolor (LED 12, 17, 23, 24, 25, 26)

The tricolor LEDs have the red/green brightness ratio set so that they provide an amber color similar to that of the individual amber LED. As a result, when all three colors in the tricolor LED are turned on, the color is not white.

The icons associated with each status LED are determined by the overlay, which can be customer-specific.



6.4. Buttons

Two buttons on the DPS-C allow you to interact with the unit by scrolling through and selecting menu items and notifications displayed on the center display.

The buttons have rubber button caps over metal switch domes that, when pushed, close the switches electrically. The switch domes have a trip force of 700 grams +/- 40 grams. The rated life of the push button is 100,000 cycles.

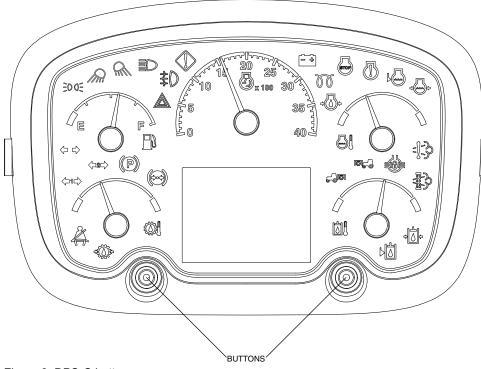


Figure 8: DPS-C buttons



6.5. Buzzer

The DPS-C has a buzzer that may be used as a fault alarm. In some applications, the frequency of the buzzer can be adjusted to create other noises, such as a relay clicking noise.

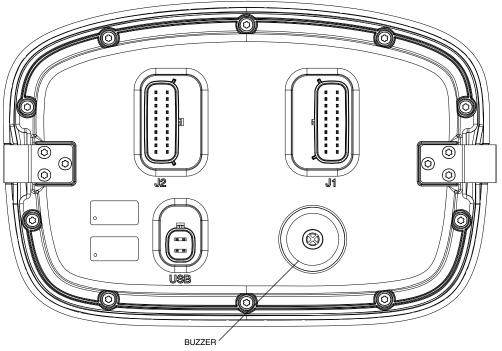


Figure 9: DPS-C buzzer location

A hole in the back cover of the enclosure allows the sound to exit the DPS-C. A buzzer gasket is placed between the buzzer housing and the back cover, which prevents water and dust from entering the unit. This gasket also acts as a tunnel for the sound coming from the buzzer. The buzzer is significantly louder with the gasket installed.

6.6. Real-time clock

The real-time clock is implemented by the co-processor. The primary power for the clock is from the direct battery connection. If the direct battery connection is not present, power is supplied by the lithium backup battery in the DPS-C. The backup battery is 3 V 1000 mAh. Minimum lifetime is 10 years when disconnected from the vehicle battery.



6.7. Temperature sensor

The temperature sensor is specified to be accurate to ± 4 °C over the whole -40 °C to 125 °C temperature range.

7. Communication

The DPS-C uses two methods of communication with other modules on the vehicle or with a personal computer:

- CAN communication
- USB communication

7.1. Controller area network

The DPS-C hardware provides controller area network (CAN) communication according to the SAE J1939 specification, making the DPS-C compatible with any CAN-based protocol through software.

CAN communication is used to communicate the status of multiple modules that are connected together in the same network.

The DPS-C has two CAN buses, each of which can be terminated with a software-selectable 120 Ω terminating resistor.

CAN Bus Parameters					
Parameter	Min	Nom	Max	Units	
Overvoltage	-		+/- 30	V	
Baud rate (see note)	-	250	1000	kBd	
Terminating resistor	-	120	-	Ω	
Input capacitance (CANH or CANL)	-	90	-	pF	
Slew rate (CANH or CANL)	-	15	-	V/µs	
Note: Tested at 250 kBd. Speed of up to 1 MBd is theoretically possible, but not tested.					

7.2. USB communication

An optional USB connection allows you to connect temporarily to the unit for the purpose of retrieving logs, updating code, or configuring the unit.



Power to the USB connector is isolated from the vehicle power. Voltages are relative to USB ground on the 4-pin connector.

USB channel parameters					
Parameter	Min	Nom	Max	Unit	
Max. voltage applied to USB Power	-0.5	-	6.0	V	
USB power operating voltage	3.3	5	5.25	V	
Operating supply current	-	15	-	mA	
Max. voltage applied to data signals	-0.5	-	3.8	V	
Data signal output voltage (high)	2.8	-	3.6	V	
Data signal output voltage (low)	0	-	0.3	V	
Driver output impedance	26	29	44	Ω	
Communication speed	-	-	800	kBd	

8. Installation

Because every system is different, it is not feasible to provide detailed installation instructions that will be suitable for every assembly. This chapter therefore provides only high-level guidelines on installing the DPS-C.

The vehicle manufacturer is responsible for creating procedures for mounting the DPS-C in a vehicle during production assembly.

8.1. Environmental requirements

The DPS-C is intended to be mounted in a panel or dashboard in vehicles such as agricultural equipment or construction equipment, which may be subject to extreme temperatures and other unusual environmental conditions.

The DPS-C warranty does not cover damage caused by exposure of the product to environmental conditions that exceed its design limitations.

- 1. Mount the DPS-C in an environment that is within its ambient temperature range of -40 °C to +85 °C.
- 2. Mount the DPS-C in an environment that is within its ingress rating. The sealing standard for the DPS-C is EP455 level 1 (IPX6) from the front.

8.2. Electrical installation procedures

Use the following guidelines when installing the DPS-C in a vehicle.

8.2.1. Logic and output power connections

When connecting the DPS-C logic and output power, note that

- Logic and output power connections are made using the VBATT and GND pins.
- The number of wires needed to connect the DPS-C power depends on the amount of current required by the application.
 - It is recommended that you use one 16 AWG wire for every 8 A of expected output current; however, this is not always true and depends on your application.



The DPS-C is protected against reverse-battery connections by an internal high-current conduction path that goes from ground to power. To protect the DPS-C from damage in a reverse-battery condition, place a fuse of 20 A or less in series with the power wires in the application harness.

Select fuse sizes by multiplying the maximum continuous current during normal operation by 1.333 (75% de-rating factor). Do not use slow-blow fuses for this application.

 All power connections to the DPS-C should be fused to protect the vehicle harness.

8.2.2. Digital inputs connections

A digital input is typically connected to a switch that is either open or closed.

- When the switch is open, the pull-down resistor ensures that no voltage exists on the input signal, which will be interpreted by the DPS-C as inactive.
- When the switch is closed, the input is connected to battery voltage, which will be interpreted by the DPS-C as active.

Since the input is active-high

- It must be connected to battery power so that there is a battery connection when the state of the input changes.
- The power provided to the digital switch connected to the input must be provided through a fuse in the wire harness.

A typical active-high digital input connection is shown below:

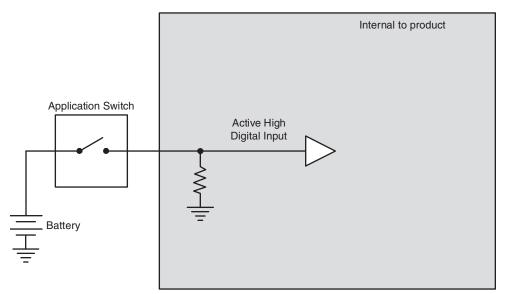


Figure 10: Active high digital input



8.2.3. Analog inputs connections

Analog inputs are susceptible to system noise, which can affect the accuracy of the signal. Signal accuracy can also be affected by ground level shift, which can cause inputs to activate when they shouldn't.

System noise

To prevent noise pickup on the sensors,

• Use the shortest possible wires when connecting analog inputs to sensors.

The following shows how to connect an analog input to reduce system noise:

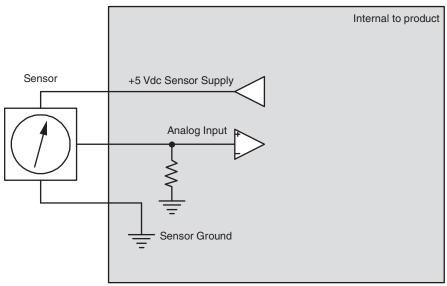


Figure 11: Analog input system noise reduction

Ground level shift

To reduce ground level shift:

- 1. Dedicate one of the four system ground inputs (GND) to sensors that have dedicated ground wires, and connect all sensor grounds to this system ground input.
- 2. Splice the other three system ground inputs together in the vehicle harness (close to the connector) to provide a better ground for the noisier low-side outputs and digital circuits.



3. Position the sensor's ground connection near the system ground connections to ensure that the signal remains within the digital activation range of the input.

Note 1: The system ground inputs are rated for low-current signals, which ensures the sensor's ground is very close in voltage potential to the system ground.

Note 2: Sensors that don't have a dedicated ground wire are typically grounded to the vehicle chassis through the sensor's body.

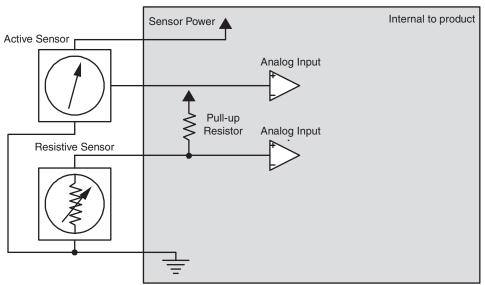


Figure 12: Analog input ground shift connection for sensors that have dedicated ground wires

8.2.4. Direct-coupled frequency inputs connections

As with analog inputs, direct-coupled frequency inputs are also susceptible to system noise and ground shift.

To reduce system noise,

- 1. Connect direct-coupled frequency inputs to sensors that produce signals with no DC offset.
- 2. To prevent noise pickup on the sensors, use the shortest possible wires when connecting direct-coupled frequency inputs to sensors.



To reduce ground shift:

- 1. Dedicate one of the two system ground inputs (labeled GND) to sensors that have dedicated ground wires, and connect all sensor grounds to this system ground input.
- 2. Provide a better ground for the noisier low-side outputs and digital circuits by splicing the other system ground inputs together in the vehicle harness (close to the connector).
- 3. Locate the sensor's ground connection close to the system ground connections. This will help ensure the signal remains within the digital activation range of the input.

The DPS-C system ground inputs are rated for low-current signals, ensuring that the sensor's ground is close in voltage potential to the system ground.

Sensors that don't have a dedicated ground wire are typically grounded to the vehicle chassis through the sensor's body.

The following shows a typical direct-coupled frequency input connection:

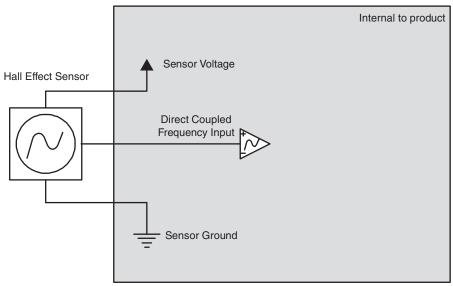


Figure 13: Direct coupled frequency input installation connections

8.2.5. High-side outputs

When connecting the high-side output, note that



- The high-side output is connected to an internal bus bar, which can be connected to a +12 V or +24 V battery. The bus bar is connected to logic power (VBATT), and both share the same connector pins.
- The high-side output can provide switched battery power to any load type in a vehicle.
- The high-side output can source up to 140 mA in the alternator excitation configuration.
- The high-side output has an internal flyback diode to absorb electrical energy when the load is turned off.

Inductive loads will create an average current flow that moves out of the high-side output. When the output is on, the current flows through the output driver, and when the output is off, the current flows through the flyback diode. A duty cycle of 50% will produce the worst-case average current flow through these two devices.

Note: If large inductive loads are used and the high-side output is providing a continuous PWM signal, the PWM peak current must not be greater than the specified continuous current for the output (in continuous mode, the average current flow through the diode at 50% duty cycle is approximately equal to ½ the peak current).

When connecting high-side outputs,

- Connect the load grounds close to the power grounds.
- Do not connect high-side outputs to loads that will draw currents greater than the maximum peak current or maximum continuous current.



The following shows a typical high-side output connection:

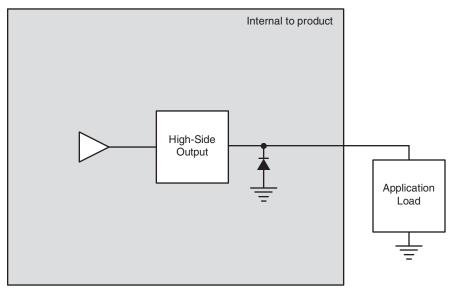


Figure 14: Typical high-side output installation connections

8.2.6. Low-side outputs

When connecting low-side outputs, note that

- low-side outputs are connected to a common internal ground point that is connected to the battery ground (GND).
- low-side outputs provide switched ground to any load type in a vehicle.
- low-side outputs can sink up to 2.5 A.

When connecting a load to a low-side output, ensure that the load will not drive currents greater than the maximum specified peak current or the maximum specified continuous current.



The following shows a typical low-side output connection:

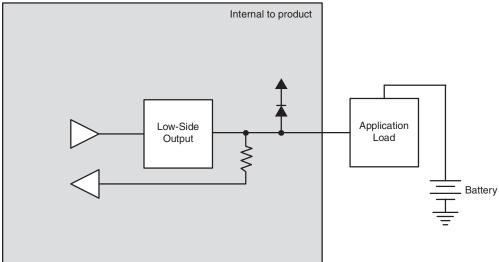


Figure 15: Low-side outputs with current sense installation connections

8.3. Mechanical installation procedures

Use the following guidelines when installing the DPS-C in a vehicle.

8.3.1. DPS-C dimensions

The DPS-C is approximately 257 mm wide x 172 mm high x 62 mm deep.

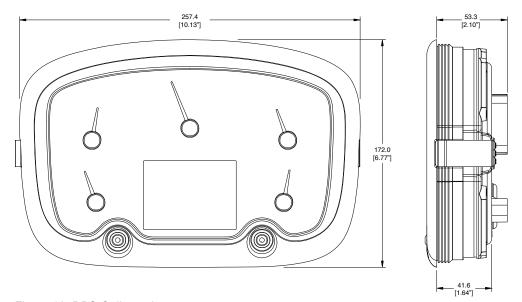


Figure 16: DPS-C dimensions



8.3.2. Cut-out dimensions

The suggested minimum panel thickness is 5 mm.

As shown in the side-view illustration above, the DPS-C has a bezeled edge. If the panel cut-out exceeds the bezel perimeter, the bezel will not hide the cut-out.

The illustration below provides more details about the cut-out. You can order a full-size .dxf version of the drawing from your Parker Vansco Account Representative. The file name is 971B01R00A-Sheet3.dxf.

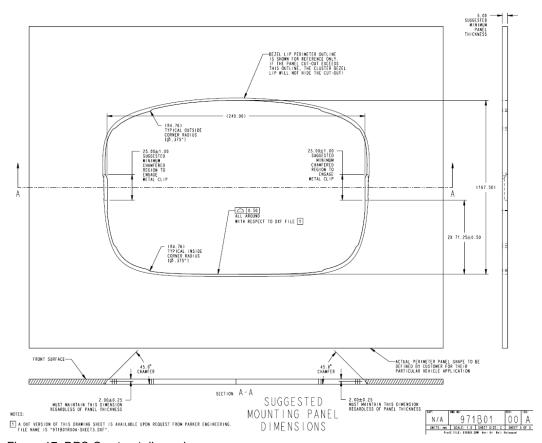


Figure 17: DPS-C cut-out dimensions

8.3.3. Mounting the DPS-C

To mount the DPS-C into a vehicle mounting panel,

- 1. Install the DPS-C from the front.
- 2. Ensure that
 - the DPS-C is oriented to the operator's viewing angle



- the wire harness connects easily to the connectors and that the bend radius is adequate
- the harness is shielded from harsh impact
- 3. Secure the DPS-C using the rubber mounting gasket and the two metal mounting clips.

8.3.4. Removing the DPS-C

In general, the DPS-C must be returned to Parker-Hannifin Electronic Controls for service or replacement.

To remove the DPS-C from the mounting panel,

- 1. Work from the front of the DPS-C.
- 2. Insert a large slot-type screwdriver into the pry slot of one of the mounting clips and fully compress the mounting clip to disengage it.
- 3. Repeat at the other mounting clip.
- 4. Pull the DPS-C from the mounting panel.

9. Startup

Oanger! Risk of injury. If the control system is not fitted properly, the machine could move uncontrollably. Do not start the machine's engine before the control system is completely fitted and its signals are verified.

In addition to the measures described below, the machine must also meet the machine directives of the country in question.

Starting the control system

Start the control system as follows:

- 1. Ensure that all modules and cables are fitted correctly.
- 2. Ensure that the correct fuses are installed.
- 3. Ensure that for supply voltage and return lines in the cable's conductor joint are connected correctly.
- 4. Verify that the emergency stop works by ensuring that it does either of the following:
 - disconnects the supply voltage to all modules
 - shuts off the diesel engine or a dump valve, thereby depressurizing the hydraulic system

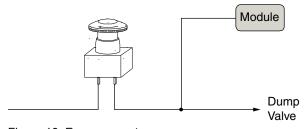


Figure 18: Emergency stop



Prepare for system start



2 Danger! Risk of injury. Make sure no one is in dangerous proximity to the vehicle.

Prepare for the initial system start as follows:

- 1. Ensure that the engine for the hydraulic system's pump is in the off position.
- 2. Ensure that all connectors are properly connected.
- 3. Turn on the control system.
- 4. Ensure that voltage is being supplied to all modules.
- 5. Ensure that the emergency stop is functioning properly.

Start the system

After the above inspections have been completed, start the system as follows:

- 1. Start the engine for the hydraulic system's pump.
- 2. Calibrate and adjust input and output signals, and carefully check every output function

10. Verification tests

The DPS-C meets the requirements of each of the tests listed below.

Test	Test Specification		
Temperature storage	EP455 Dec 1990 (R2008) Section 5.1.2 Level 2		
High temperature soak	IEC 68-2-2:1974, Section 2 - Test Bb		
Low temperature soak	IEC 68-2-1:1990, Section 2 - Test Ab		
Temperature cycling	EP455 Dec 1990 (R2008) Section 5.1.1		
Temperature shock	SAE J1455 (Jun 2006) Section 4.1.3.2		
Humidity cycling	EP455 Dec 1990 (R2008) Section 5.13.1		
Humidity soak	EP455 Dec 1990 (R2008) Section 5.13.2		
Altitude storage	EP455 Dec 1990 (R2008) Section 5.2.2		
Handling drop	EP455 Dec 1990 (R2008), Section 5.14.2.2 Level 1		
Installation harness shock	EP455 Dec 1990 (R2008) Section 5.14.2.1		
Operating shock	EN 60068-2-29:1987		
Vibration, resonance	BS 7691 (1994) Section 6.2.2		
Vibration, Sine Sweep	SAE J1455 (Jun 2006 Section 4.10.4.1 Appendix A		
Vibration, Random	BS 7691 (1994) Section 6.6.1		
Particle Impact (Lenses/Display Glass)	SAE J400 (NOV2002) Section 4.1.3.2		
Pressure wash, level 1 (front only)	DIN 40050 Part 9 (May 1993) Figure 7&8		
Pressure wash, level 2	IEC 60529 Ed. 2.1 (Feb 2001) Section 14.2.6		
Hose Wash	IEC 60529 Ed. 2.1 (Feb 2001) Section 14.2.5		
Chemical, Brush	EP455 Dec 1990 (R2008) Section 5.8.2		
Dust Ingress	IEC 60529 Ed. 2.1 (Feb 2001) Section 13.5.1		
Salt Spray	MIL-STD-202F Method D and J1226 Section 9.6.2		
Readability	EP455 Dec 1990 (R2008) Section 5.4.2		
Solar Radiation	IEC 68-2-5:1975, Procedure C		



Test	Test Specification			
Steady state (12 V) reverse polarity	EP455 Dec 1990 (R2008) Section 5.10.3			
Steady state (12 V) short circuit	EP455 Dec 1990 (R2008) Section 5.10.4			
Steady state (24 V) operating voltage	SAE J1455 Section 4.13.12.1			
Steady state (24 V) overvoltage	EP455 Dec 1990 (R2008) Section 5.10.2			
Steady state (24 V) reverse polarity	EP455 Dec 1990 (R2008) Section 5.10.3			
Steady state (24 V) short circuit	EP455 Dec 1990 (R2008) Section 5.10.4			
Transient (12 V) accessory noise	EP455 Dec 1990 (R2008) Section 5.11.1			
Transient (12 V) alternator field decay	EP455 Dec 1990 (R2008) Section 5.11.2			
Transient (12 V) batteryless operation	EP455 Dec 1990 (R2008) Section 5.11.3			
Transient (12 V) inductive load	ISO 7637-2 (2004) Section 5.6.1 Pulse 1			
Transient (12 V) positive inductive	ISO 7637-2 (2004) Section 5.6.2 Pulse 2a			
Transient (12 V) load dump	EP455 Dec 1990 (R2008) Section 5.11.5			
Transient (12 V) direct coupling	ISO 7637-2 (2004) Section 5.6.3 Pulse 3a/3b			
Transient (12 V) mutual coupling with coupling clamp	ISO 7637-2 (2004) Section 5.6.3 Pulse 3a/3b			
Transient (12 V) cranking waveform	ISO 7637-2 (2004) Section 5.6.4 Pulse 4			
Transient (12 V) DC motor field decay	ISO 7637-2 (2004) Section 5.6.2 Pulse 2b			
Transient (24 V) accessory noise	EP455 Dec 1990 (R2008) Section 5.11.1			
Transient (24 V) alternator field decay	EP455 Dec 1990 (R2008) Section 5.11.2			
Transient (24 V) batteryless operation	EP455 Dec 1990 (R2008) Section 5.11.3			
Transient (24 V) inductive load switching	ISO 7637-2 (2004) Section 5.6.1 Pulse 1			
Transient (24 V) positive inductive transient	ISO 7637-2 (2004) Section 5.6.2 Pulse 2a			
Transient (24 V) load dump	EP455 Dec 1990 (R2008) Section 5.11.5			
Transient (24 V) direct coupling	Parker Environmental Test Section 4.6.19 Level 1			
Transient (24 V) mutual coupling with coupling clamp	Parker Environmental Test Section 4.6.20 Level 1			
Transient (24 V) cranking waveform	ISO 7637-2 (2004) Section 5.6.4 Pulse 4			
Transient (24 V) DC motor field decay	ISO 7637-2 (2004) Section 5.6.2 Pulse 2b			
ESD	EP455 Dec 1990 (R2008) Section 5.12 Level 1			
EMC emissions	EP455 Dec 1990 (R2008) ISO 14982 SAE J1113/41			
EMC susceptibility	EP455 Dec 1990 (R2008) ISO 14982 SAE J1113/41 (May 2000)			

11. Glossary

active high

Input type that is on when it reads a battery voltage level, and off when it is floating or grounded.

active low

Input type that is on when it reads a ground voltage level, and off when it is floating or connected to battery voltage.

analog input

An input that allows a voltage level to be read and converted to discrete digital values within a microprocessor.

application software

A level of software that makes a product (hardware) perform desired functions for the end user

bus bar

A strip or bar of copper, brass, or aluminum that conducts electricity.

CAN bus

See controller area network (CAN) bus.

CAN high

The positive wire in a shielded twisted-pair cable, which, when connected with a CAN low, provides a complete CAN differential signal.

CAN low

The negative wire in a shielded twisted-pair cable, which, when connected with a CAN high, provides a complete CAN differential signal.

CAN shield

The shielding that wraps around the CAN high and CAN low wires in a shielded twisted-pair cable.



controller area network (CAN) bus

A communications network bus that permits data from sensors and other equipment within a motor vehicle to communicate with each other and, through telltales and other diagnostic tools, with the operator.

current feedback

A circuit that allows software to measure the amount of current provided by the outputs. This circuit is typically connected to an analog input that is connected to the microprocessor. Also known as current sense or current sensing.

current sensor

A device that detects electrical current in a wire and generates a signal proportional to it.

DC-coupled

DC coupling passes the full spectrum of frequencies including direct current. The signal being read by this circuit must fall within the detection threshold range specified for the input.

digital input

An input that is typically controlled by an external switch that makes the input either active (on), or inactive (off).

duty cycle

The time that a device spends in an active or operative state, expressed as a fraction or percentage of the total cycle time (start, operate, stop).

electromagnetic compatibility (EMC)

The ability of a component within a system to function correctly despite electromagnetic interference propagated by other components in the system.

electromagnetic susceptibility

The ease with which a device, component, circuit, etc., suffers a degradation of performance when subjected to electromagnetic energy.

EMC

See electromagnetic compatibility.

FET

See field effect transistor.



field-effect transistor (FET)

A transistor whose flow of charge carriers is controlled by an external electric field

flyback

A voltage spike seen across an inductive load when its supply voltage is suddenly reduced or removed.

frequency input

An input that allows a frequency value to be read from an oscillating input signal.

gain

To increase the voltage level of an input signal to maximize the resolution of an input.

ground level shift

An undesirable condition in which the ground level elevates. This condition can cause inputs to activate when they shouldn't.

high-side output

An output that provides switched battery voltage to an external load.

inductive load

A load that produces a magnetic field when energized. Inductors are electrical components that store energy and are characterized by the following equation:

$$E_{\text{stored}} = \frac{1}{2}LI^2$$

inrush current

The peak instantaneous input current drawn by an electrical device when first turned on

load

Any component that draws current from a module and is typically switched on and off with outputs. Examples include bulbs, solenoids, motors, etc.

load dump

A surge in the power line caused by the disconnection of a vehicle battery from the alternator while the battery is being charged. The peak voltage of this surge may be as high as 120 V and may, unless precautions are taken, affect other loads connected to the alternator.



low-side output

An output that provides a switched ground voltage to an external load.

open load

The disconnection of a load from an output, often because of a broken or worn wire or connector pin.

overcurrent

A fault state that occurs when a load draws more current than specified for an output, which results in the output shutting down to protect the circuitry of the product.

overvoltage

A situation in which the voltage in a circuit rises above its upper design limit.

pull-down resistor

A resistor that connects an input to a ground reference so that an open circuit can be recognized by the microprocessor, which is typically used on active-high digital inputs or analog inputs.

pull-up resistor

A resistor that connects an input to a voltage reference so that an open circuit can be recognized by the microprocessor, which is typically used on active-low digital inputs or analog inputs.

pulse counter

A device that detects and counts pulses occurring on a frequency input for a given period of time.

pulse-width modulation (PWM)

A digital logic circuit programmed to produce a pulse having any desired period or duty cycle. It is a means of controlling variable speed motors. See also duty cycle.

PWM

See *pulse-width modulation*.

sensor power

A regulated voltage output that provides a set voltage level for analog sensors attached to the product.



short-to-battery

A fault state that occurs when an input or output pin is connected to battery power, potentially resulting in high current flow.

short-to-ground

A fault state that occurs when an input or output pin is connected to system ground, potentially resulting in high current flow.

slew rate

- 1. The maximum rate at which an output voltage can swing across its full dynamic range.
- 2. The maximum rate at which a control system can react to an adjustment or change.

steady state

In a circuit or network, a state of equilibrium undisturbed by transients. Compare *transient*.

switching threshold current

The minimum amount of current required in an input before its associated telltale illuminates

system noise

Electrical interference generated from external devices that affect the behavior of inputs, outputs, and sensors. System noise can be generated from things like the vehicle alternator, engine, transmission, etc.

telltale

An optical signal that, when illuminated, indicates the status of a system within a motor vehicle.

terminating resistor

A resistor placed at the end of a wire to absorb signals and prevent them from reflecting back into the line and causing interference.

TFT LCD

See thin-film transistor liquid-crystal display.

thin-film transistor liquid crystal display (TFT LCD)

A liquid crystal display in which each pixel of the screen is powered separately by a transistor.



transflective liquid crystal display

A liquid crystal display that reflects and transmits light, permitting readability in varying light conditions.

transient

A short-lived burst of energy caused by a sudden change of state. Compare *steady state*.

transient voltage suppressor

A Zener diode engineered for high-power current switching. See also *Zener diode*.

transorb

See transient voltage suppressor.

wetting current

The minimum current needed to flow through a mechanical switch to break through any film of oxidation that may be on the switch contacts.

Zener diode

A diode that allows current to flow in the reverse direction when voltage is above a certain value.

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