

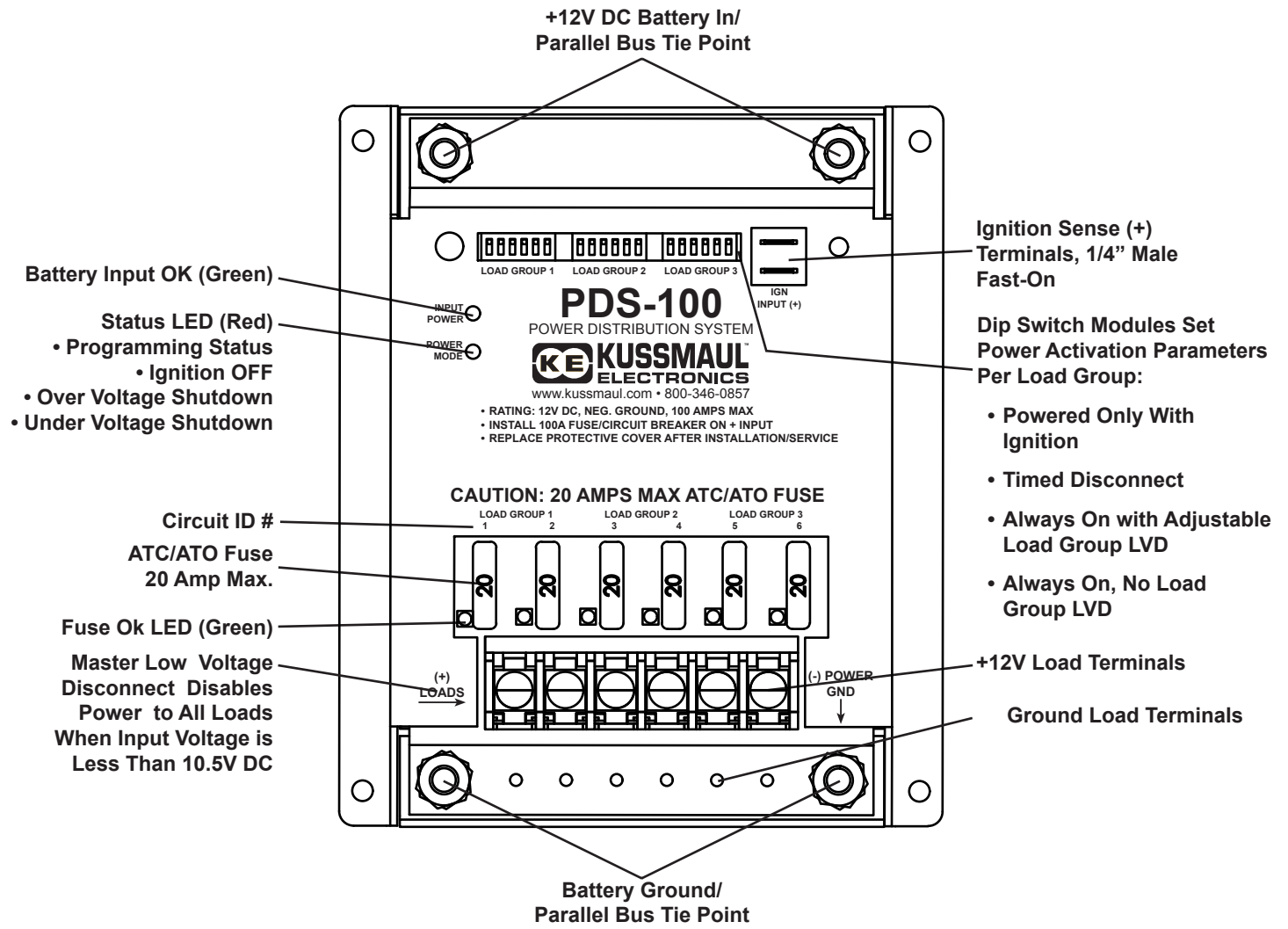


# Power Distribution System User's Manual

**Model:  
PDS-100**

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# Product Overview



## I) GENERAL INFORMATION

The PDS-100 provides emergency and public safety vehicle electronics installers with a convenient, efficient, safe and dependable method for adding distribution, circuit protection, timer and power control to communication electronics and electrical devices. Its compact size allows installation under consoles and in interior compartments (not intended for installation in engine compartment). As a standalone power distribution system, there is no interference with the vehicles factory installed wire harness; the PDS wires directly to the vehicle battery. Each of the 6 circuits are individually fused (ATO /ATC type) and wired to power-on/fuse fail indicator LED's which simplifies circuit troubleshooting.

The 6 distribution circuits are configured into 3 load groups of two, power control to each individually group is programmable via 4 user selectable options:

- Always ON
- ON with Ignition, OFF with Ignition
- ON with Ignition, Timed OFF (adjustable time interval) with Ignition
- ON with Battery, OFF upon Low Voltage sense LVD (adjustable disconnect point) with 20 second delay

In addition, the unit contains a master Under Voltage sense circuit that de-activates the whole unit @ 10.5V to save the vehicle battery from extreme discharge, and automatically reconnects when battery charge recovers. Contact factory for custom Master Under Voltage Shutdown threshold.

A High Voltage Shutdown circuit is also built-in that de-activates the whole unit @ 16.0V protecting loads against damage due to malfunctioning alternators.

System capacity can easily be expanded by wiring additional PDS in parallel (18 circuits maximum), see options below.

### Optional Accessories

- 1) Parallel Bus Bar Kit allows up to three PDS-100s inputs to be paralleled for additional circuits. One kit required for two PDS-100s, two kits for three PDS-100s. Order model PBK, part number 390-5723-0.
- 2) Parallel Load Terminal Kit allows two output circuits in the same Load Group to be paralleled for loads that exceed the single circuit, 20 amp capacity, providing up to a 32 amp circuit. One kit includes one fork terminal with hardware to allow one heavy cable to land on to two +12V load terminals of the same Load Group. Load ground cable connects to single #6 screw located on the Battery Ground bar. Order model PTK, part number 390-5725-0.

## II) IMPORTANT SAFETY INFORMATION

### CAUTION:

- Read and fully understand the installation/operation manual before making any wiring connections.
- To avoid reverse polarity confirm correct polarity before connecting cables to PDS-100.  
Stud ends are color coded with polarity:  
RED = +12 VDC/Positive  
BLACK = - 12 VDC/Negative
- Install fuse/circuit breaker on +12 VDC power feed/input wire to PDS-100. Size to match your loads and wire size.
- Connect high current feeder cables to the provided ¼" studs only.
- Run separate, dedicated ground cable (- 12 VDC) to PDS-100 ground stud. Do not rely on chassis frame for grounding connections.
- 20 Amp maximum fuse. Use ATC/ATO style fuses only.
- 12 VDC nominal negative ground systems only
- Do not exceed 100 Amps total load per unit
- Replace protective cover after installation

### III) INSTALLATION

#### IMPORTANT NOTICE:

If not using the factory default programming (see page 9, Setting to Factory Defaults), we recommend first programming the PDS-100 on a bench for convenience before installation. See page 6, Section V - Load Group Power Activation Programming.

#### A) Materials Provided

Qty.	Description
1	Installation/Operation Manual (M-PDS100)
1	PDS-100 Power Distribution System
1	Protective plastic cover
1	7" jumper wire with 1/4" female fast-on and ring terminal - use to jumper power from input bus to IGN. terminal when programming unit on bench
2	Cover attachment screws, nylon, black
4	Sheet metal mounting screws, #10 x 1/2", self tapping, Phillips Pan Head, S.S.
1	1/4" fast on terminal, 90°, insulated (Ignition sense)
1	Programming data card and holder to record settings entered
1	Rubber boot (+ battery/power feed)

Note: Fuses not provided

#### B) Location

Select position in the interior of the vehicle where there will be ample space for wire routing and access to the fuses, and where it will not be subjected to extreme heat, moisture – liquids, or impact by tools or other items stored in the compartment.

#### C) Mounting

Always attach to the vehicle metal frame so that it cannot come off in an accident or heavy breaking situations. Use provided self-tapping sheet metal screws (4 ea). Mount with fuse side up. Do not mount under the hood in engine compartment.

#### D) System Expansion - Parallel Units

Circuit capacity can be expanded by wiring a second and third PDS unit to the first (see Figure 2) each additional PDS provides 6 additional load circuits (18 circuits maximum).

### IV) Wiring Instructions & Diagrams

Refer to **Figure 1** wiring diagram for a single unit wiring & **Figure 2** for multiple unit wiring.

Refer to Tables 1, 2 & 3 on page 5 for recommended wire size for input power feed, load wiring & multiple unit input power feed.

#### Battery

**CAUTION:** Install a fuse or circuit breaker on the positive (+) battery power feed wire as close to the battery as possible in order to protect the input power feed wires. Size fuse or circuit breaker 125-150% of the maximum load current.

For single PDS-100 installations, see Table 1 "Recommended Input Power Feed Wire Size". Identify the total amperage of all loads to be connected to PDS-100 and then identify recommended wire size based on the cable distance between the vehicle battery and the PDS-100 mounting location.

Note: For any wire runs that fall between wire length shown in tables on page 5, use the longer wire run to determine wire size.

Slide provided rubber boot over positive (+) battery feed cable before crimping 1/4" stud.

For multiple PDS-100 installations, refer to Table 3 "Recommended Input Power Feed Wire Size for Multiple Units" for



battery wire size.

Use 1/4" crimp ring terminals to make the wire connection to the +12V and ground input studs on single PDS-100 installations and 5/16" crimp ring terminals (Parallel Bus Bar Kit, model PBK) for multiple PDS-100 installations. Slide rubber boot over positive (+) stud after securing cable to stud.

### Loads

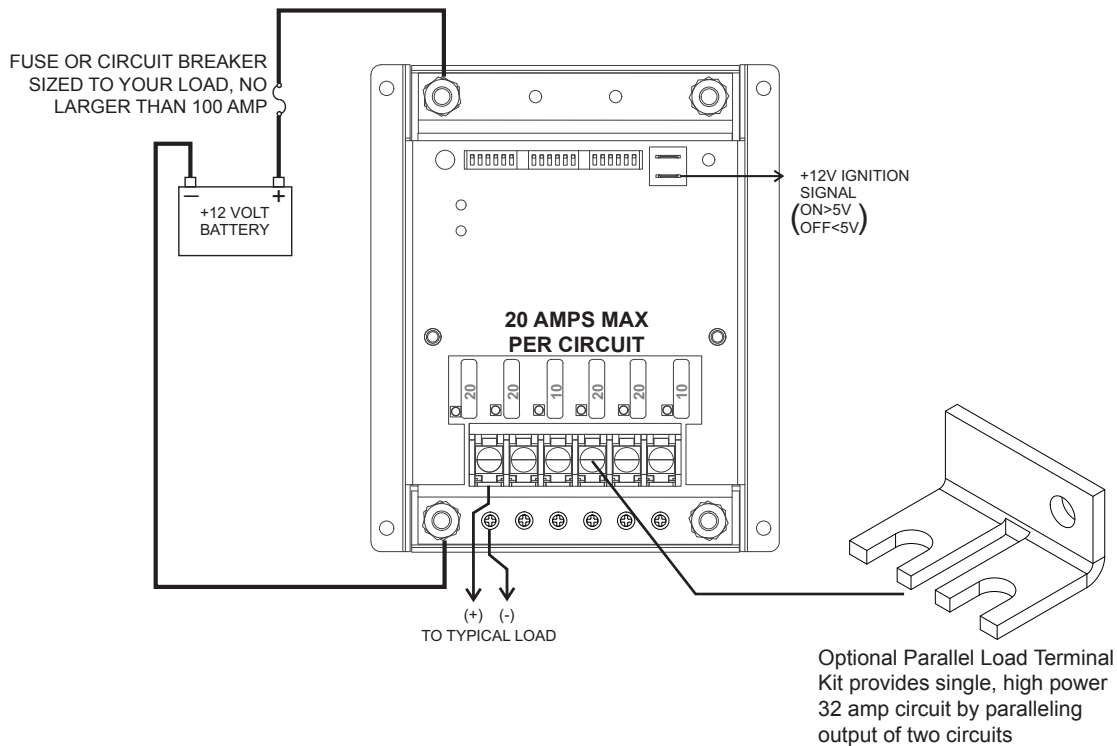
**CAUTION:** Maximum load group circuit fuse value is 20 amps. Fuses should be sized to 125-150% of the load current to prevent nuisance fuse blowing.

Refer to Table 2, "Recommended Circuit Load Wire Size" for recommended wire size for each load. Use ring or fork crimp terminals to make the wire connections to the +12V load terminal block and ground load terminals.

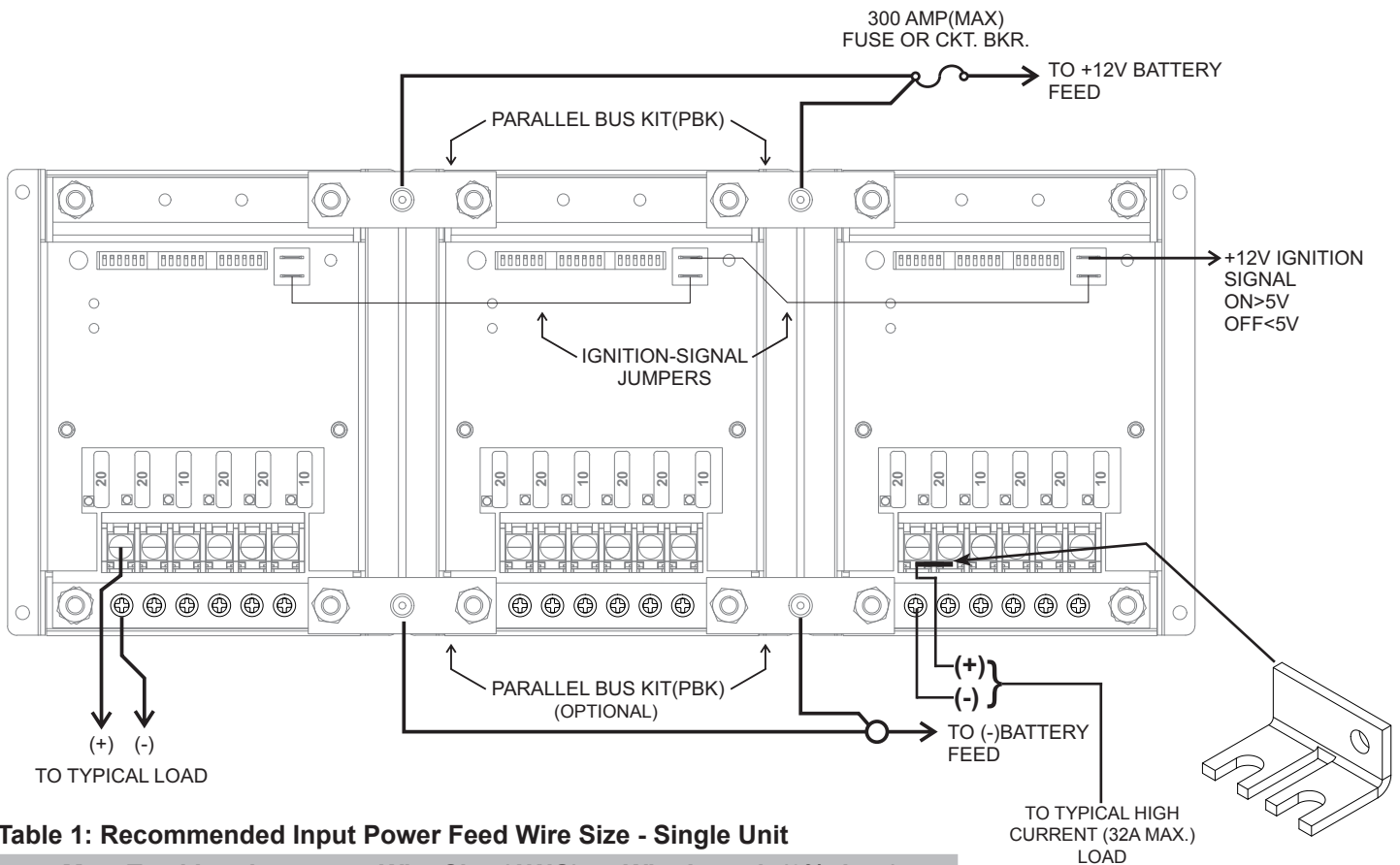
### Ignition

A wire size of 18 AWG or greater should be used to make the ignition input connection to the PDS-100. An insulated, 16/14 AWG, 1/4" female fast-on (90°) is provided.

**Figure 1: Single Unit Wiring Drawing**



**Figure 2: Multiple Unit Wiring Drawing**



**Table 1: Recommended Input Power Feed Wire Size - Single Unit**

Max. Total Load Current Amps	Wire Size (AWG) vs Wire Length (3% drop)				
	<5 ft.	5-10 ft.	10-15 ft.	15-20 ft.	25-30 ft.
25	#10	#6	#6	#4	#2
50	#6	#4	#2	#2	#0
75	#6	#2	#1	#0	#3/0
100	#4	#2	#0	#2/0	#4/0

**Table 2: Recommended Circuit Load Wire Size**

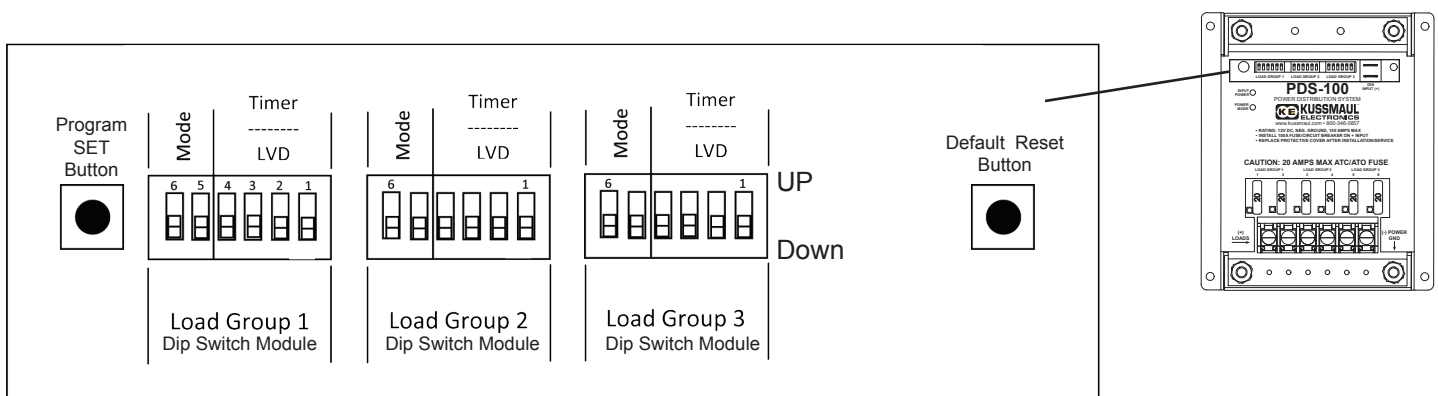
Individual Circuit Load Current	Wire Size (AWG) vs Wire Length (10% drop)				
	1-5 ft.	5-10 ft.	10-15 ft.	15-20 ft.	20-30 ft.
5	18	18	18	16	14
10	18	16	14	14	12
15	18	14	12	12	10
20	16	14	12	10	8

**Table 3: Recommended Input Power Feed Wire Size for Multiple Units**

No. of PDS-100 Units/ Max. Load Current	Wire Size (AWG) vs Wire Length (5% drop)				
	<5 ft.	5-10 ft.	10-15 ft.	15-20 ft.	20+ ft.
2/200 Amps	#2	#0	#2/0	#3/0	Not Recommended
3/300 Amps	2 x #2	2 x #0	2 x #0	2 x #2/0	Not recommended

## V) LOAD GROUP POWER ACTIVATION PROGRAMMING

### Switch Guide



### Programming Overview

The PDS-100 can be programmed to independently disconnect the 3 Load Groups based on various selected conditions. There are 3 input elements to the programming process

#### 1) Dip-Switches

Programming is provided through three sets of dip-switch modules. One per each Load Group. Each set is divided into two sections. The first section, made up of switches 5 & 6, is for selecting the power activation MODE to the Load Group. The second section, made up of switches 1 through 4, is for setting either a TIMER duration or Low Voltage Disconnect and reconnect (LVD) level of the Load Group (dependent on MODE selected). Use a screwdriver or pen to adjust dip switch positions; there are two positions - up and down.

#### 2) SET Button

This switch is used to put the PDS-100 into programming mode and save settings to memory. Also used for resetting the PDS-100 to factory defaults (see Setting to Factory Defaults on page 9).

#### 3) RESET Button

This switch resets the microcontroller. Use it to exit the programming mode without saving any settings and when resetting the PDS-100 back to factory defaults. **WARNING:** pressing the RESET switch will momentarily interrupt power to loads.

### Programming the Load Group Relays (easier performed on test bench rather than in vehicle)

Note: A short programming jumper wire is provided to aid in programming the PDS-100.

Before programming ensure 12 volt power is properly applied to unit. Connect (+) power to (+) INPUT stud and the (-) power return to the (-) ground bus stud. The PDS-100 will not power up unless input power is above 10 volts.

#### Programming

Once the battery is first connected to the PDS-100, the microcontroller operates at the factory default settings. To change any of the settings, the PDS-100 will first need to be set to programming mode. To do this:

- 1) Jumper the IGN-In terminal to the (+) INPUT bus using the programming jumper wire provided, then press and hold the SET button until the red status LED begins flashing.
- 2) Release the button and LED will stay illuminated.

The PDS is now in programming mode. **Note: if programming mode has been entered unintentionally or if you don't want to save any changes, press the RESET switch at this point to abort programming mode. Pressing reset will momentarily interrupt output voltage of all Load Groups.**

#### Load Group Activation Selection

Each of the three Load Group relays can be programmed, independent of each other, to one of four activation modes using dip-switch positions 5 & 6 (refer to the Switch Guide).

The modes are as follows:

- 1) ON with Ignition, OFF with Ignition: Circuits will be energized anytime the ignition signal is  $\geq 5$  volts and de-energized if  $< 5$  volts (with 1 second delay). When this mode is selected dip-switches 1 through 4 of that relay group have no effect.
- 2) ON with Ignition, OFF with Timer: Relay will stay energized after the ignition signal reaches  $< 5$  volts for a period of time set by dip-switches labeled 1 through 4 of that relay group.
- 3) ON with Battery Power, OFF by Load Group LVD: Relay will stay energized until the battery voltage drops below a specified level for 20 seconds set by dip-switches 1 through 4 of that relay group. The ignition signal has no effect on this group mode.
- 4) Always ON: Relay energized no matter state of ignition signal, OFF only by Master Under Voltage Shutdown (UVS).

*NOTE: Under Voltage Shutdown (UVS) or Over Voltage Shutdown (OVS) will de-energize all relays in any MODE. If the UVS or OVS threshold is reached before timer times out, power will be disconnected from load group.*

**Table 4: Power Activation Selection Table**

Mode	Description	Switch Position	
		Switch 6	Switch 5
1	IGN ON/OFF	Down	Down
2	IGN with Timeout	Down	Up
3	LVD	Up	Down
4	Always ON	Up	Up

**Timer Duration Selection (MODE 2)**

When the Load Group mode is set for mode 2, dip-switch positions 1 though 4 will set the desired timeout duration, which is the time from when the vehicle IGN is shut off to when the load is disconnected, see Table 5 for timer selection. Timer is reset when IGN input voltage is again sensed when ignition switch is turned on.

**Table 5: Timer Duration Selections**

Duration	Switch 4	Switch 3	Switch 2	Switch 1
2 min	Down	Down	Down	Down
10 min	Down	Down	Down	Up
30 min	Down	Down	Up	Down
1 hr	Down	Down	Up	Up
2 hrs	Down	Up	Down	Down
3 hrs	Down	Up	Down	Up
4 hrs	Down	Up	Up	Down
5 hrs	Down	Up	Up	Up
6 hrs	Up	Down	Down	Down
7 hrs	Up	Down	Down	Up
8 hrs	Up	Down	Up	Down
9 hrs	Up	Down	Up	Up
10 hrs	Up	Up	Down	Down
11 hrs	Up	Up	Down	Up
12 hrs	Up	Up	Up	Down
13 hrs	Up	Up	Up	Up



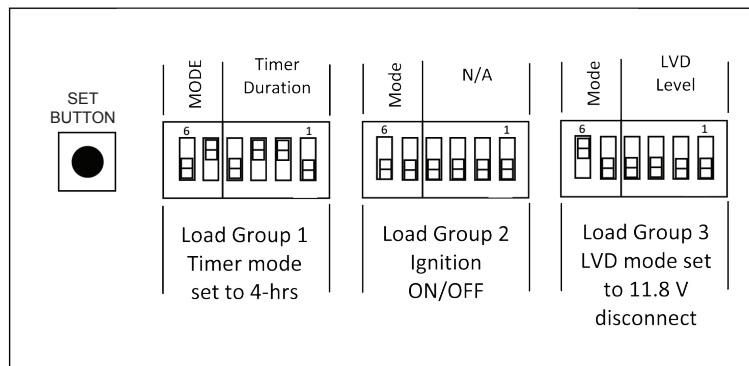
### LVD Selection (MODE 3)

When the Load Group relay is set for mode 3, dip-switch positions 1 through 4 will set the desired Low Voltage Disconnect and re-connect trip points. This is the level at which the Load Group is disconnected and re-connected. In this mode, the ignition signal has no effect on the Load Group operation.

**Table 6: Low Voltage Selection**

LV Disconnect	Reconnect	Switch 4	Switch 3	Switch 2	Switch 1
11.8	13.5	Down	Down	Down	Down
11.7	13.5	Down	Down	Down	Up
11.6	13.5	Down	Down	Up	Down
11.5	13.5	Down	Down	Up	Up
11.4	13.5	Down	Up	Down	Down
11.3	13.5	Down	Up	Down	Up
11.2	13	Down	Up	Up	Down
11.1	13	Down	Up	Up	Up
11.0	13	Up	Down	Down	Down
10.9	13	Up	Down	Down	Up
10.8	13	Up	Down	Up	Down
10.7	13	Up	Down	Up	Up
10.6	12.5	Up	Up	Down	Down
10.5	12.5	Up	Up	Down	Up
10.4	12.5	Up	Up	Up	Down
10.3	12.5	Up	Up	Up	Up

### Example Settings



### Saving and Applying the Dip Switch Settings

Once the dip-switches have been set to the desired positions press and hold the SET switch for 1 second then release to save to memory. The red status LED will flash for 4 seconds then extinguish. The PDS dip-switch settings are now stored in memory and the PDS will start operating with the new settings. NOTE: Even if power is completely removed from the PDS-100 or the reset button is pressed the new settings will not change.

### Re-Setting to Factory Defaults

To set PDS to its factory default settings press and hold the SET button, then press the RESET switch for 2 seconds when the status LED begins to flash. Release the SET button. The PDS is now reset to the factory settings.

## Default Factory Setting:

### LOAD GROUP 1

MODE = 1 ON with Ignition, OFF with Ignition

### LOAD GROUP 2

MODE = 2 ON with Ignition, OFF with Timer

TIMER = 2 minutes

### LOAD GROUP 3

MODE = 3 ON with Battery, OFF with Programmed Voltage Disconnect

LVD SET = 11.5 volts (Reconnect 13.0V)

## VI) OPERATION

A) Fuse Installation: We recommend pre-installing fuse values before powering PDS-100. The PDS-100 will accept ATO/ ATC style fuses, 20 Amp maximum rating.

B) Fuse Removal: Firmly grip fuse with fingers or needle nose pliers and pull straight out

C) Fuse OK LED: A green LED next to each fuse will illuminate when a good fuse is installed

Note: If using blown fuse indicating type fuses a minimum load of at least 20 milliamps is required for proper indication

D) Master Under Voltage Shutdown (UVS) & Over Voltage Shutdown (OVS)

UVS - If the INPUT bus voltage drops below 10.5V for more than 20 seconds all Load Group relays will de-energize and all loads will disconnect from the INPUT bus and will reconnect when battery voltage is restored to 13V.

OVS – If the INPUT bus increases to over 16V all Load Groups relays will de-energize and loads will disconnected from the INPUT bus and will restore 15V.

E) Input Power and Power Mode Indicators

INPUT POWER LED – indicates the presence of voltage on INPUT bus (>6 volts)

POWER MODE LED – rate of flashing light indicates different power conditions:

OVS: Over Voltage Shutdown, all circuits off – constant flashing at a rate of once every 1 second.

UVS: Low Voltage Shutdown, all circuits off – constant flashing at a rate of once every 2 seconds.

IGN: Ignition not present – quickly flashes 3 times every 2 seconds.

## VII) Specifications

### Electrical:

**Input:** 12V, neg. ground

**Power Consumption:** Idle: 8mA, Active: 180 mA/circuit

**Maximum Load:** 100A per PDS, 20A max. per fuse position

**Maximum System:** 3 PDS wired in parallel, 18 circuits

**Fuse Type:** ATC/ATO

**Programmable Timer Range:** 2 min. – 13 hours

**Low Voltage Disconnect Point Range:** Selectable per load group, 10.3 to 11.8V (see table 6 for reconnect voltages), 20 second delay

**Master Disconnect:** High Voltage 16.0V (OVS), Low Voltage 10.5 (UVS), 20 second delay

**Operating Temperature Range:** -20° C to +60° C

### Mechanical:

**Case:** Powder coated aluminum

**Protective Covers:** Battery “+” bus and “+” power out terminals

**Dimensions (H x W x D):** 5.6” x 4.75” x 3.1”, **Weight:** 2 Lbs.



## VIII) Troubleshooting

Problem/Symptom	Possible Cause	Solution
No power to any of the six outputs	<ol style="list-style-type: none"> <li>1) No or low (&lt;10V) input power</li> <li>2) Bad power input ground connection</li> <li>3) Defective unit.</li> </ol>	<ol style="list-style-type: none"> <li>1) Remove protective plastic cover &amp; place a dc voltmeter or DMM across PDS-100 positive &amp; negative power input studs to verify input voltage. If no voltage check for blown or tripped input fuse/circuit breaker.</li> <li>2) If no power to PDS-100 input and fuse/breaker is OK, check for loose ground cable.</li> <li>3) Contact Kussmaul for RMA.</li> </ol>
Load Group set for timed disconnect turns off too soon	<ol style="list-style-type: none"> <li>1) DIP switches not set correctly</li> <li>2) Battery voltage is dropping below 10.0 VDC causing activation of Master Low Voltage Shutdown circuit</li> <li>3) Unit may have been reset to Factory Default settings, thus unit is not operating according to the dip switch positions observed.</li> </ol>	<ol style="list-style-type: none"> <li>1) Reset this Load Group for Mode 2: IGN with Timeout &amp; verify time period selected, see Section V.</li> <li>2) Check for low voltage at the battery terminals. If voltage is low: recharge. If problems persists check for faulty alternator or replace battery.</li> <li>3) Re-program the unit - see page 6.</li> </ol>
Load Group set for timed disconnect does not disconnect	<ol style="list-style-type: none"> <li>1) DIP switches not set correctly</li> <li>2) Defective unit</li> <li>3) Unit may have been reset to Factory Default settings, thus unit is not operating according to the dip switch positions observed.</li> </ol>	<ol style="list-style-type: none"> <li>1) Verify DIP switches for this Load Group are set for Mode 2: IGN with Timeout &amp; verify time period selected, see Section V.</li> <li>2) Contact Kussmaul for an RMA.</li> <li>3) Re-program the unit - see page 6.</li> </ol>
Ignition controlled circuits not on when ignition is ON.	<ol style="list-style-type: none"> <li>1) Ignition terminal on PDS-100 not receiving +12 vdc when ignition is on.</li> <li>2) Incorrect Mode programming selected for this Load Group.</li> <li>3) Unit may have been reset to Factory Default settings, thus unit is not operating according to the dip switch positions observed.</li> </ol>	<ol style="list-style-type: none"> <li>1) Check ignition wiring, check for blown ignition source fuse.</li> <li>2) See Mode selection section on page 6.</li> <li>3) Re-program the unit - see page 6.</li> </ol>
Load Group set for low voltage disconnect, disconnects when battery is not below selected disconnect threshold	<ol style="list-style-type: none"> <li>1) DIP switches not set properly</li> <li>2) PDS-100 input wires under-sized or too long resulting in excessive voltage drop</li> <li>3) Unit may have been reset to Factory Default settings, thus unit is not operating according to the dip switch positions observed.</li> </ol>	<ol style="list-style-type: none"> <li>1) See Table 6 for LVD disconnect voltage choices</li> <li>2) See Table 1 'Recommended input power feed wire size' and increase wire size or reduce wire length.</li> <li>3) Re-program the unit - see page 6.</li> </ol>

No output power from individual fuse      Blown fuse  
output

Determine reason for blown fuse,  
correct fault & replace fuse

## **IX) WARRANTY**

All products of Kussmaul Electronics Company Inc. are warranted to be free of defects of material or workmanship. Liability is limited to repairing or replacing at our factory, without charge, any material or defects which become apparent in normal use within 3 years from the date the equipment was shipped. Equipment is to be returned, shipping charges prepaid and will be returned, after repair, shipping charges paid.

Kussmaul Electronics Company, Inc. shall have no liability for damages of any kind to associated equipment arising from the installation and /or use of the Kussmaul Electronics Company, Inc. products. The purchaser, by the acceptance of the equipment, assumes all liability for any damages which may result from its installation, use or misuse, by the purchaser, his or its employees or others.

# X) Dimensional Drawing

