Display Panel Standard

DPS70

With 7” touchscreen

User Guide

UG-DPS70-1020000-201906-003

Parker Hannifin Canada

Electronic Motion and Controls Division

1305 Clarence Avenue

Winnipeg, MB R3T 1T4 Canada

office +1 204 452 6776

Fax +1 204 478 1749

http://www.parker.com/emc

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Contents

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. 001	First release of this document, February 2014
Rev. 002	Minor edits from User Guide review meeting, 2014-02-25 and 2014-03-03
Rev. 003	Remove 3rd CAN bus (not implemented), 2019-06-05
Rev. 004	Adding additional communication text for hardware revisions
Rev. 005	Update to the sleep mode current draw in section 4 (02/27/2024)
Rev. 006	Added new section “7.5 Odometer” (4/01/2024)

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:

Danger! Risk of death or injury.

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.

⚠ Electronic 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

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.

1. About the DPS70

The DPS70 product is a display cluster that has a 7" touch screen, 4 analog gauges and 26 indicator lights. The product is provided with a Linux operating system.

The product includes five NTSC/PAL D1 video inputs for display of vehicle cameras. Four of the video inputs can be simultaneously viewed on the display. The fifth input is recommended to be dedicated for the backup camera.

The communication options to the cluster are USB host, USB device, RS232, 10/100 Ethernet and 2 CAN buses.

Figure 1: DPS70 display cluster

The DPS70 is controlled by software. Contact your Parker Vansco Account Representative for more details about the programming tools.

The DPS70 has 26 LEDs that are used as status indicators:

- 6 RGB tricolor with feed back
- 6 RGB tricolor
- 2 green
- 2 amber
- 6 red
- 1 blue
- 3 red gauge warnings.

The locations of the colors are fixed. The overlay can be configured by the customer. Contact your Parker Vansco Account Representative for more details.

The DPS70 has 4 gauges and a large 7" (800x480) TFT LCD, IPS.

The DPS70 has a buzzer that is intended to be used typically for a fault alarm but could also be used for other sounds.

The DPS70 can monitor up to 26 inputs:

- 10 analog inputs.
- 2 frequency inputs.
- 9 digital inputs (3 have option to be populated as wake-up/power control).
- 5 video inputs.

The DPS70 has 2 outputs:

- 2 high-side outputs.

The DPS70 has a sensor supply output:

- 1 sensor supply output (5 V, 100 mA).

The DPS70 can detect the following faults on the outputs:

- Short-circuit
- Overcurrent
- Open load

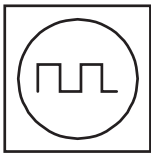
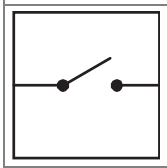
The DPS70 has 10 connectors:

- 2 x 20-pin Molex connectors that are used to interface with the inputs, outputs, and CAN.
- 1 USB host type A.
- 1 USB device type B.
- 1 Ethernet RJ45
- 5 BNC for video inputs

This manual describes the hardware components of the DPS70 but does not explain how to write or configure the software. For more information about software, refer to the appropriate software manual or contact your Parker Vansco Account Representative.

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
	Pull-down resistor

Symbol	Meaning
	Pull-up resistor
	Battery
	Fuse
	Resistor
	Ground
	Chassis ground

1.2. Regulatory Requirements

The following sections summarize the regulatory requirements to be met by the DPS70.

1.2.1. Regulatory Compliance

This product will be regulatory compliant to the following:

- Restriction of Hazardous Substances (RoHS) Compliant to Directive 2002/95/EC
- Waste Electrical and Electronic Equipment (WEEE) Compliant to Directive 2002/96/EC

1.2.2. Declaration of Regulatory Compliance

The product will be declared RoHS Compliant to IPC-1752 Class 1.

2. Inputs

The DPS70 has digital, frequency, and analog inputs.

> ⚠ ***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 DPS70. If an inductive load must be connected to an input, use a protective diode or transorb.

2.1. Analog Inputs

The DPS70 has 10 analog inputs, Analog Input 1 to Analog Input 10. All of the analog inputs are biased to a midpoint with pull-up resistor. This allows them to be used as a tri-state input.

2.1.1. Analog Input Capabilities

The following table provides specifications for the analog inputs:

Analog Input Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Input voltage range	0		6.6	V
Input pin capacitance		.05		µF
Pull-up/down resistance		10		kΩ
Response to step change		5		ms
Over-voltage			36	V
ADC reference voltage		3.3		V
Resolution - 10 bit ADC		3.2		mV
Offset error			50	mV
Drift error			±1	%
Open Load Voltage with 10k pull-up	1.36	1.46	1.56	V

2.1.2. Analog Input Configuration Options

All analog inputs are hardware configurable with an optional pull-up resistor to +5V. The default configuration for all of the analog inputs has the resistor populated.

2.1.3. Analog Input Installation Connections

The sensor supply along with the sensor ground are the recommended power feed to external sensors. This will prevent system noise from affecting the analog input signals.

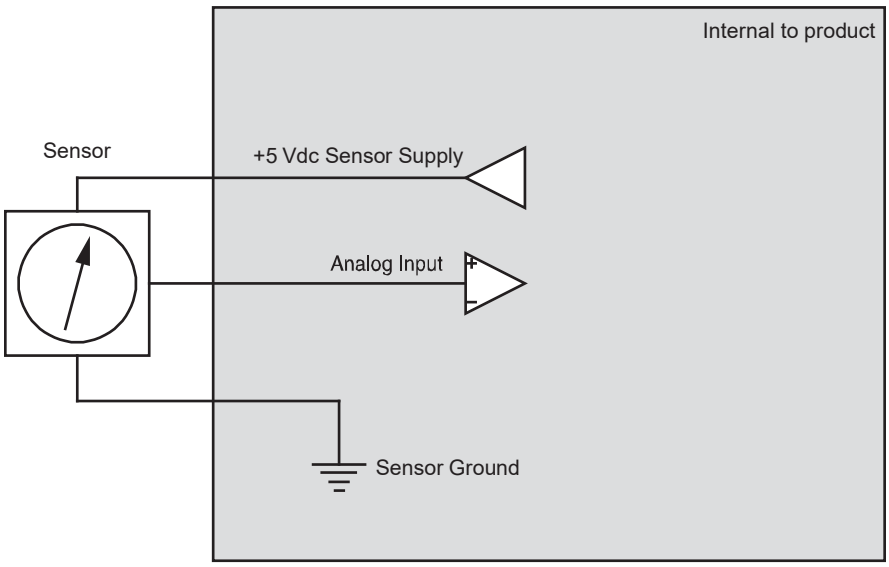


Figure 2: Analog input system noise connection

> ***Note:*** It is important that the sensor supply does not connect to another power source external to the DPS70. The sensor ground should also not be connected to any other ground on the vehicle.

2.2. DPS70 Frequency Inputs

There is one type of frequency input in the DPS70:

- Direct coupled frequency input

Direct coupled frequency inputs are typically used to read pulse signals.

The DPS70 has 2 direct coupled frequency inputs:

- Frequency Input 1 to Frequency Input 2

2.2.1. DPS70 Frequency Input Capabilities

Direct coupled frequency inputs allow you to read the frequency of external signals that have a ground reference and no DC offset. These inputs are ideal for use with hall-effect type sensors.

The following table provides specifications for the DPS70's direct coupled frequency inputs:

Direct Coupled Frequency Input Specifications				
Item	**MIN**	**NOM**	**MAX**	**UNIT**
Negative going switching threshold			1.56	V
Positive going switching threshold	3.82			V
Input capacitance at pin		.005		µF
Over-voltage			36	V
Frequency accuracy			5	%
Frequency range (note 1)	0		10000	Hz
Pull-up/down resistor		10		kΩ

Note 1: Electrically signals to 0 are possible, but the software will limit the minimum measureable frequency

2.2.2. DPS70 Frequency Input Installation Connections

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

The sensor supply along with the sensor ground are the recommended power feed to external sensors. This will prevent system noise from effecting the frequency input signals.

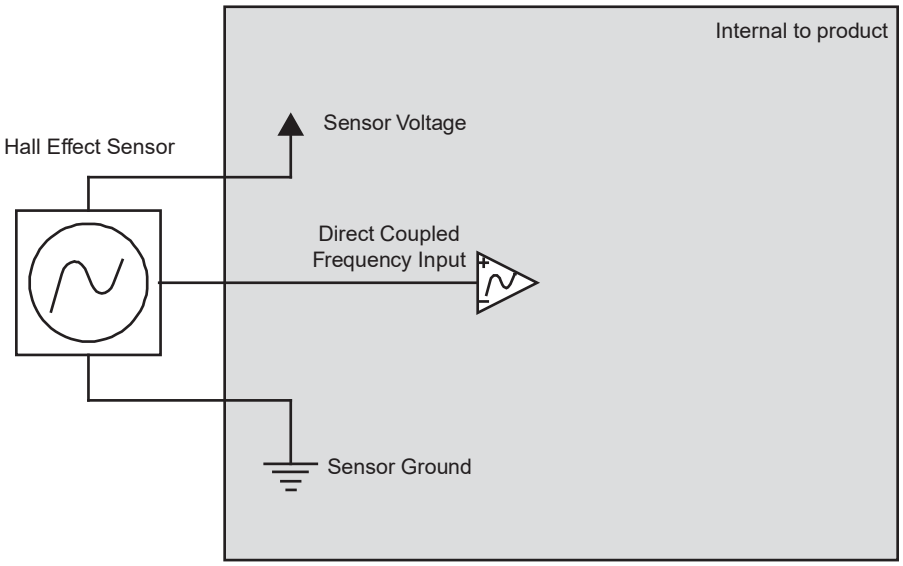


Figure 3: Direct coupled frequency input installation connections

Note: It is important that the sensor supply does not connect to another power source external to the DPS70. The sensor ground should also not be connected to any other ground on the vehicle.

2.3. Digital Inputs

The DPS70 has 9 digital inputs:

- Digital Input 1 to Digital Input 3
- Digital Input 4 to Digital Input 9

All of 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_{BATT} depending on the active state of the input.

The DPS70 has 2 types of digital inputs:

- Hardware configurable active-high or active low, Digital Input 1 through Digital Input 9
- Hardware configurable to be active-high "Wake-up input", Digital Input 1 through Digital Input 3

2.3.1. DPS70 Digital Input Capabilities

All digital inputs are hardware configurable as either an active-high input (with a pull-down resistor), or an active-low input (with a pull-up resistor).

Digital Input 1 to Digital Input 3 can be configured as wake-up inputs. When the unit is in inactive power mode and a high signal is applied to a digital input configured as a wake-up input, the unit will enter normal operating mode and begin to operate.

> ***Note:*** A digital input that is configured as a wake-up input must also be hardware configured as an active-high input (pull-down resistor) to prevent the system from continuously remaining powered up.

The following table provides specifications for the DPS70's digital inputs:

Digital Input Specifications - HW configurable as Active-High or Active-Low				
Item	**Min**	**Nom**	**Max**	**Unit**
Input voltage range	0		32	V
Over-voltage			36	V
Inductive load protection		no		
Input capacitance		.05		µF
Response time to step input		1.5		ms
Input high threshold			4.62	V
Input low threshold	1.98			V
Active-High Configuration				
Input resistance to ground		1.2		kΩ
High threshold @ 9 V	1			kΩ
Low threshold @ 16 V			8.2	kΩ
Active-Low configuration				
Input resistance to 3.3 V `(note 1)`		1.2		kΩ
High threshold			700	Ω
Low threshold	200			Ω

Note 1: Active low has pull-up to 3.3V through a diode to prevent backfeeding into power supply.

2.3.2. Digital Input Installation Connections

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

When the input is active-low

- When the switch is open, the pull-up resistor ensures that voltage exists on the input signal, which will be interpreted by the DPS70 as inactive
- When the switch is closed, the input is connected to ground, which will be interpreted by the DPS70 as active

When the input is active-high

- When the switch is open, the pull-down resistor ensures that no voltage exists on the input signal, which will be interpreted by the DPS70 as inactive
- When the switch is closed, the input is connected to battery voltage, which will be interpreted by the DPS70 as active

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

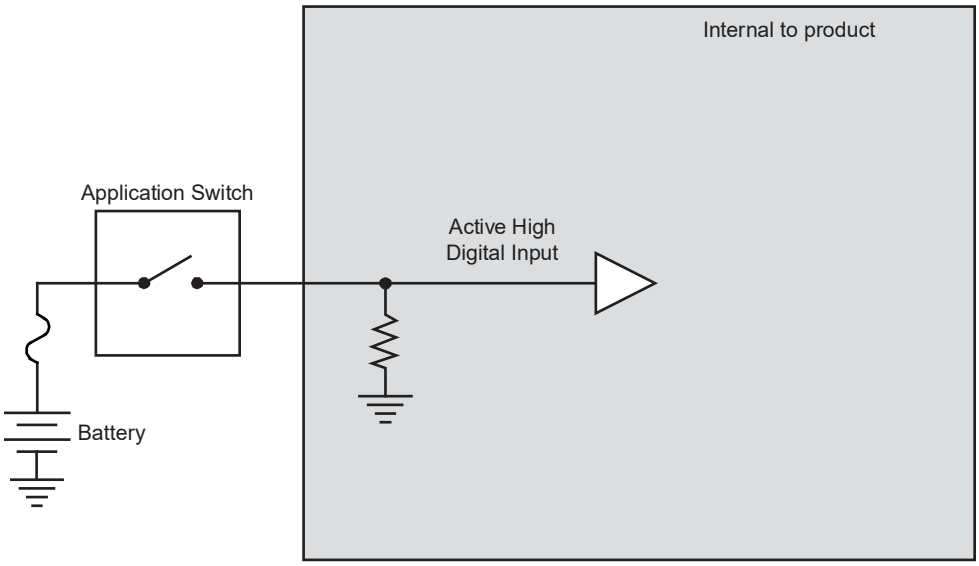


Figure 4: Active high digital input

2.4. Video Inputs

The DPS70 accepts 5 NTSC/PAL camera inputs via BNC video connectors on the rear of the unit. Inputs #1 and #2 feed are multiplexed to the same input of the video decoder. Video inputs 3, 4 and 5 have dedicated decoder inputs. Up to 4 video feeds can be shown on the display simultaneously.

2.4.1. Video Input Capabilities

The following table provides specifications for the video inputs:

Video Input Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Input voltage range	-5.6		5.6	V
Input resistance		75		Ω
Capacitance at pin		65	100	pF

3. Outputs

There are 2 types of outputs on the DPS70. There are two high-side outputs and a 5V sensor supply output.

- High-side outputs
- Sensor supply output

3.1. High-Side Outputs

The DPS70 has 2 high-side outputs:

- High-Side Output 1 to High-Side Output 2

High-side outputs are used for switching voltages to loads using either a pulse width modulated (PWM) signal, or an on/off signal. They can also test for various fault conditions.

3.1.1. High-Side Output Capabilities

All high-side outputs come with internal flyback diodes that provide protection when driving inductive loads.

- When a high-side output is used as a PWM signal, a pulsed output signal is provided by the DPS70, where the percentage of time that the output is “on” vs. “off” is determined by the duty cycle of the signal. The duty cycle is determined by the software
- When a high-side output is used as an on/off signal, the output provides battery voltage when in the “on” state (the software is responsible for switching high-side outputs on and off)

The following table provides specifications for the DPS70's high-side outputs:

High-Side Output Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Switchable voltage range	9		32	V
Over-voltage			36	V
Inductive pulse protection		yes		
Output pin capacitance		.005		µF
Single Output				
Output current (DC)			4	A
Output current (200 Hz)	1		2.5	A
Output current (500 Hz)			1.5	A
2 Outputs				
Output current (DC)			3	A
Output current (200 Hz)			1.5	A
Output current (500 Hz)			.75	A

3.1.2. High-Side Output Configuration Options

The DPS70 high-side outputs may be configured with a software controlled 10 kΩ pull-up resistor to battery for open load detection in the off state.

3.1.3. High-Side Output Installation Connections

When connecting the high-side outputs, 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 high-side output can provide switched battery power to any load type in a vehicle
- The high-side output has an internal flyback diode to absorb electrical energy when the load is turned off

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:

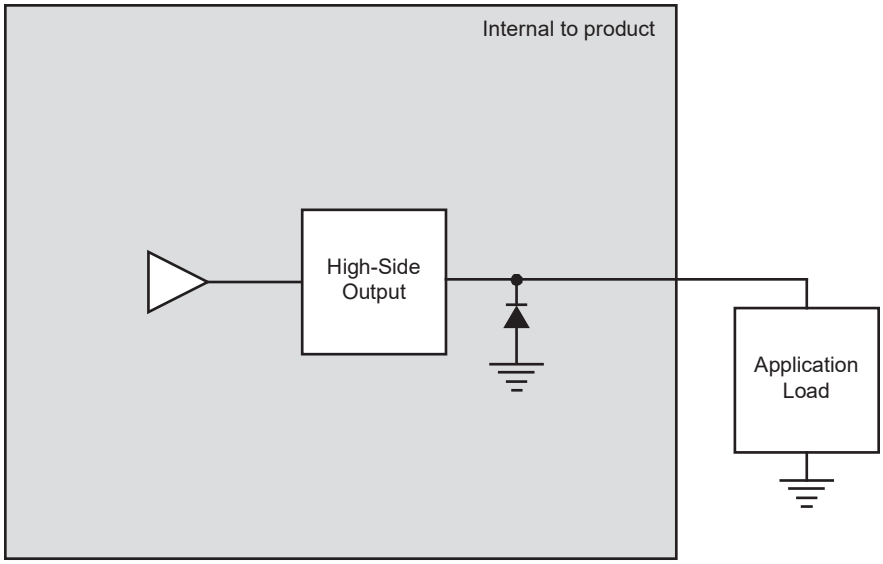


Figure 5: Typical high-side output installation connections

The high-side driver is self-protecting and will shut off during a short circuit or if an over temperature condition occurs. When the condition clears, the output driver automatically tries to turn on the load.

> ⚠ ***Damage to equipment!*** Repeated cycling into a short circuit could potentially lead to damage.

The output will be latched off if a short circuit or over temperature fault occurs. A software cycling of the output driver state is required to turn the output on again.

3.1.4. High-Side Output Diagnostics and Fault Detection

The DPS70 high-side outputs have the ability to report many different fault conditions. They are protected against short-circuit, overcurrent, open load, short-to-battery and short-to-ground faults.

3.1.4.1. Short Circuit

Short-circuit faults occur when a low-side output pin is shorted to battery and produces an output current above the specified over-current trip point, causing an over-current on the circuit.

When a short circuit or over-current fault is detected, the software automatically turns off the output.

The short circuit trip time for low-side outputs depends on how the outputs are configured.

The application software can be used to reset an output from a short circuit or an over-current fault by turning the output off and then on again.

3.1.4.2. Overcurrent

Overcurrent faults occur when a low-side output pin draws more current than the specified overcurrent trip point.

When an overcurrent fault is detected, the hardware automatically turns off the output.

The overcurrent trip time for low-side outputs is approximately 1 second.

> ***Note:*** The DPS70 can be programmed to automatically reset an output from an overcurrent fault.

3.1.4.3. Open Load

Open load faults occur when a high-side output pin is open circuit (not connected to a load). The high-side output circuit uses a small amount of current on the output pin to determine if an open load condition exists.

High-side outputs with current sense can detect an open load fault when on or off. High-side outputs without current sense must be off to detect an open load fault.

3.1.4.4. Open Load

Open load faults occur when a low-side output pin is open circuit (not connected to a load). The use of this feature operates as defined by the programmer

The low-side output circuit uses a small amount of current on the output pin to determine if an open load condition exists.

> ***Note:*** Low-side outputs must be on to detect an open-load fault.

3.1.4.5. Short-to-Battery

Short-to-battery faults occur when a high-side output pin is connected to battery voltage.

The high-side output circuit uses voltage on the output pin to determine if a short-to-battery condition exists.

> ***Note:*** High-side outputs must be off to detect a short-to-battery fault.

3.1.4.6. Short-to-Ground

Short-to-ground faults occur when a low-side output pin is connected to ground.

The low-side output circuit uses a small amount of current on the output pin to determine if a short-to-ground condition exists.

3.2. Sensor Supply Output

The DPS70 has 2 pins, labeled `SENSOR_SUPPLY` and `SENSOR_GND`, dedicated to providing power to external sensors.

> ⚠ ***Warning!*** Do not drive more than 100 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.

3.2.1. Sensor Supply Output Capabilities

SENSOR_SUPPLY is a 5 V linear power supply that is capable of continuously providing 100 mA to external sensors.

The following table provides specifications for the DPS70's sensor supply output:

Sensor Supply Output Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Output voltage	4.75	5.0	5.25	V
Current limit		100		mA
Over-voltage			36	V

3.2.2. Sensor Supply Output Installation Connections

The sensor supply and the sensor ground are intended to be the power source for external sensors. It is important that these power signals do not connect to another power source or ground external to the DPS70.

3.2.3. Sensor Supply Output Diagnostics and Fault Detection

The sensor supply voltage is monitored as an analog channel. This allows for increased accuracy of external sensors that are connected to the supply, and permits fault detection from short circuit to the supply.

4. Power

The DPS70 operates in a 12 V or 24 V system and is powered by a direct battery connection. The direct battery input is protected against vehicle transients. It is also protected against reverse battery voltage and abnormal high battery voltage by shunting the internal current to ground and blowing the automotive fuse that must be designed into the power circuit in the end system application.

The following table provides specifications for the DPS70's power supply:

Power Specifications				
Item	**Min**	**Nom**	**Max**	**Units**
Input voltage for normal operation	9	-	32	V
Minimum cranking voltage (note 1)	7	-		V
Overvoltage protection (DC)	-	-	36	V
Reverse battery protection (note 2)	-	-	-36	V
Typical current at 12 V (note 3)	-	700		mA
Off-state current, V_{BATT} of 12 V			<10	mA
Rating of External Fuse	-	-	10	A

Note 1: The unit will operate below 9V, down to 7V, but the warning LED's may be dim.
Note 2: The unit is protected against a reverse battery condition by causing an external fuse to blow.
Note 3: Does not include current required for outputs

5. Communication

The types of communication available to the DPS70 are Controller Area Network (CAN) communication, USB host, USB device, RS232 and Ethernet.

If the PC used for ladder logic and diagnostics has additional software loaded on it (not a PC dedicated solely to VMMS), viewing the ladder logic rungs, performing diagnostics or other PC to VMM system diagnostics will slow significantly if the VMM ladder logic file is large. This is due to the amount of information that needs to be transferred and configured on the PC. Note this delay could be up to 10 or 15 minutes, depending on the size of the ladder logic file, the PC and other software and configurations loaded on the PC.

When loading the VMM application file and the DPS70 configuration file, the application file must be loaded before the configuration file or the DPS70 will become unresponsive.

When loading the DPS70 files from a USB stick, the major version of the NeRP file and the major version of the configuration tool are compared. If the major versions don't match, when the DPS70 is repowered, it will boot to the service screen. Once in the service screen, the Menu screen can be selected to retry the file load. In order to prevent incorrect operation of the DPS70, the unit will not be functional beyond the menu screens. The version mismatch must be resolved before the DPS70 will be fully operational.

A hardware revision has been made to the DPS70. The new revision of hardware is identified as Rev B. Units with this new revision, will be noted on the product label as “Rev B”. In addition, when the DPS70 is booted up for the first time from

the factory, the text “Rev B Hardware” will appear in the lower left corner of the LCD screen.

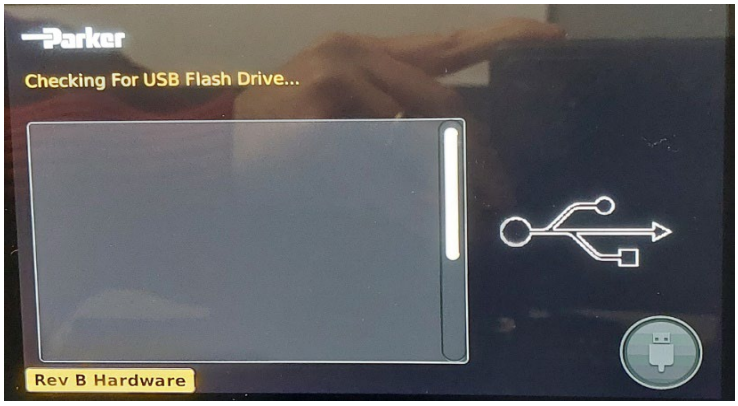


Figure 6: RevB hardware version

The older versions of the NeRP files are not compatible with the Rev B hardware, so a new version of the NeRP files have been released. Theses can be found on the Parker website, under www.parker.com/dps70, under Related Documents. The new software is compatible with both the older hardware and the REV B hardware so user should download and use the new Rev B software in all cases.

5.1. CAN

There are two CAN buses on the DPS70 that meet the CAN2.0B specification. All buses can be hardware configured for an internal 120 Ω termination resistor. The resistor is not populated in the default version.

The following table provides specifications for the CAN:

CAN Specification				
Item	**Min**	**Nom**	**Max**	**Unit**
Over-voltage			30	V
On-board terminator (optional)		120		Ω
Baud rate	125	250	500	Kbps
Capacitance		33		pF

5.2. USB Host

The DPS70 supports one USB Host port capable of high speed USB 2.0. The USB Host port will support a device with current drain not exceeding 500mA.

The following table provides specifications for the USB host:

USB Host Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Communication speed - High Speed			480	Mbps
Capacitance of I/O to ground		2.5	3.5	pF
Reverse standoff voltage `(note 1)`			5	V

Note 1: USB connectors are not rated to survive a short to vehicle battery.

5.3. USB Device

The DPS70 supports one isolated USB device capable of full speed USB 2.0. When there is no software installed, the USB device slot will default to being enabled when power is applied. Once the board is programmed, it is up to the application or driver layer to determine whether or not this interface is to remain active.

The following table provides specifications for the USB device:

USB Device Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Communication speed - Full Speed			12	Mbps
Capacitance of I/O to ground		2.5	3.5	pF
Reverse standoff voltage (note 1)			5	V

Note 1: USB connectors are not rated to survive a short to vehicle battery.

5.4. RS232

The UART is an external serial port used as a 3 wire serial interface (Rx, Tx, Gnd) operating up to 115200, 8, N, 1.

The following table provides specifications for the RS232:

RS232 Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Communication speed			115.2	kbps
Output capacitance			350	pF
Series resistance		470		Ω

5.5. Ethernet

The Ethernet port on the main microprocessor supports the Ethernet MAC layer and an external physical layer is used from the Ethernet transceiver.

The Ethernet interface supports both 10 Mbps and 100 Mbps interfaces.

6. Display

The display LCD is a 7.0” TFT LCD within Plane Switching (IPS) for a wide viewing angle and has a capacitive touch screen.

The following table provides specifications for the DPS70's display:

Display Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Size				
Aspect ratio		16:9		
Screen size		7		inch
Active area		152.4x91.44		mm
Resolution		800x480		pixels
Viewability				
Viewing angle (CR>10), U/D		178		degrees
Viewing angle (CR>10), R/L		178		degrees
Color		8 bit		
Contrast ratio (CR)	560	800		
Brightness	360	450		cd/m²
Backlight lifetime		30,000		hrs
Environmental				
Operating temperature	-30		+80	°C
Storage temperature	-30		+85	°C
Interface - LVDS				
LVDS clock	25			MHz

The following table provides the touchscreen specifications for the DPS70's display:

Touchscreen Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Surface hardness		6 - 7		H
Transmissivity		90		%
Operating temperature	-20		+70	°C
Storage temperature	-30		+85	°C
Impact rating		IK06		
Response time		60		ms

7. Gauge Area

The DPS70 has a large area for gauges that includes 26 status indicator LEDs and 4 analog stepper motor gauges.

7.1. Status Indicator LEDs

There are 26 status LEDs (telltales) on the DPS70.

The brightness of the telltales can be adjusted through software. This adjustment controls the brightness of all of the telltales, and the analog gauge backlighting, together.

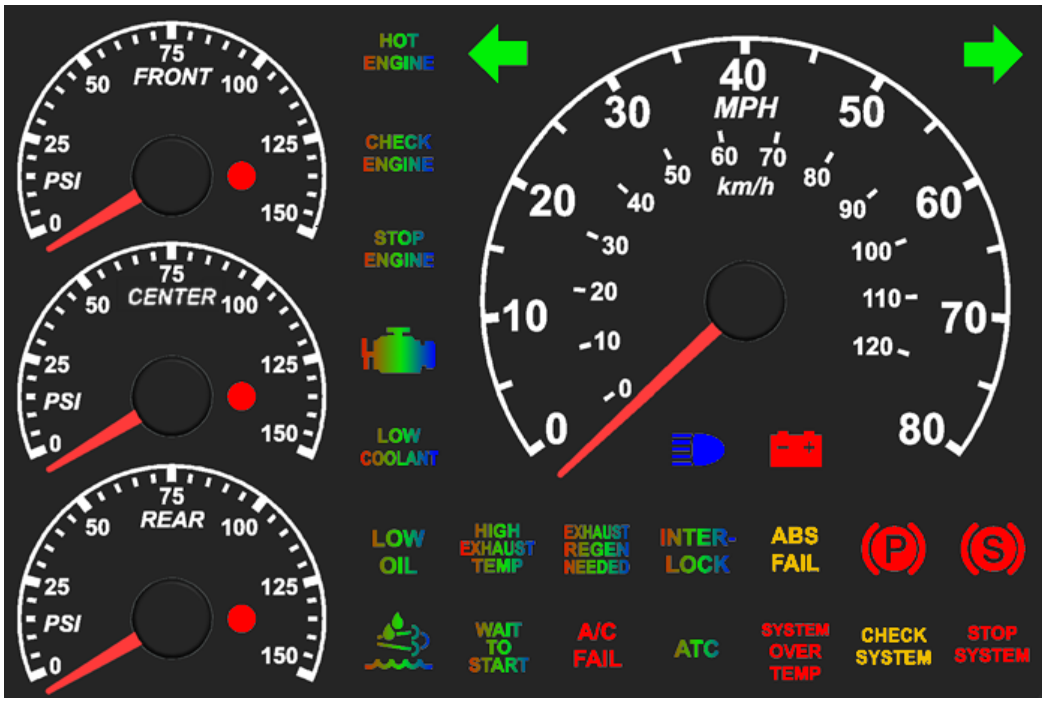


Figure 7: DPS70 telltale LEDs and color locations

The colors of the LEDs are defined as follows:

- 6 LEDs are RGB with feedback
- 6 LEDs are RGB
- 2 LEDs are Green
- 2 LEDs are Amber
- 6 LEDs are Red
- 1 LED is Blue
- 3 LEDs are Red for analog gauge warnings

Note: 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. The default overlay is shown above, but it can be customer-specific.

7.2. Analog Gauges

There are four analog gauges on the DPS70. They are implemented using stepper motors and can be micro-stepped. Micro-stepping results in pointer movement of 1/12 ° per step. The motors have internal stops and the pointers are zeroed on each power cycle.

The following table has the specifications for the analog gauges:

Analog Gauge Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Sweep range - small gauge		225		degrees
Sweep range - large gauge		250		degrees
Step size		1/12		degrees
Maximum sweep speed			600	deg/s

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

7.2.1. Gauge Backlighting

The gauges have backlighting for the sweep area and the pointers. The pointers are backlit red and gauge areas are backlit blue. The brightness of the pointer and gauges is done together with the status LEDs.

7.3. Buzzer

The DPS70 has a rear facing piezo transducer. It has two volume settings and frequency control. The volume is controlled by adjusting the duty cycle with 25% being low volume and 75% being high volume.

The following table provides specifications for the DPS70's buzzer:

Buzzer Specifications				
Item	**Min**	**Nom**	**Max**	**Unit**
Resonant frequency	2900	3400	3900	Hz
Sound pressure level @ 10 cm (note 1)	110			dBa
Voltage	1	12	36	V
Operating temperature range	-40		+85	°C
Storage temperature range	-40		+85	°C

Note 1: SPL at resonant frequency with product not installed in vehicle and the distance is off the rear cover.

7.4. Real Time Clock

The real time clock is incorporated in the gauge co-microprocessor. 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 unit. The backup battery is 3 V 1000 mAh. Minimum lifetime is 10 years when disconnected from the vehicle battery.

7.5. Odometer

The DPS70 stores the value of the odometer and trip odometer. For the standard system using the CM3033 or VMM1615 controllers and the DPS70 Instrument Panel, the odometer and trip odometer values are stored in both the controllers and the Instrument Panel. On power up, the Instrument Panel queries the controllers for the odometer reading stored on each unit. In the case where there is a difference between the values from the controllers and the that on the Instrument Panels, the value from the majority of the responding controllers is considered to be the correct value and is stored on the Instrument Panel. Since this is a “Majority rules” based system, this requires a minimum of four VMM1615 units per bus, or a minimum of two CM3033 units per bus.

8. Connectors

The connectors on the rear panel of the DPS70 are;

- MX150 – Vehicle Harness Connectors
- USB Type A - Host
- USB Type B - Device
- RJ45 - 10/100 Ethernet
- BNC - Video Camera Inputs

The Molex MX150 connectors are used to interface the DPS70 to the vehicle.

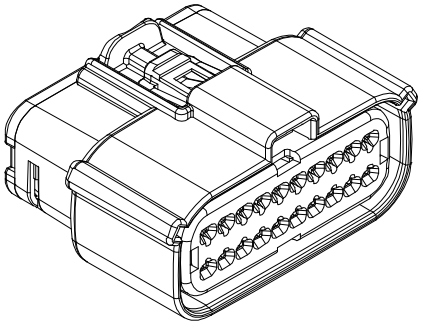


Figure 8: MX150 20-pin connector

Mating Connector Part Numbers			
Connector	**Shell part no. with locking clip**	**Shell part no. without locking clip**	**Terminals**
J1 connector (gray), 20-pin, key option B	334722007	334722002	330012004 (18-20 AWG)
J2 connector (black), 20-pin, key option A	334722006	334722001	330012004 (18-20 AWG)

8.1. Pinouts

The pins in connector positions J1 and J2 connect to inputs, outputs, power and CAN communication channels.

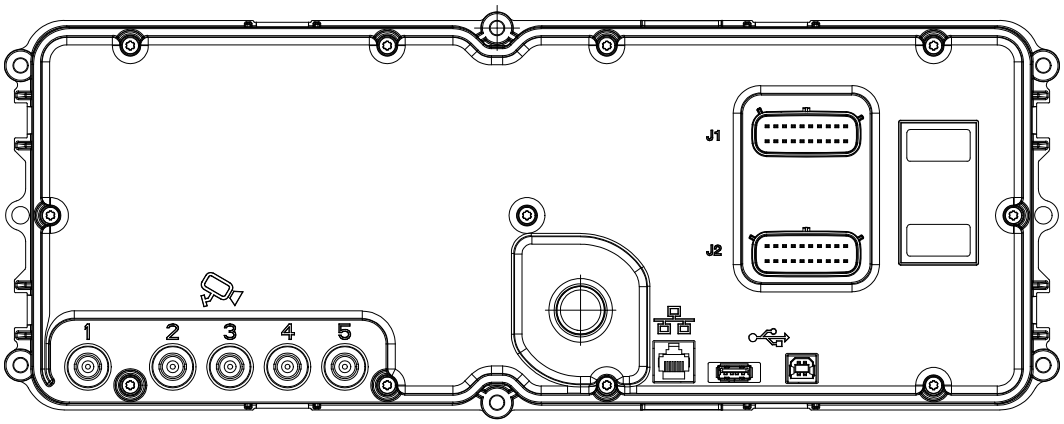


Figure 9: DPS70 rear view showing connectors

The following tables show the pinouts for each connector:

J1 Connector Pinout	
Pin	**Function**
1	Digital input 2 (Wake up)
2	Digital input 1 (Wake up)
3	CAN 2 shield
4	CAN 2 low
5	CAN 2 high
6	CAN 1 shield
7	CAN 1 low
8	CAN 1 high
9	Negative battery
10	Positive battery
11	Digital input 3 (Wake up)
12	Analog input 3
13	Analog input 4
14	Frequency input 1
15	Sensor supply ground
16	Analog input 1
17	Analog input 2
18	High-side output 1
19	High-side output 2
20	Positive battery

J2 Connector Pinout	
Pin	**Function**
1	NC
2	NC
3	NC
4	Digital input 4
5	Analog input 10
6	Analog input 9
7	Analog input 8
8	Analog input 7
9	Analog input 6
10	Analog input 5
11	Digital input 5
12	Digital input 6
13	Frequency input 2
14	Digital input 7
15	Negative battery
16	RS232 Rx
17	RS232 Tx
18	Digital input 8
19	Digital input 9
20	Sensor supply +5V

9. Mounting

It is up to the original equipment manufacturer (OEM) to ensure the product is securely mounted to the vehicle.

The following guidelines are related to physically attaching the DPS70 to a vehicle:

- Mount the DPS70 onto a flat dash panel, from behind/below
- The DPS70 should be secured with screws in all 6 screw holes using #8-32 screws from the front/top
- The screws should be tightened according to the fastener manufacturer's tightening torque specifications
- The dash panel must include a cutout(s) for the viewing areas of the gauges and LCD
- A bezel (trim ring) is recommended (usually specified and supplied by the OEM)
- Clip the bezel onto the cluster from the front after the cluster is installed into the dash panel (the dash panel must allow clearance for the bezel mounting clip features)

Refer to Parker product drawing for cluster dimensions and further mounting details. For more information contact your Parker Vansco Account Representative.

9.1. Mechanical requirements

When mounting the DPS70, ensure that

- the DPS70 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
- the buzzer hole is not blocked

9.2. Dimensions

The overall cluster envelope (including a Bezel) is nominally 472.4mm x 184.0mm x 76.6mm. Refer to Parker product drawings for more detail. For more information contact your Parker Vansco Account Representative.

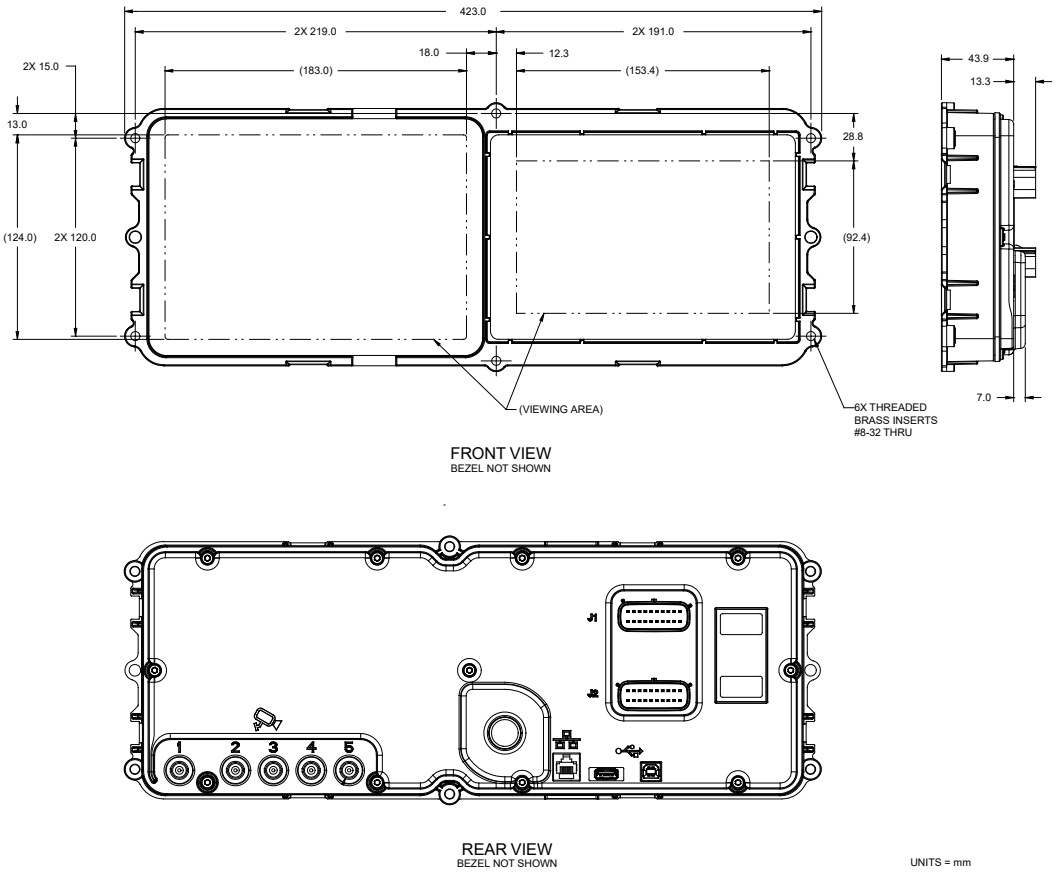


Figure 10: DPS70 dimensions without bezel

10. Environmental Protection

The DPS70 is manufactured to meet stringent industry standards. A summary of tested specifications was not available when this document was published. The information will be included in future editions. Please contact your Parker Vansco representative for more details.

11. Glossary

AC-coupled

A circuit that eliminates the DC offset voltage of the signal. This circuit is typically used with frequency inputs that have a DC offset. Note that the DC offset value varies by product.

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.

ADC

Analog to digital conversion.

aliasing

In analog-to-digital conversion, distortion that occurs when the analog signal being sampled has a frequency greater than half the sample rate. An example of aliasing is the wagon-wheel effect often seen in films, in which a spoked wheel appears to rotate differently from its true rotation.

amplified

A circuit that applies a gain with a value greater than one (1) to a measured signal, which is typically used with analog inputs.

analog input

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

anti-alias filtering

Filters incorporated in hardware that ensure the analog value being read by the module does not have a frequency component greater than half the sample rate.

application software

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

attenuation

A gradual decrease in a current's intensity. Such a decrease may occur naturally, or intentionally through the use of an attenuator.

bi-directional pin

A pin that can be used as either an input or output.

black box

A custom-compiled algorithm written in C programming language that allows a system designer to implement algorithms that are not possible in ladder logic.

bus

A subsystem that transfers data between components within a computer or between computers.

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.

clamped

Voltage that is prevented from going above a specific value.

CMOS

See *Complementary Metal-Oxide Semi-Conductor*.

complementary metal-oxide semi-conductor

A technology for constructing integrated circuits that yield high speed combined with low power consumption. CMOS technology is used in computer chips.

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.

controller I/O board

A development product that allows users to test products on a bench in a development environment before installing the product on a vehicle.

controller module

Any module that has embedded software used for controlling input and output functions.

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 feedback control

Varying the duty cycle of an output so that the output provides a desired amount of current to the load.

current sensor

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

data link adaptor (DLA)

A development tool that connects the CAN bus to a personal computer (through a USB or RS232 port), so that programming and diagnostics can be performed on the product before installing it in a vehicle.

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.

dead-fronted

A situation in which the telltales are inactive and the display appears black.

de-rating

The reduction of the rated output current level to a value less than the specified rating. De-rating is typically done so that a product does not overheat.

digital input

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

dimension

To select values so that they generate optimal results.

driver (hardware)

An electronic device that switches power or ground to an external load. The driver is a key component used in all output circuits.

driver (software)

A block of software that provides access to different hardware components.

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.

floating input

An input, isolated from a ground connection, that does not resist being pulled high or low when inactive.

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.

general purpose input

An input that can be used as an analog, digital, or frequency input.

ground level shift

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

half-bridge

The simultaneous use of a high-side switch and a low-side switch in order to provide a load having both a battery voltage and a ground.

harness address pins

The pins a product uses to identify itself within a system.

H-bridge

A combination of two half-bridge circuits used together to form one circuit. H-bridges provide current flow in both directions on a load, allowing the direction of a load to be reversed.

high-side output

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

hysteresis

The tendency, either by nature or design, for a device or system to remain temporarily (lag) in one state before switching to another. Hysteresis might be intentionally added to electronic circuits prevent unwanted rapid switching. A furnace, for example, is designed to remain on or off for some time after the room temperature reaches the thermostat's set point.

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.

keyed

Notches, slots, or other mechanical devices added to connectors so that they are connected to their mates with the proper orientation.

ladder logic

A programming language often used in industrial-control settings to control electromechanical devices in a relay. Programs written in this language resemble ladders: two vertical rails with a series of horizontal rungs—each representing a logical rule—between them. Ladder programs for Parker Vansco products are written using Vansco Multiplexing Module Software (VMMS).

leakage current

Current that flows when the ideal current is zero.

LIM16H

A light indicator module with 16 inputs that are hardwired to telltales.

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.

logic ground

Ground pins for the microprocessor and logic peripherals.

logic power

Power pins for the microprocessor and logic peripherals.

low-side output

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

module address

The binary address of the DPS70, as determined by the harnessing.

multiplexing

Transmitting multiple messages simultaneously over one channel in a local area network.

network fault flag

A special flag available in ladder logic that indicates a network problem exists (when master power is inactive and ladder logic references VMM(s) that are not available, or VMM(s) do not contain the same version of ladder logic).

Nyquist criterion

A theorem stating that a reconstructed signal will match the original signal provided that the original signal contains no frequencies at or higher than one-half the sampling frequency

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.

panel-mounted

A device mounted into a flat panel that has a cutout in the shape of the device.

PID controller

See *proportional-integral-differential (PID) controller*.

power control input

A digital input that is used to turn on the product. When the input is active, the product turns on and operates in normal mode; when the input is inactive, the product powers down and will not operate.

procurement drawing

A mechanical drawing showing the dimensions, pinouts, and implemented configuration options for a Parker Vansco product.

proportional-integral-differential (PID) controller

A system or device controller that, through constant feedback about differences between the desired state and the current state, adjusts inputs accordingly. An example of such a controller is one that prevents a vehicle from traveling faster than a specified speed, regardless of the amount of pressure on the gas pedal.

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*.

quadrature

A shaft rotation monitoring technique that provides the speed, position, and direction of the shaft.

RMS

Root Mean Square. This is a statistical measure of the magnitude of a varying quantity.

RS232

An inexpensive type of serial communication used on most PC and laptop computers that doesn't define the communication protocol, making it attractive for embedded applications. RS232 is an older technology that is slowly being phased out of production in favor of USB.

sample rate

The rate at which the microprocessor reads analog voltage levels.

sensor power

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

shielded twisted-pair cable

A type of cable used for CAN communication that consists of two wires (CAN high and CAN low) twisted together. These wires are covered by a shield material (CAN shield) that improves the cable's immunity against electrical noise.

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.

sleep mode

A low-power mode that is assumed by the DPS70 when the voltage on the power control inputs drop below a certain value.

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*.

switch outputs

An output that is digital in nature. It switches to battery and/or ground levels.

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.

temperature sensor

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

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*.

translucent

The state in which an icon diffuses light so that objects on the other side of the icon are not clearly visible (also known as semi-transparent).

transorb

See transient voltage suppressor.

transparent

The state in which you can see through an icon when the telltale is inactive.

trip time

The amount of time it takes a circuit to protect itself after a fault occurs.

VMM

Vansco Multiplexing Module

VMM system

A collection of multiplexing products that function together in a system through software.

VMMS

Vansco Multiplexing Module Software.

wake on CAN

A method of power control that makes the product turn on when a CAN message is received from another module in the system, and turn off as determined by the application software.

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.

12. Index

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