

# SOLAR DRIVE PSD15



# INSTALLATION AND OPERATION MANUAL

pentair.com

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### Important Safety Instructions

SAVE THESE INSTRUCTIONS - This manual contains important instructions that should be followed during installation, operation, and maintenance of the Pentair Pentek Solar Drive.

This is the safety alert symbol. When you see this symbol on your Pentair Pentek Solar Drive or in this manual, look for one of the following signal words and be alert to the potential for personal injury!

**A WARNING** indicates a hazard which, if not avoided, will result in death or serious injury.

**A WARNING** indicates a hazard which, if not avoided, *could* result in death or serious injury.

**A CAUTION** indicates a hazard which, if not avoided, *could* result in minor or moderate injury.

**NOTICE** addresses practices not related to personal injury.

Carefully read and follow all safety instructions in this manual and on the Pentair Pentek Solar Drive.

Keep safety labels in good condition. Replace missing or damaged safety labels.

#### **California Proposition 65 Warning**

**WARNING** This product and related accessories contain chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

**AWARNING** Risk of high-voltage electrical shock from EMI/RFI filter inside drive. Can shock, burn or kill if the front cover of the Pentair Pentek Solar Drive is open or removed while power is connected to the Drive or the Drive is running. The front cover of the Drive must be closed during operation.

- Make all wiring connections, then close and fasten the cover before turning on power to drive.
- **NEVER** open the box when power is connected to Drive.
- Before doing any service or maintenance inside Drive or when connecting or disconnecting any wires inside Drive:
  - 1. DISCONNECT power.
  - 2. WAIT 5 minutes for retained voltage to discharge.
  - 3. Open box.
- Before starting any wiring or inspection procedures, check for residual voltage with a voltage tester.
- **NEVER** connect power wiring to Drive before mounting the box.
- NEVER handle or service Drive with wet or damp hands. Always make sure hands are dry before working on Drive.

• **NEVER** touch the printed circuit board when power is applied to Drive.

**WARNING Risk of fire.** Can cause severe injury, property damage or death if installed with incorrect or inadequate circuit breaker protection. To ensure protection in the event of an internal fault in the Pentair Pentek Solar Drive, install the Drive on an independent branch circuit protected by a circuit breaker, with no other appliances on the circuit.

**CAUTION** Risk of burns. The Drive can become hot during normal operation. Allow it to cool for 5 minutes after shut-down and before handling it to avoid burns.

**NOTICE** To avoid damage to Drive or problems with Drive make sure:

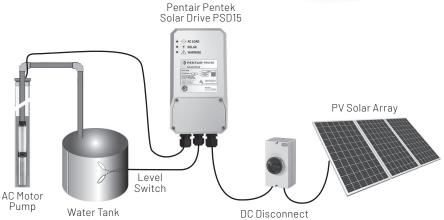
- Drive is correctly wired to the solar source and motor load
- DIP switches are configured to match motor specification
- Drive is installed in the shade away from direct sunlight
- Do not modify equipment.
- Do not use power factor correction capacitors as they will damage both motor and Pentair Pentek Solar Drive.
- Do not remove any parts unless instructed to do so in Owner's Manual.
- Do not use a magnetic contactor on Drive for frequent starting/stopping.
- Do not install or operate Drive if it is damaged or parts are missing.
- Before starting Drive that has been in storage, always inspect it and test operation.
- Do not carry out a megger (insulation resistance) test on the control circuit of the Drive.
- Do not allow loose foreign objects which can conduct electricity (such as screws and metal fragments) inside Drive box at any time. Do not allow flammable substances (such as oil) inside Drive box at any time.
- Ground Drive according to the requirements of the National Electrical Code Section 250, IEC 536 Class 1, or the Canadian Electrical Code (as applicable), and any other codes and ordinances that apply.
- All installation, service work, and inspections must be done by qualified electrician.

The Pentair Pentek Solar Drive PSD15 is an off-grid solar controller that can operate any approved Pentair Pentek submersible motor loads or operate approved alternative 3-phase alternating current (AC) motor loads up to 1.5HP from solar photovoltaic (PV) power.

To size the solar PV array to your specific motor, please consult with your local dealer or Pentair. A typical diagram for a Pentair Pentek Solar Drive operated solar water pumping system is shown in Figure 1. The solar PV array must be connected to an external DC Disconnect and then to the Pentair Pentek Solar Drive controller. The Pentair Pentek Solar Drive controller should be installed in the shade (potentially mounted under the PV array) and away from the direct sun.

The Pentair Pentek Solar Drive can accept up to two digital sensor inputs. For example, in solar water pumping applications, an optional float switch can be connected to the Pentair Pentek Solar Drive to monitor when a water tank is full, or a pressure switch can be used in combination with a pressure tank.







#### Input Specification:

- Minimum Operating Voltage :
- Maximum Solar Open Circuit Voltage:
- Maximum Solar PV Current in Series:
- Earth-ground connected to chassis

#### Output Specification:

- Maximum Output Current:
- Maximum Power Sustained:

### 7 Arms (3-phase motors) 2000W

100 Vdc (for 115 Vac) 150 Vdc (for 230 Vac)

400 Vdc

9 Amps

#### Protections:

- Short-circuit, ground-fault, over-temperature, overload, over-voltage, over-current, and solar input reverse polarity protection
- Automatic dry well protection and pump locked rotor protection

Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.

ELECTRICAL	MECHANICAL		
Solar PV open circuit voltage: 400V	Operating temperature:	-40°C to 50°C	
Max PV panel current in series: <b>9A</b>	Dimensions:	10″x5.5″x4″	
	AC Source Terminals:	AWG #10-16	
Max Three phase AC motor current: <b>7A</b>	Solar Terminals:	AWG #10-16	
Degree of protection: <b>TYPE 4</b>	Motor terminal:	AWG #8-16	
Enclosure material: Aluminum	Float Sensor terminals:	AWG #14-20	

### MARNING:

Carefully check the motor load specifications and solar PV array maximum power point voltage to set up the system properly using this manual!

### Environmental - Compliance with IEC 60068

IEC 60068-2-2 – Cold IEC 60068-2-14 – Change of Temperature IEC 60068-2-2 - Dry Heat IEC 60068-2-30 - Damp Heat The Pentair Pentek Solar Drive must be installed in a shaded location, away from any source of heat and in an area free of vegetation. Measures must also be made to protect the unit from damage by unauthorized persons, large animals, overgrowth, flooding, or other harm.

### 🛝 WARNING

The Pentair Pentek Solar Drive has voltages capable of causing severe injury or death by electrical shock. It should only be installed and serviced by Pentair authorized suppliers, dealers and installers.

- Contact your Pentair Supplier/Dealer for any service or warranty claims
- NEC codes take precedence over suggestions in this manual
- We strongly recommend that the installation data be recorded into the "Installation Notes" section
  on page 14 and that the manual is stored near the unit

The Pentair Pentek Solar Drive should be mounted at least 2 feet (60cm) above the ground when possible. A minimum of 10 inches (25cm) of clearance above the Pentair Pentek Solar Drive is required for internal access. There must be no obstruction of air flow to the heat sink. A typical installation on an array structure is shown in Figure 3, below.

Once the Pentair Pentek Solar Drive is installed in a shaded location (see Figure 3), it can be wired to DC (solar) sources. Maximum cable lengths for 115 and 230Vac for different motor load currents are shown in Figure 2 below.

Motor Load [A]	Nominal Voltage [V]	AWG Copper Wire Sizes 90°C (194°F) insulation [ft]				
		16	14	12	10	8
3.5	115	125	180	300	450	700
0.0	230	250	360	600	900	1400
4.5	115	100	150	250	350	500
4.5	230	200	300	500	700	1000
5.5	115	80	125	200	300	450
5.5	230	160	250	400	600	900
7	115	65	95	150	230	350
/	230	130	190	300	460	700

This unit was evaluated for temperature rating of 60/75°C (140/167°F) on power field wiring terminals.

#### IMPORTANT: Use copper conductors only!

#### Figure 2: Maximum Input Cable Lengths in Feet (based on 3% voltage drop)

Dimensions of the Pentair Pentek Solar Drive and back panel are shown in Figure 4, with additional details on how to mount the unit on page 7.

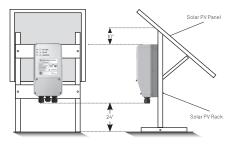


Figure 3: Pentair Pentek Solar Drive Mounting

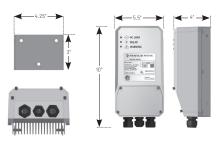
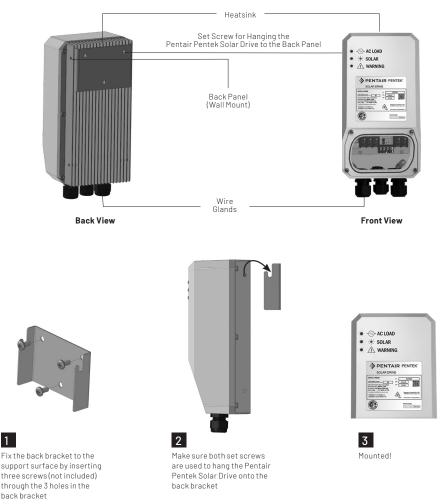


Figure 4: Pentair Pentek Solar Drive Dimensions

### Pentair Pentek Solar Drive Hardware

The Pentair Pentek Solar Drive controller consists of several components, as shown in Figure 5. The unit has three wire glands: two large glands for a motor cable (left) and for solar PV array (right), and one gland for data cables (middle), a float switch sensor or other optional sensor. There is direct access to the power and signal terminals on the circuit board once the enclosure door is removed.

The Pentair Pentek Solar Drive controller should be mounted on a wall or other vertical surface using the back bracket (see Figure 5 below). On the back side of the unit there are two set screws used to hang the unit on the back bracket. More detailed mounting instructions are shown below.



### Figure 5: Pentair Pentek Solar Drive Hardware

### Pentair Pentek Solar Drive Overview

The features of the Pentair Pentek Solar Drive controller are shown in Figure 6.

Three LEDs are used to indicate the Pentair Pentek Solar Drive controller's operation (more details provided on page 10).

Once the door of the enclosure is open, there are three terminal blocks:



1 Solar PV wires



2 Motor/pump wires

3 Pump or tank sensor wires. More information about sensor wiring and DIP switches is provided on page 8.

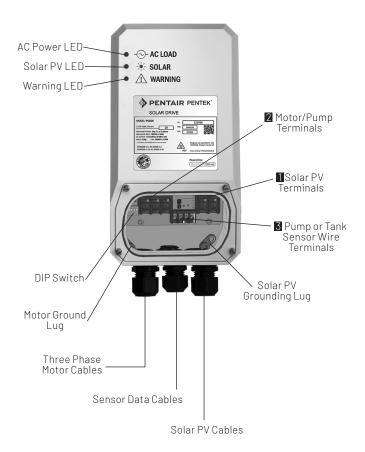


Figure 6: Pentair Pentek Solar Drive Features Overview

## **Pentair Pentek Solar Drive Wiring Instructions**

Once the system is wired (per Figure 7), the power conductors wired to the terminals blocks inside the Pentair Pentek Solar Drive should be tightened with torque values of:

- Power solar PV and motor load conductors: 10 lb-in
- Float switch signal conductors: 8 lb-in

The cable glands (cord grips) on the bottom of the enclosure should be used as shown on Figure 7 below. Solar power wires feed through the right gland, float switch/signal wires feed through the middle gland, and motor load wires feed through the left gland.

When all conductors are wired into the controller, the cover (door) should be replaced and tightened using the cover screws to 2-3 in-lb or equivalent.



Figure 7: Wiring Inside the Pentair Pentek Solar Drive

### 🚹 WARNING

#### Do not ground the positive or negative leads of the PV modules!

Only ground the mounting frames of the PV modules.

**Never run the Pentair Pentek Solar Drive controller when the AC pump is not connected!** It might cause damage to the controller.

If an installed 3-phase pump does not start pumping water, switch the positions of any two of the three motor wires. It will change the direction of rotation and it should start pumping water!

### Pentair Pentek Solar Drive DIP Switch Settings

The Pentair Pentek Solar Drive controller can operate most AC motors up to the power limits of the controller: 50 or 60Hz; 120Vac or 230Vac. In order for the Pentair Pentek Solar Drive to match the motor specifications, the first three DIP switches on the left are used for motor selection.

The Pentair Pentek Solar Drive PSD15 powers 3-phase motors only.

**DIP Switch 1 – 120/230Vac:** See Figure 8. If switched ON, the unit is configured for 120Vac pump operation; if switched OFF (down), the unit is configured for 230Vac.

**DIP Switch 3 – 50/60Hz:** If switched ON, the unit is configured for 50Hz motors; if switched OFF (down), the unit is configured for 60Hz motors.



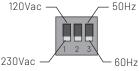


Figure 8: DIP Switches

**DIP Switches 4 and 5 – Over-current Protection:** See Figure 9. The Pentair Pentek Solar Drive can set over-current protection based on the motor pump and controller combination being used. The default value of RMS current (when both switches are OFF) is 7A for three phase. DIP switches 4 and 5 are to be used to match or exceed the motor nameplate's SFAMPS in order to protect from over-current. For example, if a three phase motor has SFAMPS: 6A then DIP switches 4 and 5 have to be set for 7A, as this is the next highest protection current for this motor. Configuring over-current protection also configures automatic **Dry Well Protection**. The Pentair Pentek Solar Drive monitors motor amperage for dry well protection, and no other dry well sensor input is needed unless desired.



Motor HP	Phase	PNR Motor	DIP 4	DIP 5	DIP Switches 4 and 5
1/2	3	P43B0005A3-C	UP	UP	4 5
3/4	3	P43B0007A3-C	UP	DOWN	4 5
1	3	P43B0010A3-C	DOWN	UP	4 5
1.5	3	P43B0015A3-C	DOWN	DOWN	4 5

#### Figure 9: Over-current Protection

### WARNING

Do NOT modify DIP switch settings until power has been turned off and five minutes have passed.

The Pentair Pentek Solar Drive controller can be turned ON or OFF remotely by using a digital input or by using a standard float switch. There is a float switch terminal block (Figure 6 on page 8) where digital signal wires are connected.

If Digital Inputs 1 and G experience a short circuit, the Pentair Pentek Solar Drive automatically turns off. Similarly, if Digital Input 2 and G experience an open circuit, the Pentair Pentek Solar Drive automatically turns off. There are numerous remote sensors that can be used: float switch, pressure switch, flow switch, water level sensor, dry run protection, etc. Ask your dealer about configuring sensors and switches for your application.

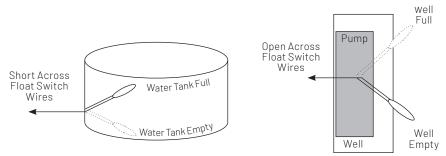


Figure 10: "Water Tank Full" and "Well Empty"

A typical example of how tank and well switch signals can be used with a digital input port is shown in Figure 10. For a tank application, if the active wire is connected to Position 1 and the return wire (usually black) is connected to Position G, then the Pentair Pentek Solar Drive will stop the pump when the tank gets full because Terminals 1 and G will be "shorted" (active short). This turns off the Pentair Pentek Solar Drive. See Figure 11.

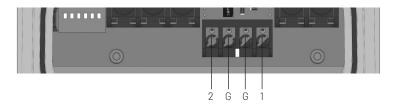
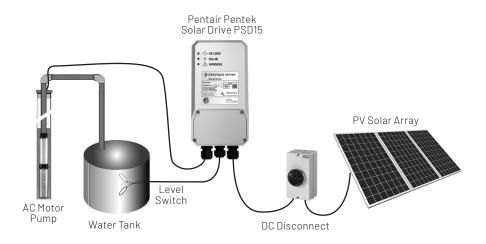


Figure 11: Tank/Well Float Switch

For a well application, if the active wire is connected to Position 2 and the return wire (usually black) is connected to Position G, then the Pentair Pentek Solar Drive will stop the pump when the well runs out of water because Terminals 2 and G will be "open" (active open). This turns off the Pentair Pentek Solar Drive.

# Pentair Pentek Solar Drive Operation

Once the Pentair Pentek Solar Drive controller is wired to the solar source and a motor load, and the DIP switches settings are configured to match the motor specification, then the Pentair Pentek Solar Drive is ready for operation.



### Figure 12: Solar Water Pumping System Diagram

#### Startup:

When starting the Pentair Pentek Solar Drive for the first time:

- 1. While the Pentair Pentek Solar Drive is still de-energized, configure the DIP switches per the AC motor load of the connected device (see DIP switch details on page 8).
- After DIP switches are configured, turn ON the toggle switch, and replace the door. Make sure to never touch toggle switch while connected to solar.
- 3. Power up the Pentair Pentek Solar Drive from solar PV by switching the solar DC disconnect to the ON position. All LEDs will light up, and after a few seconds the Pentair Pentek Solar Drive will try to start the pump, indicated by a blinking green light, and upon starting the green LED will remain ON.
- 4. If there is not enough solar power available, the middle LED will blink yellow, indicating insufficient solar power to start the motor load.

During start-up mode, the Pentair Pentek Solar Drive soft starts a 60Hz motor/pump from a standstill to 45Hz operation in 1 second, and then the Maximum Power Point Tracking (MPPT) algorithm takes over, increasing the motor to 60Hz operation during full sunlight. This optimizes the motor/pump speed to match available power from the solar PV source. For 50 Hz motors, the Pentair Pentek Solar Drive soft starts to 40Hz within one second, and then switches to Max Power Point Tracking (MPPT) control.

### Pentair Pentek Solar Drive Operation

If the motor is properly connected, the Pentair Pentek Solar Drive will begin the startup procedure. The green AC LOAD LED (Figure 13) will have a solid green light, and the motor will start running. Additionally, the Pentair Pentek Solar Drive will immediately start performing MPPT operation over the solar PV source. The MPPT operating range is 45 to 60Hz for 60Hz rated motors, or 40 to 50Hz for 50Hz rated motors.

The Pentair Pentek Solar Drive has built-in overload protection, so if a connected motor has a power level higher than the Pentair Pentek Solar Drive limitations, it first slows down and tries to run the motor at a lower power level. If the motor power continues to be outside the power range of the Pentair Pentek Solar Drive, it will shut off the motor operation. If there is not enough solar power, the unit's SOLAR LED light will blink yellow, as shown in Figure 14. This usually happens in the early morning or late evening, or during overcast weather. The Pentair Pentek Solar Drive controller will try to start the motor once every minute with increasing time between start attempts. Each attempt will be indicated by the blinking green LED. If there is not enough solar production from the solar panels, the yellow LED will start blinking again.



Figure 13: LED1 – AC LOAD is ON



Figure 14: LED 2 – SOLAR is BLINKING

### Shutdown:

To stop the Pentair Pentek Solar Drive's operation, the DC Disconnect should be used. Once in the OFF position, the Pentair Pentek Solar Drive will automatically stop the motor's operation.

However, if a tank or well float switch is used when the tank becomes full or the well becomes empty, the Pentair Pentek Solar Drive will stop its operation, and the WARNING LED will blink red.

The WARNING LED will be solid red if the temperature of the Pentair Pentek Solar Drive rises above 80°C (176°), at which point the Pentair Pentek Solar Drive will stop operating and wait until the temperature drops. This can happen if the unit is exposed to direct sunlight, which should be avoided.

If the Pentair Pentek Solar Drive gets too hot during normal operation, it will switch to Power Deration mode, limiting the maximum power that is transferred to the motor load. During that time, the AC LOAD LED will be solid green and the WARNING LED will be solid red. If the unit cools down to a regular operating temperature, it will automatically continue operation without the thermal deration. If the temperature of the Pentair Pentek Solar Drive continues to increase, it will eventually stop operating, at which point the WARNING LED will be solid red.

### **Installation Notes:**

Date Installed:
Serial No. (Spec Label):
Installer:
Phone:
Location of Installation:
Pump Model No:
Motor: HP, Vac, Ph, SF Amps
Static Depth: (m/ft)
Flow Rate: (lpd/gpd)
PV Panel Manufacturer/Model Number:
No. of Solar PV Panels in Series:

**Note to Installer:** Record the data listed above along with DIP switch setting for future reference. Give manual to end user or attach to Pentair Pentek Solar Drive when installation is complete.

# Maintenance:

The Pentair Pentek Solar Drive is designed to operate autonomously, however it is suggested to be inspected every 3 months. If there are any external obstructions that prevent proper cooling of the heat sink, please remove them to make sure nothing blocks the air flow from the bottom of the device.

If the Pentair Pentek Solar Drive will operate in a location where freezing temperatures may occur, deactivate the system with the DC Disconnect during these conditions. This will prevent the pump from potentially dead heading against a frozen pipe.

Check external sensors every 3 months: float switch, pressure switch, etc.

There are three LED lights on the Pentair Pentek Solar Drive. The indicator lights and their definitions are listed below.

AC POWER (Green)	SOLAR (Yellow)	WARNING (Red)		MODE
ON	ON	ON	-	Unit is OFF
FLASHING	OFF	OFF	-	Startup
ON	OFF	OFF	-	Running
OFF	FLASHING	OFF	-	Standby
OFF	OFF	FLASHING	-	Float Switch
OFF	OFF	ON	-	Over Temperature
ON	OFF	ON	-	Power Deration
FLASHING	OFF	FLASHING	-	Over-current
OFF	FLASHING	FLASHING	-	Short/Open Circuit
FLASHING	FLASHING	FLASHING	-	Dry Well Protection
OFF Mode	Pentair Pentek S	Solar Drive toggle s	switc	ch is in the OFF position.
Startup Mode	Pentair Pentek S	Solar Drive is in the	pro	cess of starting the motor pump.
Running Mode	Pentair Pentek S	Solar Drive is runni	ng th	ne motor pump.
Standby Mode	There is not enough power from the solar PV panels for Pentair Pentek Solar Drive to start the motor.			
Float Switch Mode	Pentair Pentek Solar Drive is turned OFF as a result of input from one or more external sensors that are connected to the digital input.			
Over Temperature Mode	Pentair Pentek Solar Drive stops operation when the temperature inside the unit exceeds 80°C/176°F.			
Power Deration Mode	Pentair Pentek Solar Drive still operates but with reduced power throughput due to increased operating temperature, or if a load is connected with current higher than Over-current Protection DIP Switches 4 and 5.			
Over-current Mode	Pentair Pentek Solar Drive stops operation when it detects high current on the motor terminals. This can also be due to a short circuit event if the unit is mis-wired. Requires manual restart by cycling power to the unit.			
Open Circuit Mode	Pentair Pentek Solar Drive will not start operation if the motor wiring does not align with DIP switch configuration.			
Dry Well Protection	Pentair Pentek Solar Drive detects dry well condition, and ceases pump operation, which is restored after 30 minutes. If dry well indication appears faulty, check that <b>Over-current Protection</b> DIP Switches 4 and 5 are configured correctly.			

# **Limited Warranty**

PENTAIR warrants to the original consumer purchaser ("Purchaser" or "You") of the products listed below, that they will be free from defects in material and workmanship for the Warranty Period shown below.

Product	Warranty Period
Water Systems Products – jet pumps, small centrifugal pumps, submersible pumps and related accessories	whichever occurs first: 12 months from date of original installation, 18 months from date of manufacture
Pentek Intellidrive*	12 months from date of original installation, or
Pentek* Solar Drive	18 months from date of manufacture
Pro-Source <sup>*</sup> Composite Tanks	5 years from date of original installation
Pro-Source <sup>*</sup> Steel Pressure Tanks	5 years from date of original installation
Pro-Source <sup>*</sup> Epoxy-Line Tanks	3 years from date of original installation
Sump/Sewage/Effluent Products	12 months from date of original installation, or 18 months from date of manufacture

Our warranty will not apply to any product that, in our sole judgment, has been subject to negligence, misapplication, improper installation, or improper maintenance. Without limiting the foregoing, operating a three phase motor with single phase power through a phase converter will void the warranty. Note also that three phase motors must be protected by three-leg, ambient compensated, extra-quick trip overload relays of the recommended size or the warranty is void.

Your only remedy, and PENTAIR's only duty, is that PENTAIR repair or replace defective products (at PENTAIR's choice). You must pay all labor and shipping charges associated with this warranty and must request warranty service through the installing dealer as soon as a problem is discovered. No request for service will be accepted if received after the Warranty Period has expired. This warranty is not transferable.

PENTAIR IS NOT LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, OR CONTINGENT DAMAGES WHATSOEVER.

THE FOREGOING LIMITED WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE FOREGOING LIMITED WARRANTIES SHALL NOT EXTEND BEYOND THE DURATION PROVIDED HEREIN.

Some states do not allow the exclusion or limitation of incidental or consequential damages or limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to You. This warranty gives You specific legal rights and You may also have other rights which vary from state to state.

This Limited Warranty is effective March 6, 2019 and replaces all undated warranties and warranties dated before March 6, 2019.



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