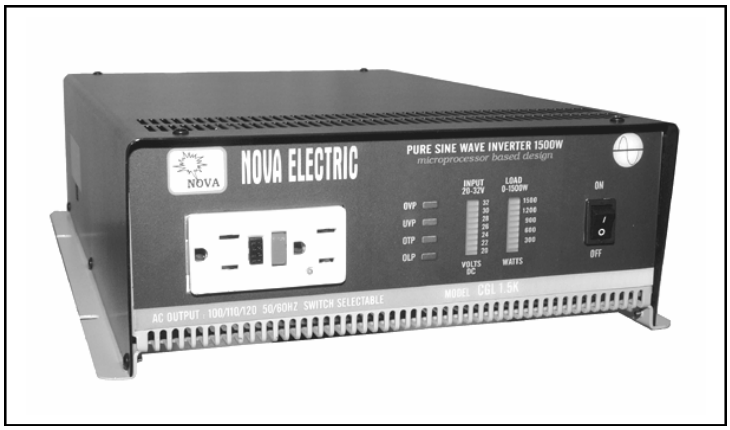
NOVA ELECTRIC CGL SERIES
PURE SINE-WAVE DC-AC INVERTERS



CGL-SERIES INVERTER

(Optional GFCI Outlet shown)

USER MANUAL

NOVA ELECTRIC

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Features

- Pure Sine Wave output (<3%THD)
- Low power "Power Saving Mode" to conserve energy
- RS-232C interface / remote control port
- Built-in voltage and watt meter display on front panel
- Thermostatically controlled cooling fan
- Advanced microprocessor design
- Protection: • Input low voltage • Input overvoltage
- Low battery alarm • Short circuit

Applications

- Electronic applications: communications equipment, commercial gear, etc.
- Office equipment—computers, printers, monitors, facsimile machines, scanner.
- Mobile equipment vans
- Kitchen appliances – microwave ovens, refrigerators and freezers, coffeemakers, blenders, ice makers, toasters.
- Household items – vacuum cleaners, fans, fluorescent and incandescent lights, shavers, sewing machines.
- Power tools – circular saws, drills, grinders, sanders, buffers, wedge and hedge trimmers, air compressors.
- Home entertainment electronics – television, VCRs, video games, stereos, musical instruments, satellite equipment.

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Electrical Performance

Specification	Model No.	Model No.	Model No.	Model No.	Model No.	Model No.
Item	CGL1.5K-12-120	CGL1.5K-24-120	CGL1.5K-48-120	CGL1.5K-12-220	CGL1.5K-24-220	CGL1.5K-48-220
Continuous Output Power	1500W	1500W	1500W	1500W	1500W	1500W
Surge Rating	2000W	2000W	2000W	2000W	2000W	2000W
Nominal Input Voltage	12V	24V	48V	12V	24V	48V
Output Voltage/Frequency (Switch Selectable)	100 / 110 / 120 ± 3%			220 / 230 / 240 ± 3%		
	50/60Hz ± 0.05%			50/60Hz ± 0.05%		
Peak Output Current	25A			11A		
Typical Efficiency (Full Load)	85%	87%	88%	86%	89%	90%
No Load Current	≤ 1.5W Saving Mode					
Output Waveform	Sine Wave < 3% THD					
Output Voltage Regulation	100/ 110/120V RMS -10%/+4%			200/ 210/220V RMS -10%/+4%		
Input Voltage Regulation						
Protection	Overload, Short Circuit, Reverse Polarity (Fuse), Over/Under Input Voltage, Over Temperature, GFCI					
Power Saving Recovery Time	5 Second					
Interface Control Port	RS-232C with Baud Rate 1200, 2400, 4800 (Switch Selectable)					
Remote Control Unit	Optional					
Operating Temperature Range	0-50°C.					
Storage Temperature Range	-30°C to 70°C.					
Dimensions	15.3 x 10.8 x 4.13 inch (390 x 275 x 105mm)					
Weight	15.5 lbs. (7 kgs)					

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1. **Introduction:**

This power inverter series are part of the most advanced line of mobile AC power systems available.

This model is used in a wide range of applications including mobile equipment shelters, remote homes, RVs, sailboats and powerboats. It will operate most televisions and VCRs personal computers, small appliances and tools such as drills, sanders, grinders, mixers and blenders, within the power ratings shown in the table on the prior page.

To get the most out of the power inverter, it must be installed and used properly. Please read the instructions in this manual before installing and using this model.

1. **Name and Main Function:**

Front View:

2-1-1. ON / OFF Switch:
Power ON/OFF switch: Leave in the OFF position during installation.

2-1-2. OVP: Over voltage protection.
UVP: Under voltage protection.

OTP: Over temperature protection.
OLP: Over load protection.
INPUT VOLTS: display input voltage.
LOAD WATTS: display AC load watts.

2-1-3. AC Outlet:

Outlet sockets available:	Australia/New Zealand
	North America/US
	Europe
	UK/Ireland
	GFCI (US Type)

Rear View:

2-2-1. Ventilation window:
Do not obstruct; allow at least 1 inch for air flow.

2-2-2. DC input terminals:
Connect to a battery or other voltage power source of the correct voltage.
[+] is positive; [-] is negative. Reverse polarity connection will blow the internal fuse and may damage the inverter permanently. The input wiring should be protected by an appropriately rated input fuse as per NEC or equivalent codes.

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2-2-3. Chassis ground or to vehicle chassis using #8 AWG wire, minimum.

Warning! Operation of the inverter without a proper ground connection may result in an electrical safety hazard.

3. Quick Hook-up and Testing:

If you would like to quick hook-up the power inverter and check its performance before going ahead with your installation, please follow these guidelines:

3-1. Unpack and inspect the power inverter; check to see that the power switch is in the OFF position.

3-2. Connect the cables to the power input terminals on the rear panel of the power inverter. The red terminal is positive (+) and the black terminal is negative (-). Connect the cables into the terminals and tighten the bolts to clamp the wires securely.

3-3. Connect the cable from the negative terminal of the inverter to the negative terminal of the power source. Make a secure connection.

Caution! Loosely tightened connectors result in excessive drop and may cause overheated wires and melted insulation, as well as other damage.

3-4. Before proceeding further, carefully check that cable you have just connected is from the negative terminal of the inverter to the negative output terminal of the power source.

Caution! Reverse polarity connection will blow a fuse in the inverter and may permanently damage the inverter. Damage caused by reverse polarity connection is not covered by our warranty.

3-5. Connect the cable from the positive terminal of the inverter to the positive terminal of the power source. Make a secure connection.

Warning! You may observe a small spark when you make this connection since current will flow to charge capacitors in the power inverter. This can be avoided by installing a properly rated switch or circuit breaker at the power source. Do not make this connection in the presence of flammable fumes; an explosion or fire may result.

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NOTE: WHEN CONNECTING TO A NEGATIVE DC VOLTAGE SOURCE (AS COMMONLY DONE ON –48 VDC TELECOM APPLICATIONS,) THE NEGATIVE 48 VDC SOURCE GOES TO THE MINUS TERMINAL OF THE INVERTER. THE RETURN (OR ZERO) SOURCE WILL GO TO THE POSITIVE TERMINAL OF THE INVERTER.

3-6. Set the power switch to the ON position. Check the meters and indicators on the front panel of the inverter. The voltage bar graph indicates 10 to 16 volts (20 to 32V when 24V version is used, and 40 to 64V when the 48V version is used), depending on the voltage of the power source. If it does not, check your power source and the connections to the inverter. The other indicators should be off.

3-7. Set the power inverter switch to the OFF position. The indicator lights may blink and the internal alarm may sound momentarily. This is normal. Plug the test load into the AC receptacle on the front panel of the inverter. Leave the test load switch off.

3-8. Set power inverter switch to the ON position and turn the test load on. The inverter should supply power to the load. If you plan to measure the true output RMS voltage of inverter, a meter such as FLUKE 87, BECKMAN 4410, or TRIPLETT 4200 must be used.

4. Installation:

4-1. Where to install.
The power inverter should be installed in a location that meets the following requirements:

4-1-1. Dry: Do not allow water to drip or splash on or in the inverter.

4-1-2. Cool: Ambient air temperature should be between 0°C. and 50°C.; the cooler, the better.

4-1-3. Ventilated: Allow at least one inch of clearance around the inverter for air flow. Ensure that ventilation openings on the sides, rear and bottom of the unit are not obstructed.

4-1-4. Safe: Do not install in a battery compartment or other areas where flammable fumes may exist, such as fuel storage areas or engine compartments.

4-2. Cables:
DC to AC inverters require high amperage / low voltage DC power to low amperage / high voltage AC power. To operate properly, connect inverter DC input terminals directly to battery through a fuse or circuit breaker. The different inverters in this family require different wire sizes due to the wide input voltage choices.

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4-3. Grounding:

The power inverter has a lug on the rear panel [chassis ground]. This is to connect the chassis of the power inverter to the ground. The ground terminals in the AC outlets on the front panel of the inverter are also connected to the ground lug.

The chassis ground lug must be connected to a grounding point, which will vary, depending on where the power inverter is installed. In a vehicle, connect the chassis ground to the chassis of the vehicle. In a boat, connect to the boat's grounding systems. In a fixed location, connect the chassis ground lug to earth ground.

On units with Ground Fault Circuit Interrupt (GFCI), the neutral (common) conductor of the power inverter AC output circuit is connected to the chassis ground. Therefore, when the chassis is connected to ground, the neutral conductor will also be grounded. This conforms to national electrical code requirements that separately derived AC sources (such as inverters and generators) have their neutral tied to ground in the same way that the neutral conductor from the utility line is tied to ground at the AC breaker panel. When the chassis ground lug on the rear panel is connected to an earth ground in the user's location, it provides shock hazard protection. The GFCI has a test button and a reset button. Pushing in the test button will interrupt the output power. Pushing in the reset button will restore the output power and the green light will be on. Note: Repeated pressing/toggling of the GFCI test button may shut down the inverter AC output. THIS IS NORMAL.

On units without GFCI, the neutral is floating. To conform to national electrical code requirements, the neutral must be connected to ground, or other neutrals that are grounded.

Warning! Do not operate the power inverter without connecting the ground terminal to ground. Electrical shock hazard may result, and the GFCI circuit will not operate properly.

5. Operation:

To operate the power inverter, turn it on using the ON/OFF switch on the front panel. The power inverter is now ready to deliver AC power to your loads. If you are operating several loads from the power inverter, turn them on separately after the inverter has been turned on.

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This will ensure that the power inverter does not have to deliver the starting currents for all the loads at once.

5-1. Controls and Indicators:

The front panel ON/OFF switch turns the control circuit in the power inverter on and off. It does not disconnect power from the power inverter.

When the switch is in the OFF position, the power inverter draws no current from the battery. When the switch is in the ON position but with no load, the power inverter draws less than 1.65A / normal, 0.12A / power saving mode (12V version) from the battery.

5-2. Battery Voltage Indicator:

The battery voltage bar graph indicates the voltage at the input terminals of the power inverter. At low input current, this voltage is very close to the battery voltage. At high input current, this voltage will be lower than the battery voltage because of the voltage drop across the cable and connections. Ideally, the voltage should remain in the green area of the bar graph. If the voltage goes into the read area at the top and bottom of the graph, the inverter may shut down.

5-3. Load Watt Indicator:

The AC load watt bar graph indicates the power drawn from the power inverter output. It will indicate total watts drawn by all loads.

For long-term operation, the watt should be in the green and orange areas of the bar graph. Short-term operation is possible with watt in the red area. If the watt rises to the "Flash All" bar, the inverter will protect itself, and may reduce its output voltage or shut down entirely.

5-4. Over Voltage Indicator:

The over voltage indicator indicates that the power inverter has shut itself down because its input voltage has been over the high limit.

5-5. Under voltage indicator:

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The under voltage indicator indicates that the power inverter has shut itself down because its input voltage has been lower than the low limit.

5-6. Over Temp Indicators:
The over temp indicator indicates that the power inverter has shut itself down because it has become overheated. The power inverter may overheat because it has been operated at power levels above its rating, or because it has been installed in a loction which does not allow it to dissipate heat properly. The power inverter will restart automatically once it has cooled off. "Over Temp" indicator may also indicate a fan failure.

5-7. Overload Indicator:

The overload indicator indicates that the power inverter has shut itself down because its output circuit has been short circuited or drastically overloaded. Switch the front panel ON/OFF switch to OFF, correct the fault condition, and then switch the ON/OFF switch back to ON.

6. Operating Limits:

6-1. Power Output:

The 1500W inverter will operate most AC loads within its power rating. When determining whether a microwave oven can be operated by the 1500W inverter, remember that the power commonly advertised for microwave ovens is the cooking power (the power delivered to the food); not the power actually consumed by the microwave oven. The microwave oven will consume 40% to 100% more than its advertised cooking power. Check the rating sticker on the back of the oven to determine its actual power draw. The 1500W inverter will operate small microwave ovens (0.2 to 0.3 cubic foot capacity) that draw about 1700 watts. It will provide 3 minutes of cooking time.

Some induction motors used in refrigerators, freezers, pumps and other motor-operated equipment require very high surge currents to start, often as much as 6 – 7 times rated. The power inverter may not be able to start some of these motors, even though their rated current draw is within the power inverter.

If the motor refuses to start, observe the battery voltage indicator while trying to start the motor. If the battery voltage indicator drops below the low input level while the inverter is attempting to start the motor, this may be the reason the motor won't start. Make sure that the battery connections are good and that the battery is fully charged.

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If the connections are good and the battery is charged, but the voltage still drops below the low voltage level, you may need to use a larger battery, or larger wire.

6-2. Input Voltage:

The power inverter will operate from input voltages ranging from 10V – 15V (12V version) 20V – 32V (24V version), or 40-56V (48V version). If the voltage drops below 10.5V (12V version), 21V (24V version), an audible low battery warning will sound and the voltage indicator will be in the lower red zone. The power inverter will shut down if the input voltage drops below 10V (12V version), 20V (24V version), or 40V (48V version). This protects your battery from being overdischarged.

The power inverter will also shut down if the input voltage exceeds its rating. This protects the inverter against excessive input voltage. The voltage indicator will be in the upper red zone. Although the power inverter incorporates protection against overvoltage, it may still be damaged if the input voltage is allowed to exceed 20V (12V version) or 40V (24V version)., or 75V (48V version).

7. Troubleshooting:

7-1. Common Problems:

Television or other communication equipment interference:
Operation of the power inverter can interfere with television reception on some channels. If this situation occurs, the following steps may help to alleviate the problem.

- Make sure that the chassis ground lug on the back of the power inverter is solidly connected to the ground system of your vehicle, boat, shelter, or home.
- Move the television as far away from the power inverter as possible.
- Keep the cables between the battery and the power inverter as short as possible and twist them together with about 2 to 3 twists per foot. This minimizes radiated interference from the cables.

Overheating:
- Check for clean air intake and an exhaust opening, and check that both fans are operating.

No Output:
- Check the input fuses (remove cover).
- Check for correct input voltage

7-2 Troubleshooting Guide:

Problem and Symptoms	Possible Cause	Solution
Low output voltage (110V: 95-105VAC, 220V: 190-210VAC)	Using average reading voltmeter,	Use true RMS reading meter, (See page 5, point 3-8.of manual).
Load LED bar Flash.	Overload	Reduce load
No output voltage And voltage indicator In lower red zone	Low input voltage	Recharge battery, check connections and cable.
No output voltage, No voltage indication	Inverter switched off. No power to inverter.	Turn inverter on. Check wiring to Inverter.
	Internal fuse open	Have qualified
	Reverse DC polarity	Service technician check and replace. Have qualified service technician check And replace fuse, OBSERVE CORRECT POLARITY
No output voltage. Voltage indicator In upper red zone	High input voltage	Make sure that inverter is connected to a proper input voltage source.
		Check regulation of charging system.
Low battery alarm ON all the time, Voltage indicator Below 10.5V (12V ver.), 21V (24V ver.), or 42V (48V ver.)	Poor DC wiring, poor battery condition	Use proper cable and make solid connection. Use new battery.

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7.2 Troubleshooting Guide (cont'd.)

Problem and Symptoms	Possible Cause	Solution
No output voltage, Over Temp indicator ON; input DC current in excess of: 1500W: 150A(12V), 75A (24V), or 40A (48V)	Thermal shutdown	Allow inverter to cool off. Reduce load if continuous operation required.
No output voltage, Over Temp indicator ON, load less than: 1500W : 150A (12V) or 75A (24V); 1000W : 75A (12V) or 37.5A (24V).	Thermal shutdown	Improve ventilation. Make sure ventilation openings in inverter are not obstructed; reduce ambient temperature.
No output voltage	GFCI Tripped	Push in the RESET botton on the GFCI Receptacle. It it continues to trip, remove The load see if it is at fault.
No output voltage; Over Load indicator ON	Short circuit or wiring error.	Check AC wiring for short circuit or Improper polarity (hot and neutral reversed) Very high power load Remove load

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8. Maintenance:

Very little maintenance is required to keep your inverter operating properly. You should clean the exterior of the unit periodically with a damp cloth to prevent accumulation of dust and dirt. At the same time, tighten the screws on the DC input terminals.

9. Warranty:

All Nova Electric products are warranted against defects in material and workmanship for a period of one year from shipping date. Our obligation includes replacing, repairing, or adjusting products (excluding fuses) that prove to be defective during the warranty period. The unit must be returned to us postage paid. Contact our Customer Service Manager at (201) 385-0500 (Extension 116 or 121) for a Return Material Authorization (RMA) number.

This warranty is fully transferable. If a product is sold to a manufacturer for use in a product for resale, the complete warranty is in force, providing the power system is sold as original equipment.

This warranty will be considered void if the unit has suffered any obvious physical damage or alteration, either internally or externally, and does not cover damage arising from improper use, such as plugging the unit into an unsuitable power source, attempting to operate products with excessive power consumption requirements, or use in unsuitable climates.

Nova Electric assumes no liabilities for consequential damages of any kind through the use or misuse of its products by the purchaser or others. No other obligations are expressed or implied.

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Appendix A

Dip Switch (110V)

S1	S2	VOUT (VAC)	S3	FREQ. (Hz)	S4	POWER SAVING	S5	S6	BAUD RATE
ON	ON	100	ON	50	ON	DISABLE	ON	ON	1200
OFF	ON	110	OFF	60	OFF	ENABLE	OFF	ON	2400
ON	OFF	115	---	---	---	---	ON	OFF	4800
OFF	OFF	120	---	---	---	---	---	---	---

Dip Switch (220V)

S1	S2	VOUT (VAC)	S3	FREQ. (Hz)	S4	POWER SAVING	S5	S6	BAUD RATE
ON	ON	200	ON	50	ON	DISABLE	ON	ON	1200

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OFF	**ON**	**220**	**OFF**	**60**	**OFF**	**ENABLE**	**OFF**	**ON**	**2400**
ON	**OFF**	**230**	**---**	**---**	**---**	**---**	**ON**	**OFF**	**4800**
OFF	**OFF**	**240**	**---**	**---**	**---**	**---**	**---**	**---**	**---**

Appendix B

The Operation of RS-232

1. Hardware design
   This unit uses a 9-pin D connector and three of RS-232 signal:
   RECEIVE DATA 9RXD): PIN2
   TRANSMIT DATA (TXD): PIN3
   DATA TERMINAL READY (DTR): PIN4
2. The connection between this unit and a computer is as follows:

Computer	Power Inverter
RXD	RXD
TXD	TXD
DSR	DTR
RTS	
CTS	
GND	GND

3. The RS-232 interface of this unit employs ASCII Code to implement the asynchronous serial transmission control; the byte structure is:

   START BIT- 8.BIT DATA – STOP BIT

   Baud Rate: 1200, 2400, 4800 (SET BY DIP-SW)
   Parity Check: NONE; not settable
   Data Bit: 8, not settable
   Stop Bit: 1, not settable

4. Software Design
   The buffer size used for the RS-232 port is 12 bytes. This unit will ignore all bytes above this value.
   During this transmission, this unit will inform the readiness of receiving to the computer by DTR line. A computer has to check the unit's DTR line before sending any; information to this unit. Basically, this unit is always ready for receiving data while operating.
   When an LF character (ASCII Code 0AH) is received, this unit will finish the receiving by clearing the DTR status and begin to interpret the received information. The unit will execute the received command (and/or data) if it is correct.
   No matter whether the command is accepted or not, the unit will always send back the response signal to the computer and set the DTR ready for receiving incoming information.
5. The Baud rate of the RS-232 interface is determined by S5 and S6 of DIP-SW, as the following table shows:

Note: It is necessary to reset the unit after adjustment to activate the new Baud rate

6. Illustration of the RS-232 operation:

   6-1. RS-232 Command:
   Command Format:
   This unit uses high-level language commands with a CR (0Dh) and an LF (0Ah) as the end of the command. The system will interpret and execute the command only after these two characters are received. After the unit executes the command, it will send a response string to the computer. The response string is as follows:

   =>CR LF: Command executed successfully
   ?>CR LF: Command error; not accepted
   !> CR LF: Command correct, but execution error (e.g., parameters out of range)

If the command needs any information from the unit, the unit will send the information back to the computer (with CR and LF), and then send the response string to the computer.

   6-2. Command Format:
   This unit supports the following commands. There should always be a CR (0Dh) and an LF (0Ah) appended to the command while sending the command to this unit.

   6-2-1. PWRS Command:
   POWER SAVING FUNCTION CONTROL
   Format: PWRS < value >
   Illustration: A space (ASCII Code 20h) is needed between PWRS and < value >.
   > value > can be one of the following:
   "0": power saving disable

"1": power saving enable
"2": inquire as to the status of power saving function control; the response information will be either "0" (disable) or "1" (enable).

6-2-2 POWER Command:
POWER ON/OFF Control
Format: POWER < value >
Illustration: A space (ASCII Code 20h) is needed between PWRS and < value >. > value > can be one of the following:
"0": power off, power consumption < 2W; restart time < 5 sec
"1": power off, power consumption < 20W; restart time < 2 sec
"2": power on
"3": inquire as to the status of power on/off status; the response information will be either "0" (off) or "1" (off), or "2" (on).

Appendix C

Remote Control Operations Manual:

- System Configuration:

1. Plug the 9-pin D-SUB connector of the Remote Controller in the RS-232 of the Inverter.
2. Check the setting of DIP-SW S5 – S6. The communication BAUD RATE should be set to 4800bps (S5 – S6 OFF).
   - LED Indications:
   1. Turn on the switch of the INVERTER; there will be 2 short "beep" sounds from the INVERTER. All LEDs will be on and, one second later, there will be a short "beep" sound. The amber, green and red LEDs of the Remote Controller will be one for 0.5 seconds; then off sequentially. The INVERTER is then in the OFF mode. The amber LED will be blinking every 2 – 3 seconds.
3. Remote Controllers LEDs:
   Green: POWER SAVING ENABLE °
   Amber: POWER SAVING DISABLE °
   On: POWER ON °
   Blinking: POWER OFF °

- Operations:
1. Set SLIDE SW 'ON' (Keypads will not work if SLIDE SW is set "OFF") °

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2. Remote ON/OFF; press a button (and release it in one second) will change (toggle) the output ON/OFF mode, the display of LEDs will be changed correspondingly.

3. Operation of POWER SAVING mode:

   Press the button for 2 seconds, you will see the colors of the LEDs changing. If you keep pressing the button, the colors will be toggling between amber and green every 2 – 3 seconds. The color of the LED will determine the mode of operation. Green stands for the POWER SAVING mode, "ENABLE," and amber stands for "DISABLE." Release the button when the LED indicates the desired status.

4. The operation, POWER SAVING ENABLE/DISABLE does not change the power ON/OFF mode.

5. Despite the setting of the POWER SAVING mode, when a POWER OFF command is set by pressing a button, the power will be turned off and, in the meantime, the POWER SAVING mode will be set to DISABLE automatically; the amber LED will flash for 2 – 3 seconds). When the POWER is turned on, the POWER SAVING mode will restore the previous setting.

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