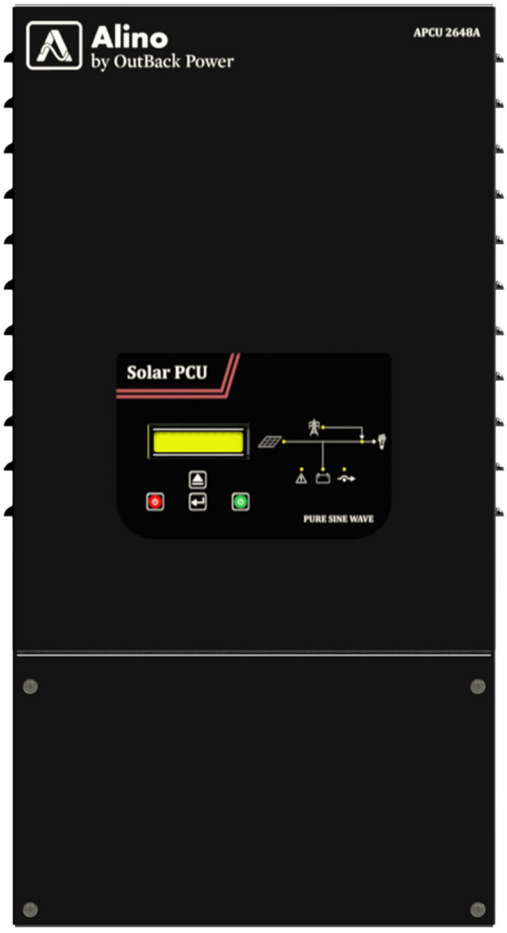
Alino PCU

User Manual



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Alino by OutBack Power represents a line of renewable energy solutions aimed at meeting the growing global demand for value-oriented, low power-range, All In One, or “Alino” bidirectional inverter with MPPT charge controller and wiring compartment, complete with circuit breakers.

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Revision

June 2018, Revision 2.0

Part Number

NTIDOC005-0618-001

About the Manual

Purpose

This manual describes the assembly, installation, operation and troubleshooting instructions for Alino Power Conditioning Unit (APCU). Please read this manual carefully before installations and operations. Keep this manual for future reference.

Scope

This manual provides safety and installation guidelines as well as information on tools and wiring. This manual is intended to be used by qualified individual required to operate the APCU.

Technical publications and other technical information can be downloaded from

www.outbackpower.com

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1 Abbreviations

Table 1. List of abbreviations

Abbreviation	Description
AC	Alternating Current
AGM	Absorbed Glass Mat type
Ah	Amp-hours
APCU	Alino Power Conditioning Unit
AVR	Automatic Voltage Regulator
CC	Constant current
CV	Constant voltage
DC	Direct Current
DSP	Digital Signal Processor
GUI	Graphical User Interface
I_{mpp}	Current corresponding to Maximum Power Point
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LVD	Low Voltage Disconnect
Max.	Maximum
MCB	Miniature Circuit Breaker (or)

MCB	Main Circuit Breaker
MPPT	Maximum Power Point Tracking
NOCT	Normal Operating Cell Temperature
NTC	Negative Temperature Coefficient
OTP	Over Temperature Protection
PCB	Printed Circuit Board
PCU	Power Conditioning Unit
P_{max}	Maximum power
PPE	Personal Protective Equipment
PV	Photovoltaic
PWM	Pulse Width Modulation
SMF	Sealed Maintenance Free
SOC	State of Charge
SPV	Solar Photovoltaic
STC	Standard Test Condition
THD	Total Harmonic Distortion
UPS	Uninterruptible Power Supply
V_{mpp}	Voltage corresponding to Maximum Power Point
VOC	Open Circuit Voltage
VRLA	Valve Regulated Lead Acid type

2 Important Safety Instructions

- Before using the APCU, read all instructions and cautionary markings on the APCU, batteries and all appropriate sections of this manual.
- The installation instructions are for use by qualified personnel only.
- No user serviceable parts – do not open the unit. Take it to a qualified service center when service or repair is required. Incorrect re-assembly may result in risk of electric shock or fire.
- Disconnect all wiring before attempting any maintenance or cleaning, to reduce risk of electric shock.
- Do not cover or block ventilation openings.
- Install appropriate external fuses / breakers.

The following symbols are used throughout this manual to indicate potentially unsafe conditions or highlight important safety instructions.

Table 2: Safety symbols

Symbol	Description
	**INSTRUCTION:** Read the user manual before installing and using the APCU.
	**NOTE:** Indicates a procedure or function that is important to the safe and proper operation of the APCU.
	**WARNING:** Indicates a potentially hazardous condition. Use extreme caution when performing this task.
	**CAUTION**: Indicates a critical procedure for safe and proper operation of the APCU.

3 Introduction

Thank you for purchasing Alino PCU series product. APCU is highly efficient Power Conditioning Unit equipped with intelligent energy management logic. It maximizes energy utilization from Solar Photovoltaic modules. It smartly utilizes AC grid power and battery power to reduce the power consumed from the grid and provide uninterrupted power to the load.

The integrated APCU system consists of Maximum Power Point Tracking solar charge controller, pure Sinewave inverter and grid charger. The APCU can charge the battery bank through solar power or AC input source power. The APCU continuously monitors the battery state of charge, the solar power input and the applied load to make intelligent decisions on energy storage. APCU automatically transfers the load to the grid and charges the battery simultaneously, when battery SOC goes below a set level due to long power usage.

The APCU has an Automatic Voltage Regulator (AVR), which regulates the grid voltage to provide stable output voltage to the loads when it operates from grid power. User can set various parameters of the APCU through front panel LCD and keypad interface.

4 Key features

The key features of the APCU series are:

- All-in-one design – Solar PV charger, AC input charger and inverter.
- Enhanced safety with use of galvanic isolated transformer.
- Robust Automatic Voltage Regulation for grid input.
- Maximum utilization of solar power using advanced Maximum Power Point Tracking algorithm.
- Improved battery performance and life through Intelligent charge management with 4-stage battery charging.
- Multiple protections: Short circuit, overload, over temperature, low battery, high battery and high panel voltage.
- Significant savings in labor cost by simplifying the installation and interface with BOS in the Alino total solution design.
- Good thermal performance ensures long life.
- High performance DSP provides sophisticated control and management.
- Faster dynamic response to load variation
- Fast transfer time <12ms, provides uninterrupted power to load.
- Simple construction for enhanced robustness.
- Robust design and high quality rated parts for longer product life.
- High surge support to start heavy loads.
- Space saving and attractive wall-mount design.
- Conformal coated PCBs enhances reliability.

5 Do's & Don'ts

5.1 Do

- Get the APCU installed by a qualified installer in accordance with the installation instructions provided in this manual.
- Plan and segregate the load and associated wiring on the site, to connect to the APCU.
- More than two sources may energize APCU. Before servicing or maintenance, make sure that all the sources are de-energized. Use proper lockout / tagout procedures.
- Use the same make and model of solar PV modules. Mixing different panels will result in decreased performance and possible failure.
- Use the same make and model of batteries, same age, Amp-hours rating, voltage and brand for battery bank.
- Tighten all the mounting anchor screws properly. Check the tightness of all electrical connection screws, every six months.
- Use standard insulated wires of correct size and type for wiring. Follow local wiring code.
- Energize the sources after completing and checking all the connections and wiring.

- Provide mechanical stress relief to cables coupled to electrical terminal.
- Do regular maintenance of the APCU – check ventilation and integrity of wire termination on connectors by a qualified service personal.
- Check the APCU for proper grounding. Ensure to comply with local requirements and regulation.
- Understand the operating modes and settings as per your requirements and customize the settings. Review and ensure the operating mode and settings for optimum operation per your requirements.

5.2 Don't

- Do not use the equipment if physically damaged.
- Do not cover or block ventilation openings in APCU.
- Do not install the APCU outdoor, prone to exposure to direct sunlight, dust, insects, rain and moisture.
- Do not recharge a frozen battery.
- Do not tamper vent plugs of the battery.
- Do not deep discharge the battery below specified limits.
- Do not allow tapping in between batteries during the service life.
- Do not work in vicinity of lead-acid batteries. Batteries can generate hazardous gases during normal operation.
- Do not change the type of battery from flooded to another type without changing the setting in APCU.
- Do not install and/or operate in compartments containing flammable materials or in locations that require ignition-protected equipment.
- Do not use the APCU in connection with life support systems and medical equipment.

6 Operations

6.1 APCU Operational Features

The operational features of the APCU are:

1) MPPT control
2) UPS functionality
3) Pure Sine Wave output
4) Intelligent energy management
5) Automatic Voltage Regulator (AVR)
6) Inverter sleep mode
7) Efficient battery charge profile

6.1.1 MPPT control

MPPT is a technique used in PV systems for extracting maximum available power from PV module under changing and variable condition. The voltage at which PV module can produce maximum power (P_{max}) is the maximum power point voltage (V_{mpp}). The corresponding current is I_{mpp}. Figure 1 illustrates the I-V and power curve of a solar module. It is important to operate the solar panel at its V_{mpp} to transfer maximum power from solar panel to battery. Maximum power varies with solar radiation (insolation), ambient temperature, wind, rain and solar cell temperature and many other environmental factors.

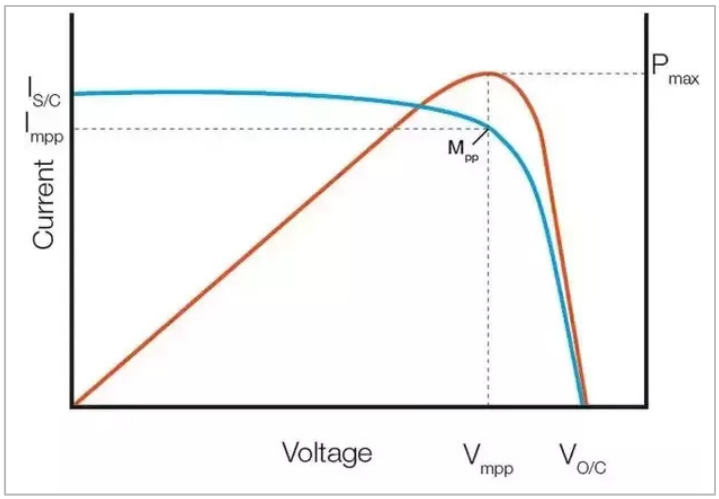


Figure 1. Voltage - current (VI) and power curves of a solar module.

Unlike the APCU, some solar system use conventional pulse width modulated solar chargers that simply connects the solar panel to battery during charging. This results in operating the PV panels just above the battery voltage, which is much lower voltage than V_{mpp}. This results in lower current and power transfer from PV to battery. Hence, even though PWM charger are cheaper, the overall system efficiency is very low.

$$pwm\ charger, battery\ charging\ current\ \approx Isc$$

The MPPT charger in APCU sweeps the PV panel for maximum available power operating the PV at V_{mpp}. It continuously tracks the MPP using sophisticated algorithm to ensure continuous maximum power transfer without noticeable fluctuations.

$$MPPT\ charger\ battery\ charging\ current = \frac{power\ conversion\ efficiency\ x\ MPPT\ efficiency\ x\ Vmpp\ x\ Impp}{battery\ voltage}$$

The power conversion efficiency of APCU solar charger is greater than 95% and MPPT efficiency is greater than 99%. Hence, the MPPT charger provides maximum current to charge the battery.

6.1.2 UPS functionality

Even short power outages can be a trouble. Losing power for even a moment can trigger events that may restart or even damage sensitive equipment. UPS functionality in the APCU ensures uninterrupted power supply to loads. It provides faster transfer times from AC input to inverting battery power to AC power during a power outage and in addition saves load equipment from exposure to wide operating ranges.

When AC input is out of range, the APCU automatically transfers the load to the inverter. The transfer time is less than 20ms, which is fast enough for consistent operation of load during the changeover.

The APCU provides uninterrupted power to the loads by utilizing solar and battery power. The power backup time depends upon the battery SOC, capacity, solar power availability and the load itself.

6.1.3 Pure sine wave output

Total Harmonic Distortion is a measurement of noise present in the sinusoidal output of a PCU. Lower the distortion, cleaner the output of the system. This APCU outputs pure Sine Wave power, which implies low distortion compared to a square or modified sine wave output inverter or other PCU. The harmonic distortion is lesser than 3 % for linear unity power factor loads. This ensures smooth and quiet operation of loads supplied by the APCU.

6.1.4 Intelligent energy management

Use the APCU as a standalone solar inverter and as a power backup solution. It uses intelligent algorithms, which monitors the solar availability, battery state of charge, grid input availability and load power to control the system for maximum utilization of solar energy. It has two modes of operation, namely Solar Priority and Grid Priority.

Program the APCU for the local power condition.

For maximum solar utilization and grid power saving, use it in Solar Priority Mode.

For maximum power backup time, set it for Grid Priority Mode. The sophisticated battery overcharge & over-discharge protection increases the battery life.

6.1.5 Automatic Voltage Regulator

AVR's primary purpose is to stabilize voltage fluctuations caused by unstable and variable AC input supply. It ensures a steady and constant power supply by automatically regulating the voltage to an appropriate level, by stepping down during a surge (over voltage or high voltage condition) or stepping up during a low voltage condition on power line. It thereby eliminates the need for a voltage stabilizer.

Voltage regulation is achieved using a robust multi tap transformer and an intelligent control system, which makes sure the output voltage is within the specified range even when the grid input is varying over a wide specified operating range.

The APCU regulates the grid input voltage from 165VAC to 275VAC for 230V/50Hz model, 165V to 265V for 220V/60Hz model and 85VAC to 143VAC for 120V/60Hz model. It provides ± 10% regulation over the major operating range and ± 20% at extremes.

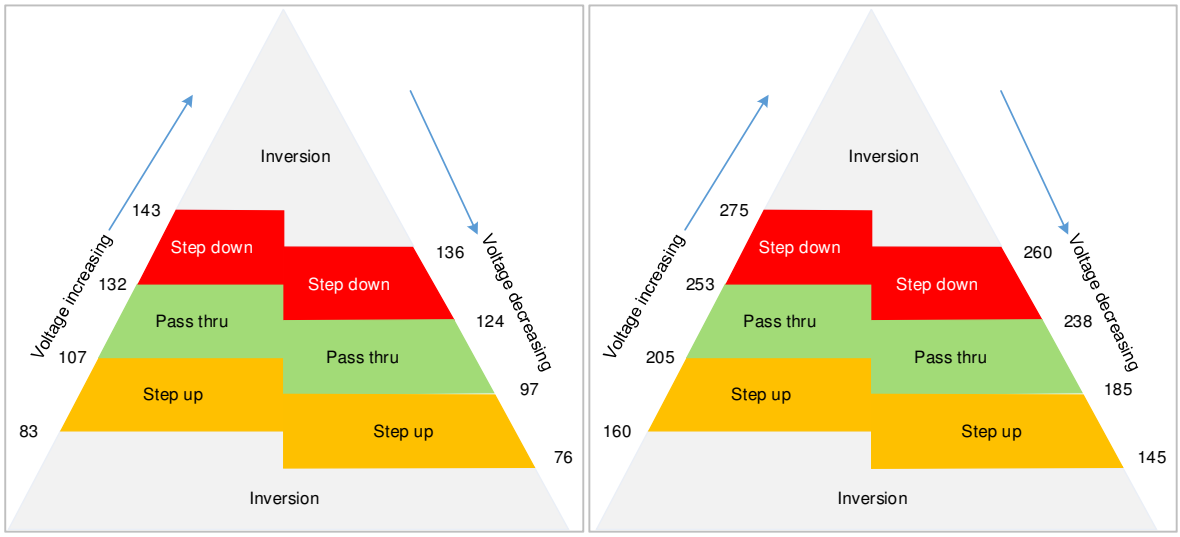


Figure 2. AVR operation chart; 120V system (left) and 230V system (right)

☞	The AVR functionality can be enabled or disabled through front panel display, as required. Default factory setting is AVR Mode-Disabled for maximum energy saving in Solar Priority Mode.

6.1.6 No load shutdown/ sleep mode

This feature reduces the standby current consumption from battery. Sleep mode is a power save mode in which the APCU switches to a hibernating state to reduce the power drawn from battery. It decreases the internal power consumption by up to 500%. The APCU enters sleep mode if it senses output current less the specified percentage of full load current (<3% for APCU 1424 / APCU 1424A / APCU 2424B and <2% for APCU 2648 / APCU 2648A / APCU 2648B / APCU 3348).

	Note that this mode will result in flickering of low power electrical appliances like LED lamps, TV etc. Disable sleep mode if the support for very low power appliance is required.

6.1.7 Efficient Battery Charge Profile

APCU's MPPT charge controller is a multi-stage battery. It enables fast recharging of the battery system while ensuring a long battery life. The multistage charger supports both flooded type and sealed maintenance free batteries like Gel, AGM, VRLA types. Choose the battery type as per the requirement.

The MPPT charger is a step down buck converter, which converts higher PV voltages into the lower charging voltages and higher charging current. The AC input charger is an isolated rectifier that provide constant voltage and constant current "CV-CC" charging. Either mains charger or the MPPT charger charges the battery based on solar power availability, battery SOC and voltage value.

	Use APCU with lead acid chemistry battery only. Do not use it with other type batteries.

PCU charges both flooded and SMF batteries in three stages, namely bulk, absorb and float modes. In addition only the flooded batteries are put through a special charge mode namely, equalization. The various modes of charging are detailed below.

	Under normal circumstances the mains charger will not charge battery when active solar PV voltage is sensed.

6.1.7.1 BULK MODE

The buck converter architecture converts the maximum power point voltage and current from solar panel to provide maximum current to the battery. The current passed to battery depends on the power available from solar panel. The MPPT charger regulates the current to a pre-set maximum value based on the battery capacity setting.

Table 3. Battery Ah capacity vs charging current limit.

Ah rating	Charging current limit
≥ 190 Ah	≥ 40 ADC
≥ 100 Ah and < 190 Ah	≥20 to ≤36 ADC linear
> 70 Ah and ≤ 100 Ah	≥10 to ≤20 ADC linear
≤70 Ah	≤10 ADC

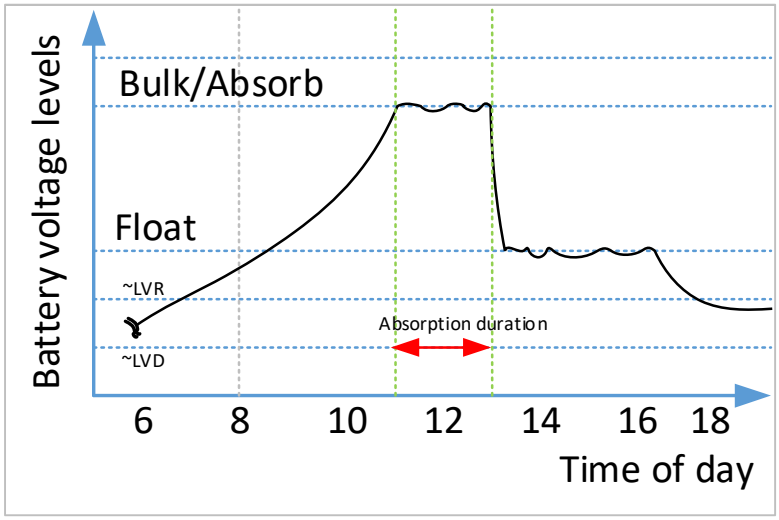


Figure 3.Normal battery charging profile of the solar MPPT charger.

	The default Ah setting is 150. For best utilization of charger set the battery capacity as appropriate.

If the solar power is not available, the AC input charger will charge the battery in constant current in bulk mode based on the priority mode set and the battery voltage. At the end of bulk mode, it is reasonable to assume the battery is charged up to 80% of its capacity. The maximum charging current of AC input charger is 20 ADC and solar MPPT charger is 40 ADC.

6.1.7.2 ABSORPTION MODE

When the bulk charging mode is complete absorption charging mode begins. In this mode, the charge controller maintains constant voltage to the battery instead of transferring maximum current from solar array. On average, only the required amount of current to maintain appropriate absorption voltage level is taken from solar. During this mode, the current fed into battery reduces gradually indicating battery is being filled. At the end of absorption mode, it is reasonable to assume the battery is charged up to 90% of its capacity.

6.1.7.3 FLOAT MODE

When the absorption mode charging is complete, float mode charging begins. This is a constant voltage mode where the voltage shall be maintained at appropriate level based on the battery type. At the end of float mode, it is reasonable to assume the battery is charged to its full capacity. If the battery voltage falls below the lower threshold limit of float, then the controller changes the mode of operation to bulk mode.

6.1.7.4 EQUALIZATION MODE

Equalization is a deliberate and controlled overcharge designed to return each cell in the battery to reduce sulfation and stratification of the electrolyte in the battery thus improving performance and battery life. The equalization charge is generally performed only on flooded, vented (non-sealed or “wet”) lead-acid batteries, as recommended by the battery manufacturer.

MPPT charger will equalize the battery only when flooded battery type is set. If initiated, the MPPT charger extends the bulk charging mode until a higher voltage threshold, usually 15.5 V. After reaching 15.5 V the charger operates in CV mode ignoring MPPT. The overall duration of this mode is one hour only. Hence, irrespective of completing the equalization process the system will prematurely exit equalization mode and enter absorption mode.

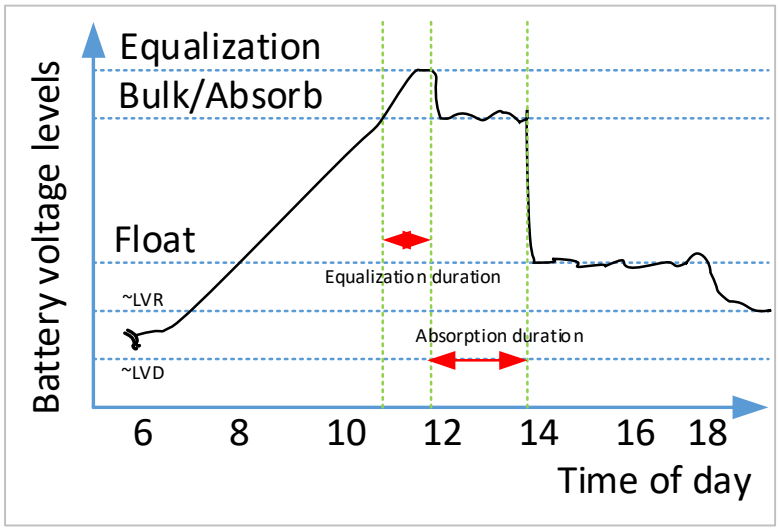


Figure 4.Normal battery charging profile of the solar MPPT charger including equalization mode.

Force equalization charging manually through front panel. It is also automatically initiated under following conditions

1) Upon completion of 60 days in solar power without any equalization.
2) If the battery bank is deeply discharges and encounters low voltage disconnect.

⚠	Consult battery manufacturer or subject expert for information on equalization charging. Equalizing a sealed battery will result in hazardous conditions.

Follow the below guidelines for configuring manually forcing equalization mode.

a. APCU is by default in USER mode. Change APCU to ADMIN mode.
b. Scroll up the front panel LCD screen to ACCESS MODE screen using increment key.
c. Once the screen displays ACCESS MODE, then press and hold the ENTER key for five seconds to enter password for changing over to ADMIN mode.
d. Default password is pressing ENTER key four times in front panel. On each press, the character changes from _ to * sequentially and then, the access mode changes from USER mode to ADMIN mode.
e. Scroll up to Bat. EQ screen, by using incremental key and then, press & hold the enter key for 5 seconds to change the ON/OFF option. Finally, press on enter key to confirm.
f. After configuring all the parameters, wait for ten minutes for new settings to record. Do not disconnect battery power during this time.

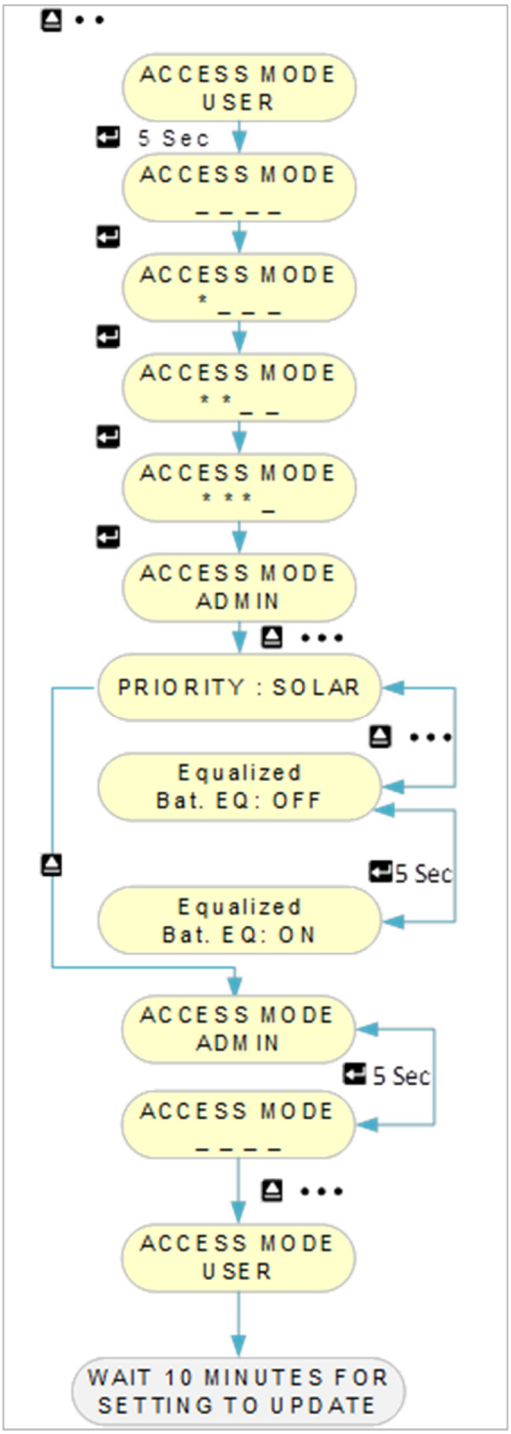


Figure 5. Flow sequence to force equalization charge manually.

☞	APCU requires about 10 minutes storing any change in settings. Ensure APCU is not power recycled within this time.

6.2 Interface description

Various operational parameters related to the APCU interface are described in detail below. The voltages provided in this section are in reference to a 12V battery for ease of understanding. Multiply the number by a factor of 2 and 4 for 24V and 48V system respectively for actual set values.

6.2.1 Battery

1. Battery low alarm indication

When battery voltage fall below this threshold, the APCU turns on the red (warning) LED on the unit, to indicate that the battery is running low on capacity. In addition to the visual indication, the APCU also provides an audio indication by producing a buzzing alarm. The default thresholds is 11 V for a 12 V battery.

If inverting, the process stops and the AC output is provided by the AC input. Based on the priority mode and the solar power availability the solar charger or AC input charger will recharge the battery.

2. Low Battery load cut-off

When battery voltage fall below load cut-off threshold, the APCU turns inversion OFF and the output will be zero. The loads will not have any power during this condition. The default thresholds is 10.8 V for a 12 V battery. APCU has a preset time delay of few seconds before it drops the load to avoid any nuisance trips while supporting surges load

3. Battery High cut-off

This is the absolute maximum voltage at which MPPT or AC input charger would stop charging the battery. The default limit is 16 V for a 12 V battery. Under normal circumstance, the battery will never be charged up to this voltage. This is used to limit operation of the APCU within validated range.

4. Deep discharge recovery

The APCU will recharge a battery discharged down to 9 V for a 12 V battery. Only solar power can recharge a deep discharged battery through MPPT charger. The AC input charger will not recover a deeply discharged battery.

5. Load reconnect

The APCU starts inverting above this voltage after a low voltage event occurrence. The default thresholds is 12.5 V for a 12 V battery.

6.2.2 Load

1. Overload

The APCU supports up to 300% overloading for short time to enable surge loads to start. Table 4 provides the support time and load relationship.

Table 4. Load vs. support time

Percentage of Load w.r.t. product rating	Support time
≤ 100 %	Indefinite
> 100 % and < 125 %	60 seconds
> 125 % and < 200 %	3 seconds
> 200 % and < 300 %	0.1 seconds

2. Load recovery

The APCU automatically disconnects / de-energizes the load from the system when overloaded. The APCU erases the disconnect event from memory, if the load is within the rated limits upon auto reconnection. If the load is above the rating, it again disconnects and reconnects after a 10-second interval. The cycle continues for three trials beyond which the APCU stops automatically trying to re-energize. Manually check any anomaly related to system and restart the unit to resume operation.

6.2.3 AC grid input

1. Transfer time

The APCU changes over from operating in mains bypass mode to inverting within 12 milli seconds (12 mS). This is fast enough to prevent any disruptions to the electronic loads connected to the APCU. In addition, while changing over from the inversion to AC input, the APCU synchronizes to mains input and changes over fast to avoid any harm to the load.

2. AVR range

The automatic voltage regulator regulates the main input over this specified range to maintain the output within ±10 % of the nominal voltage. Beyond a certain range of input voltage, the AVR output will regulate the output within ±20 % thereby further extending the operating voltage range of the APCU.

6.3 Operating modes

This APCU provides flexibility to customers to set the priority setting based on their requirement of maximum energy saving, power backup. The default setting is Solar Priority Mode. The functional aspects of the APCU in solar priority and grid priority is detailed below. Change the mode of operation to Grid priority if that suits your regional requirement.

6.3.1 Solar Priority Mode

In this mode the APCU prioritizes solar and battery power to support the load. The AC input power is reserved as a backup source if both the solar and battery is not able to match the load power requirement. This mode helps to reduce the utility (electricity) bill for you. Since it utilizes the battery power as the supplementary source to the solar power, the system sizing is very critical for this mode to operate efficiently.

	Design the complete system appropriately to ensure best operation of APCU in Solar Priority Mode.

6.3.1.1 Solar Priority Case-1: PV and grid are present

Solar Priority Mode is mainly for utilizing the maximum harvest from solar array and charge the battery. In this case,

- Grid will be in standby mode. PV will charge battery and power the inverter.
- Upon low battery condition, the load is supported by the grid. The load continues to be supported by the grid until the battery charges to a predefined voltage from PV. If PV fails to recharge the battery to 60% SOC, AC mains charger will charge them up to 60% SOC as a reserve capacity threshold.

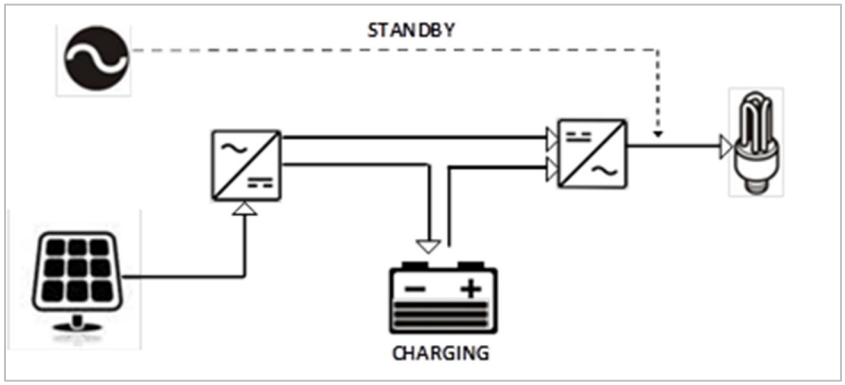


Figure 6. Illustration of APCU functionality in Solar Priority Mode, case-1.

6.3.1.2 Solar Priority Case-2: PV present, Grid absent

In this case, Grid supply is not avialable. Only PV is available.

- PV and battery will feed the load until battery discharges to a preset lower limit. This case is mainly used for remote locations where there is no grid supply.

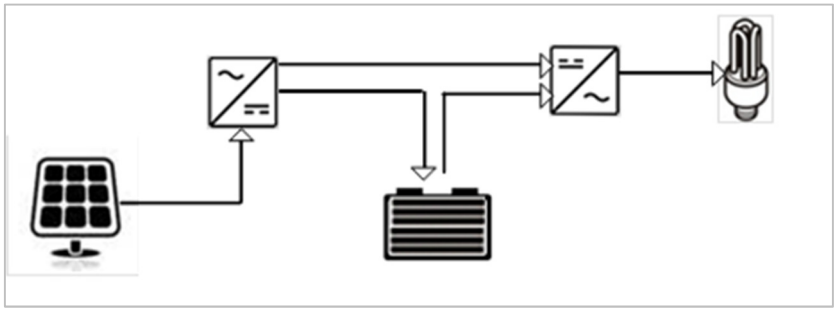


Figure 7. Illustration of APCU functionality in Solar Priority Mode, case-2.

6.3.2 Grid Priority Mode

In this mode, the APCU prioritizes battery backup and utilizes AC input power to supply AC output. Based on the presence of solar power the APCU will charge the batteries from solar or from AC input charger. The APCU operates with goal of keeping the batteries full for supporting load during an anticipated AC input (grid) outage event.

We recommend this mode if the grid is not stable in your region. In case if you are off-grid and running a generator, set the APCU in Grid Priority Mode to best utilize the available AC input. On contrary, you may also choose to continue use the solar priority and run the DG when PV and battery are not able to support the load. However, it brings inconvenience and may lead to power disruption to load.

6.3.2.1 Grid Priority Case-1: PV and grid are present

Grid Priority Mode is mainly used for backup power solutions.

In this case, both grid and solar is present,

- Higher priority to grid for charging battery and load support.
- Grid charger can charge the battery up to 100% and continue to support the load. However when PV is active, the AC input charger does not charge batteries.

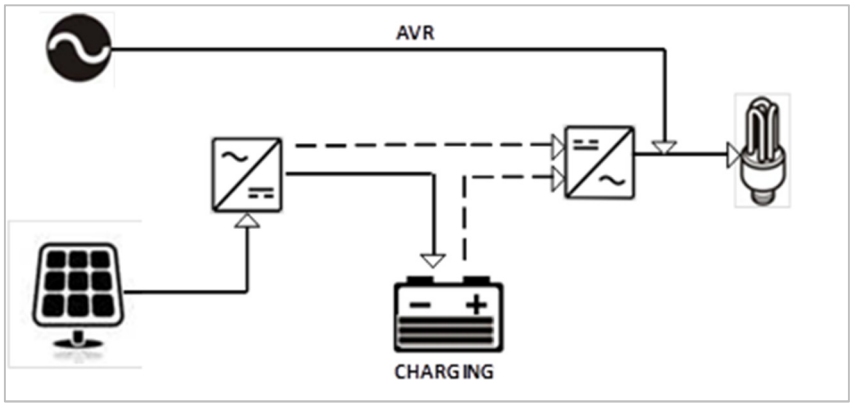


Figure 8. Illustration of APCU functionality in Grid Priority Mode, case-1.

6.3.2.2 Grid Priority Case-2: PV present, Grid absent

- If grid fails, solar and battery will support the load.
- If solar is not available, battery will support the load. Load gets disconnected after battery discharges to Low Voltage Disconnect (LVD).

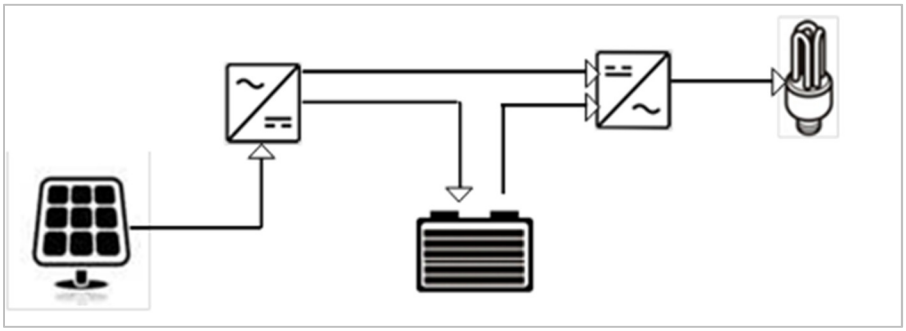


Figure 9. Illustration of APCU functionality in Grid Priority Mode, case-2.

	Change the priority setting as per your system sizing, regional & seasonal requirements for best utilization of the APCU.

7 Installation and wiring

7.1 Overview

Figure 10 provides an overview of the APCU. It is a full metal structure with louvers on the sides of the APCU to provide the best protection of system from any accidental liquid spillage without compromising cooling. The front LEDs graphically communicate the operating condition of the APCU. The LCD provides detailed information in ENGLISH alphanumeric characters. The BOS box is an additional feature that enables multiple wiring options.

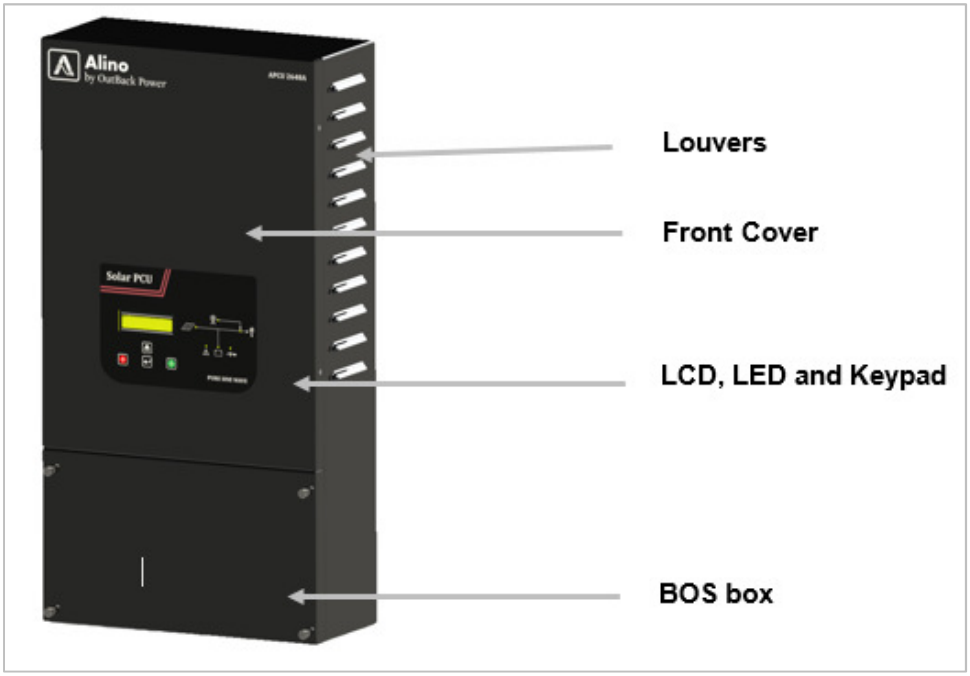


Figure 10. Overview of APCU

	Do a physical inspection, after opening the carton box. If any damage is found, immediately communicate to courier/transport company for claims. Do not use the equipment if carton box is damaged or unit is physically deformed/dented.

7.2 In the Box

The APCU box contains the following product accessories:

Table 5. Product accessories inside APCU carton box.

Sl. No.	Items	Quantity	Images
1	Quick start guide	1	
2	Mounting Bracket	1	
3	Anchor Screws	6	
4	Fuse	2 for 1 kW 3 for 2 & 3 kW	
5	AC link bus bar	1	

7.3 Tools Required for Installation

The following tools are required for installation

Table 6. Tools required for installation.

Sl. No.	Tools required	Images
1	Pencil	
2	Drill machine kit with 7.5mm wall bit size	
3	Hammer	
4	Measuring tape	
5	Screwdriver Set	
6	Spanner set	
7	Spirit Level	

	Have the installation done by qualified personnel only. The personnel must be qualified and equipped with appropriate Personal Protective Equipment (PPE) and should follow safe electrical work practices.

7.4 Cable Size

Following is the minimum cable size recommended for use during installation.

Table 7. Minimum cable size recommendations.

APCU model / Cable	1424	2648	3348	1424A	1424B	2648A	2648B
SPV	$10mm^2$ 8AWG	$10mm^2$ 8AWG	$10mm^2$ 8AWG	$10mm^2$ 8AWG	$10mm^2$ 8AWG	$10mm^2$ 8AWG	$10mm^2$ 8AWG
Battery	$16mm^2$ 6AWG	$16mm^2$ 6AWG	$16mm^2$ 6AWG	$16mm^2$ 6AWG	$16mm^2$ 6AWG	$16mm^2$ 6AWG	$16mm^2$ 6AWG
AC Input	$2.5mm^2$ 14AWG	$4mm^2$ 12AWG	$4mm^2$ 12AWG	$2.5mm^2$ 14AWG	$2.5mm^2$ 14AWG	$6mm^2$ 10AWG	$4mm^2$ 12AWG
AC Output	$2.5mm^2$ 14AWG	$2.5mm^2$ 14AWG	$2.5mm^2$ 14AWG	$2.5mm^2$ 14AWG	$2.5mm^2$ 14AWG	$4mm^2$ 12AWG	$2.5mm^2$ 14AWG

Refer local codes for appropriate cable sizes to avoid hazardous and excessive voltage drop. Local and national electrical codes must be followed for determining additional all installation requirements.

7.5 PV Wire length vs. gauge

Keep the solar modules close to the APCU for best performance and the lowest cost for wiring. Choose the cable as per your nearest distance from PV modules and the APCU. Refer to Table 8 and Table 9 for wiring recommendation for PV hook-up cable. The distances shown are one-way run for 2% overall cable drop. Use appropriate terminals and reducers to couple thicker PV cables into the PV terminals on the APCU. The maximum cable cross section rating of the terminal is 10 $mm^2 \approx 6$ AWG.

Table 8. Wire distance vs. gauge in meters.

Wire distance in meters 2% loss at 48V= 0.96 each side				
Wire AWG	**Amps**			
	10A	**20A**	**30A**	**40A**
2	-	-	48	36
4	-	45	30	22
6	57	28	19	14
8	36	18	12	9
10	22	11	7	5

Table 9. Wire distance vs gauge in feet.

Wire distance in feet 2% loss at 48V= 0.96 each side				
Wire AWG	**Amps**			
	10A	**20A**	**30A**	**40A**
2			159	119
4		149	99	74
6	187	94	62	46
8	118	59	39	29
10	74	37	24	18

Maximum one-way wire distance for less than 2 % voltage drop assuming 40 ADC charging current for a 48 VDC application is shown. For 24 VDC system, divide distance by a factor of 2.

7.6 Solar panel configurations

The Absolute Max Voc is the maximum voltage of the solar panel that PV array can present to the APCU. Voltages higher than this voltage will most likely cause failure and damage to the APCU and is not covered under warranty.

36 and 72 cell PV modules are best suited for APCU's Voc rating. Parallel the modules using a combiner boxes with appropriate fuses. 60 cell modules do not perform well due to decrease in Vmpp at increased surface temperature.

The panel voltage high cut-off is the voltage threshold above which the APCU will stop utilizing solar power. When the Voc reduces two volts below the high cut-off, the MPPT charger automatically starts operating and utilizes solar power.

Absolute Max Voc is calculated by:

$$Max\ Voc = Voc * \{100\% + [(Tmod - 25°C) * TCvoc]\} * \left[\frac{solar\ insolation}{1000}\right]$$

Where

MaxVoc is the temperature adjusted voltage

Voc is the module's rated open circuit voltage

Tmod is the temperature of the PV module

25°C is the STC condition

TCvoc is temperature correction factor in % / °C

Solar insolation is local sun power in Watts / meter ^{2}

The solar panel datasheets specify the parameters in STC and NOCT conditions. There is significant difference between the specifications. For Voc, a 72-cell module

can have up to 4V difference between STC and NOCT condition. Hence, using marginally higher Voc of 45+ V module will not exceed the 100V maximum limit of the 48V system but as the module gets warm and the system would work fine. Hence, for tropical countries using 72 cell modules for 24V and 48V system is not a concern.

Use 72-cell panel for both 24 and 48V system to account for voltage drop in NOCT and cable losses.

	Do not connect single panel-parallel configuration for 48V system. Also, never use three panels in series for any APCU model.

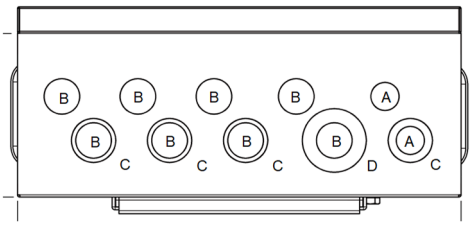
7.7 Installation

Follow below procedure to install the APCU.

1. Prepare the opening on the bottom for the APCU for cable entry. The knockouts and their gland size is given below

Bottom Knockouts	Solar PV	A; x2 or C; x1
	Battery	B; x2 or D; x1
	AC input	B; x1 or C; x1
	AC output	B; x1 or C; x1

Cable gland trade size	A	½"
	B	¾"
	C	1"
	D	1½"



2. Place the mounting bracket on wall or the plywood at the desired height for ease of operation.
3. For mounting on a wooden wall use, fix a plywood on the wall studs first. Usual wall studs are placed at 16 or 24 inch spacing. If mounting directly to the wall stud then align the center screw slots on to a wall stud for mounting stability.

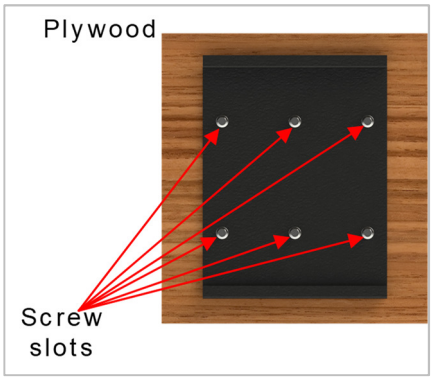


Figure 11. Mounting clamp fixed on plywood.

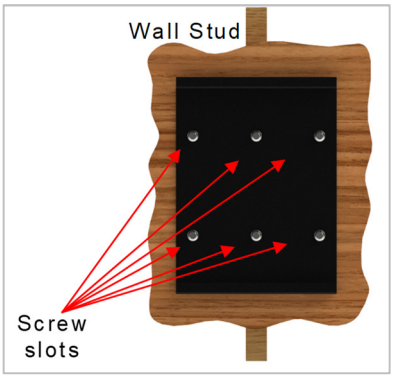


Figure 12. Mounting clamp fixed on a wall stud.

4. Use all six screws to firmly mount the bracket on surface.

5. Lift the unit above the mounting bracket.
6. Insert the top mounting portion over the bend lip of the mounting bracket.
7. Maintain a clearance of 20” (50cm) around the unit.

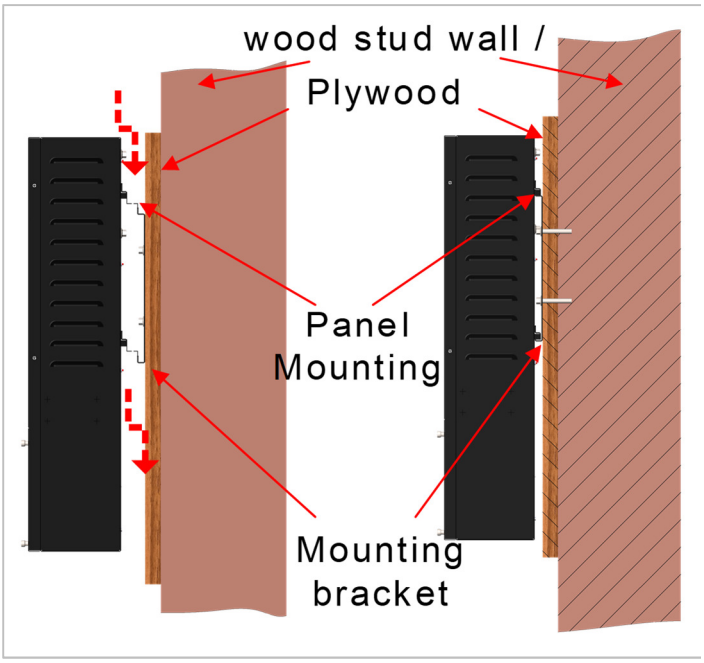


Figure 13. Illustration of APCU mounting on wall.

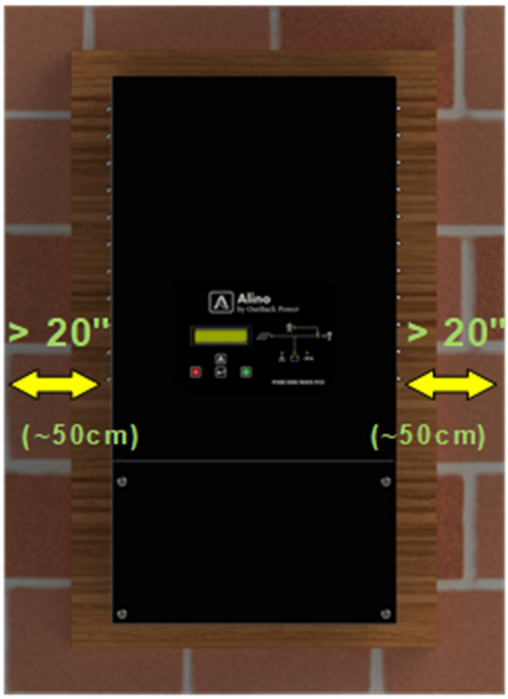


Figure 14. Illustration of APCU mounted on brick wall.

☞	There is no warranty coverage for failures due to incorrect installation practices.

7.8 Startup procedure

Follow the below procedure to start the APCU. First, complete all wiring inside the BOS compartment. Next, energize the sources.

⚠	Ensure positive/phase and negative/neutral terminals are not in close contact with each other, while connecting battery terminals, PV terminals, and AC input output terminals. Energize sources after making wire connections.

1. Remove the Balance Of Systems (BOS) box cover by loosening 4 captive screws on the front.
2. Using a digital voltmeter, verify battery voltage, solar PV voltage and grid AC voltage are appropriate for the PCU model to be installed.
3. Connect one end of both battery cables to APCU battery terminals. Do not connect batteries yet! 1
4. Connect the positive and negative photovoltaic terminals from the PV combiner box and input breaker to the APCU photovoltaic terminals. 2

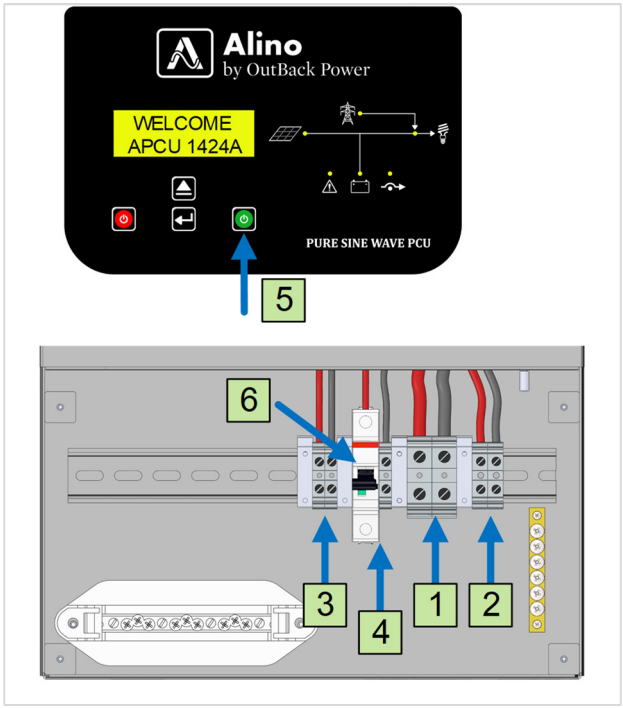


Figure 15. Procedure for energizing.

⚠	Reverse polarity of the battery connections will result in a fuse failure inside the unit. Call customer care in such cases. Warranty is void if the unit opened.

5. Connect the AC output cables to the APCU AC output terminals. 3
6. Connect the AC input cables to the APCU AC input terminals. 4
7. Connect the battery cables to the battery terminals and turn on the battery breaker or fuse (not shown.)
8. Turn ON the APCU by pressing & holding 5 sec the ON key on the front panel. 5
9. Turn ON the AC input breaker in APCU. 6
10. Turn ON the AC input breaker on service panel.
11. Turn ON the DC input breaker in the PV combiner box.
12. Close the BOS box and fasten the screws.

	Use appropriate stress relief for the cables connected to the terminals by using cable glands. Loose connections to terminals will result in hazard.

7.8.1 SOC calibration

In order for the APCU to calibrate the battery SOC, disconnect all power sources from APCU. Turn OFF AC input MCB and PV MCB. Apply maximum load to the unit. The APCU will discharge the battery and record the low voltage disconnect. Now connect the charging sources and let the APCU completely charge the system. Keep load disconnected or at minimum during this period. After battery reaches float, continue to use the APCU as intended.

Though it is not mandatory to carry out this step, we strongly recommend following this to provide APCU with best estimate of SOC.

7.9 Shutdown procedure

	Using a multimeter, ensure all power sources are de-energized before removing cable from terminals.

Ensure the below sequence/checklist is followed while turning off the unit.

1. Press and hold the OFF key on front panel for 5 seconds to turn off APCU. LCD and LED indicators will continue to be active and show status. 1
2. Turn OFF the solar DC input breaker in the PV combiner box.
3. Turn OFF the AC input breaker on service panel.
4. Turn OFF battery breaker or remove inline fuse.
5. Remove the BOS box cover by loosening four captive screws on the front.
6. Turn OFF the AC input breaker. 2
7. Disconnect the AC input cable from APCU. 3
8. Disconnect the photovoltaic positive and negative cables. 4
9. Disconnect the battery positive and negative cables. LCD and LED indications will shutdown. 5
10. Disconnect the AC output cable from APCU. 6
11. Close the BOS box and fasten the screws.

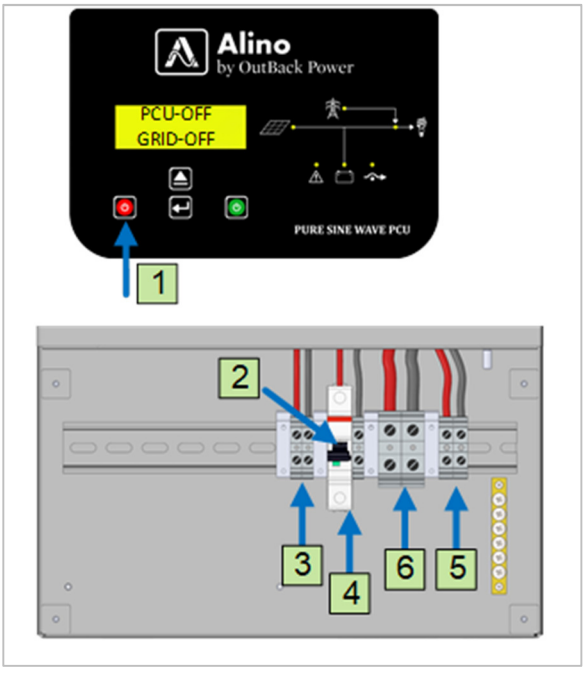


Figure 16. Procedure for de-energizing.

	Failure to follow the shutdown sequence will result in failure and is not covered under Warranty.

7.10 Load center inside BOS compartment

The BOS compartment facilitates forming a load center assembly of five AC output branches for distributing the APCU output. A five-position comb busbar with terminal lug is included in the accessory pouch. The neutral busbar terminal comes prefixed in the product.

Follow the below procedure for mounting and wiring of the AC output branches.

1. Calculate the maximum current your APCU can supply to the protected circuits.
2. Mount the fuses or MCB on the DIN RAIL. The rating depends on the individual requirements. The circuit breakers are not part of the package content. The numbers shown on circuit breakers in Figure 17 are only for illustration.
3. Connect the comb busbar to the distributed MCB/fuse.
4. Distribute the loads as per the fuse or circuit breaker ratings.
5. Connect from AC output line output to comb busbar link.
6. Connect from AC neutral output to neutral busbar.

The above process is a guideline for connections. Follow local wiring codes. Consult qualified electrical professional to avoid hazards.

	Get support of electrician qualified in home wiring and load distribution to do these wiring.

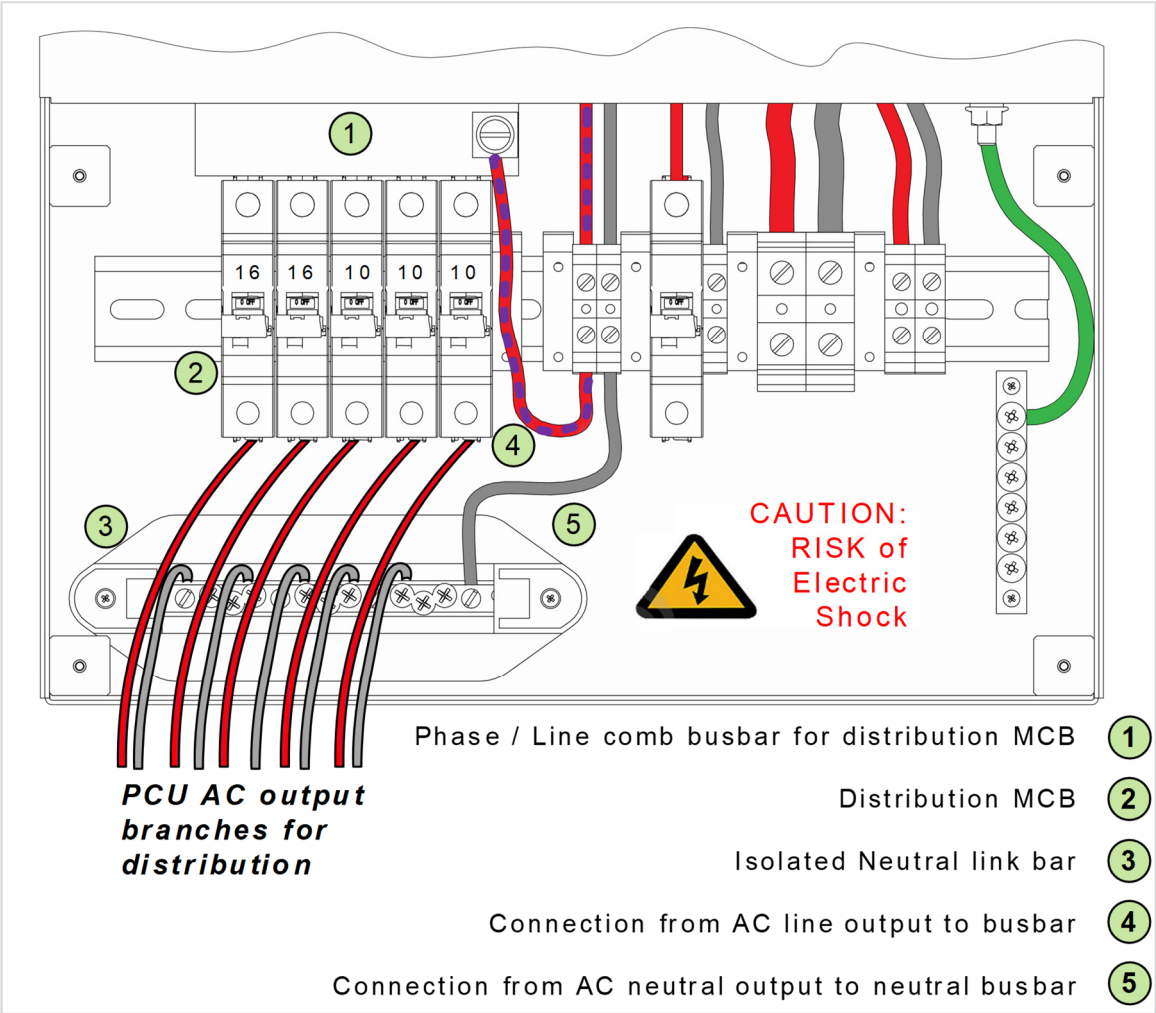


Figure 17. Load center illustration inside the BOS compartment.

⚠	DO NOT connect the AC grid input to the bussed branch link. This will result in catastrophic failure.

8 LCD and LED Indications

Figure 18 shows the front panel display of the APCU. The 16 character two line LCD and four tactile switches provides interface for user to configure and monitor the system. A set of LEDs in the front panel provides quick understanding of the operational condition of the system.

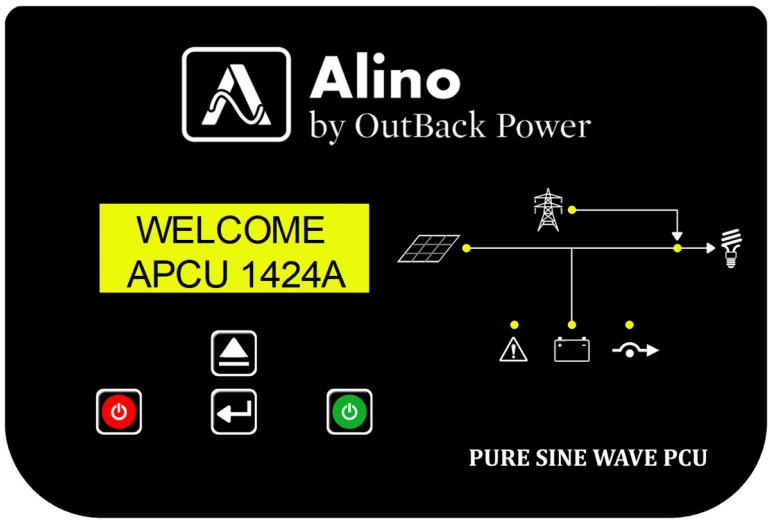


Figure 18. Front panel interface.

8.1 User buttons/keys

Key	Description	Operation
	ON KEY	'ON' key: to turn ON the APCU.
	OFF KEY	'OFF' key: to turn OFF the APCU and mute the buzzer.
	INCREMENT KEY	'INCREMENT' key: to navigate through the LCD pages.
	ENTER KEY	'ENTER' key: to make changes to LCD pages.

8.2 Operating the GUI

The APCU Series comes with a two-line 16-character (2x16) LCD to indicate system parameters and configure the APCU.

8.2.1 Auto Scrolling

LCD pages scroll automatically every three (3) seconds. Auto scrolling is enabled in USER mode only. Auto scrolling is temporarily disabled by pressing any key for ten (10) seconds and it resumes back only after thirty (30) seconds.

8.2.2 Navigating LCD pages

The LCD pages can only be incremented in one direction. Use ‘INCREMENTAL’ key to scroll through the LCD pages. The same rolls over from first page to the last page.

8.2.3 User Authentication

Among the LCD pages, some settings are restricted to access by ‘ADMIN mode’ only. Enter the ADMIN mode with valid credentials. The following parameters are listed to access only in ADMIN mode:

- Battery Type Selection
- Battery Ah Selection
- Tariff Setting
- Factory Reset
- Sleep Mode Enable/Disable
- Equalization Enable/Disable
- AVR Enable/Disable
- UPS Enable/Disable

The user authentication to change settings to ADMIN mode can be done as follows:

Navigate to ADMIN mode using 'INCREMENTAL' key		ACCESS MODE USER
Press and hold the 'ENTER' key for five (5) seconds to enter password	 5 sec	ACCESS MODE _ _ _ _
Pressing 'ENTER' key, four (4) times is the password. On each press, the character changes from '_' to '*' sequentially will interchange to 'ADMIN' mode		ACCESS MODE * _ _ _
		ACCESS MODE * * _ _
		ACCESS MODE * * * _
		ACCESS MODE * * * *
		ACCESS MODE ADMIN

8.2.4 Configuration settings

Below flow chart describes the parameter setting configuration in ADMIN mode.

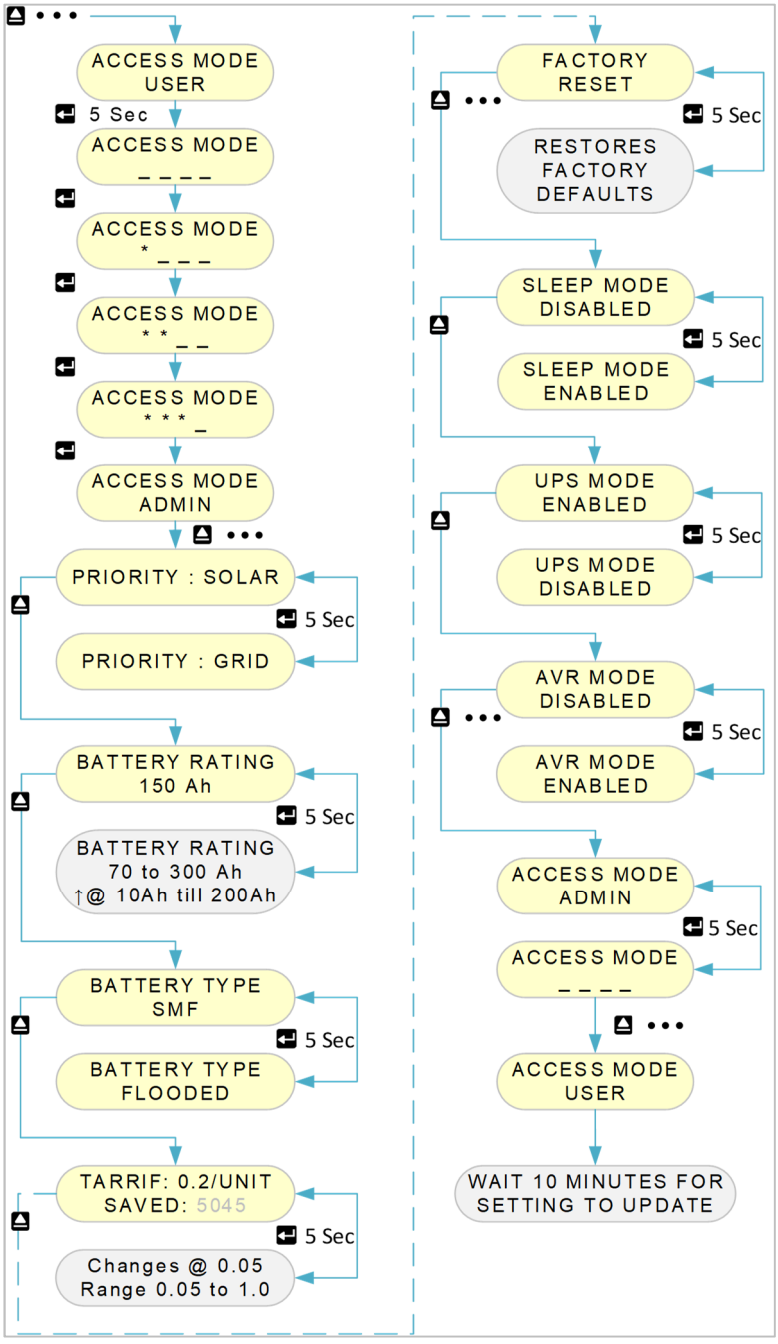


Figure 19. Configuration flowchart.

	After configuring all the parameters, wait for ten minutes for new settings to be updated.

9 LCD Pages

Below is a list of LCD pages and its details. The explanation for each LCD page detail is provided in the remarks column. The values shown under 'Display' column below are only for example.

Page	Description	Display	Remarks
1	Welcome Note	Welcome APCU 2648	
2	Rating and Version	2648VA/48VDC VER-XX:XX	Product rating and firmware version
3	Admin Access	ACCESS MODE USER	Access mode change (USER-ADMIN) – User can switch to Admin mode with a valid password of ****
4	Battery and PV Status – Line 1	SOLAR: ON	PV voltage valid
		SPV:REVERSE/OFF	PV is reverse connected or PV Open Circuit Voltage (V_{OC}) is below rated wake up voltage.
		SPV:OVER VOLTAGE	PV voltage is above safe rated voltage. Buzzer indication not present

		SPV:UNDERVOLTAGE	PV voltage is below rated low limit
		SPV:FAULT	PV related fault
	Battery and PV Status – Line 2	BATTERY:ON	Battery present at least with enough power for auxiliary electronics to be powered
		BATTERY:OFF	Battery not connected (voltage below a minimum predefined value)
		BAT:OVER VOLTAGE	Battery voltage over a predefined maximum voltage
		BAT:LOW VOLTAGE	This is a warning stage – Battery voltage is below nominal range.
		BAT: DEEP DIS.	Battery Deep Discharge Cut-off – Battery SOC is close to 20% and is deemed unsafe for the health of battery to operate in this condition
5	Charger Status – Line 1	SPV CHARGER: ON	PV charging is in progress (MPPT)

		SPV CHARGER :OFF	PV charging is OFF
	Charger Status – Line 2	GRID CHARGER :ON	Charging from AC grid is in progress
		GRID CHARGER :OFF	Charging from AC grid is OFF
6	Inverter/Grid Status – Line 1	AC OUTPUT SHORT	Grid short circuit fault
		PCU OUTPUT SHORT or PCU OUTPUT SHORT GRID: OFF	Inverter short circuit occurred
		PCU OVERLOAD GRID: OFF/ON	Inverter overload or
		PCU:OFF AC OVERLOAD or	Solar priority inverter overloaded and then connect grid, displays as given LCD page and Bypass LED ON
		BYPASS OVERLOAD	Overload in bypass mode

Inverter/Grid Status – Line 2	PCU SLEEP MODE PCU SLEEP MODE GRID: OFF or	Inverter in sleep mode due to low load.
	PCU: ON	Inverter is ON
	PCU: on STANDY	Inverter is OFF
	AC CHARGER FAULT	AC charger interrupted due to higher than rated current.
	GRID CHARGER: OFF	AC charger is OFF
	NO TXR feedback	Either AC input MCB is OFF or feedback cable (transformer connector inside the unit) is faulty
	PCU: OFF AC OVERLOAD	Overload in Grid Priority Mode Buzzer beeps with sound. (To turn OFF buzzer beep sound, press 'OFF' key) Bypass LED is ON
	GRID:BYPASS	Bypass mode is ON

		GRID:ON	Grid is present
		GRID:OFF	Grid failure
7	AC Input Voltage and Frequency	GRID INPUT: 230V FREQUENCY: 50.0Hz	
8	AC Output Voltage and Frequency	PCU OUTPUT: 230V FREQUENCY: 50.0Hz	
9	AC Output Current and Power	PCU OUTPUT: 6.25A POWER: 1440VA	
10	Inverter Generated Energy	PCU GEN. ENERGY 1000000 kWh	Energy generated from battery
11	Grid Supplied Energy	GRID POWER USAGE 100 kWh	Energy consumed from grid
12	Solar PV Voltage and Current	SPV VOLTS: 72V SPV AMPS: 20A	PV voltage and current
13	Solar PV Power	SPV INPUT POWER 1065W	PV power
14	Solar PV Extracted Energy	SPV GEN. ENERGY 1000000 kWh	Energy extracted from PV
15	Battery Voltage and Ah	BAT. VOLTS: 52.2 BAT. Ah: 65%	Battery voltage and SOC of battery

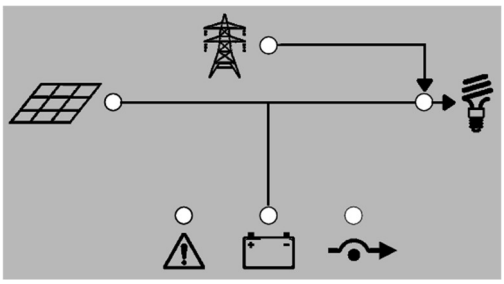
			(present available Ah)
16	Battery Charging Current	BATTERY CURRENT 20.7A BATTERY CURRENT - 30.3A or	Battery charging current and discharge current.
17	Inverter Load Percent and Temperature	PCU LOAD: 75% TEMPERATURE: 42C	Active load of APCU in terms of its full load percentage. Present operating temperature of the unit
18	System Faults – L1	SPV NTC FAIL	PV charge controller thermal sensor faulty
		PCU NTC FAIL	Inverter thermal sensor faulty
		PV OVER TEMP.	Over temperature cut-off due to charge controller heat sink temperature
		PCU OVER TEMP.	Over temperature cut-off due to the inverter heat sink temperature
		I2C COMM FAILURE	I2C communication faults

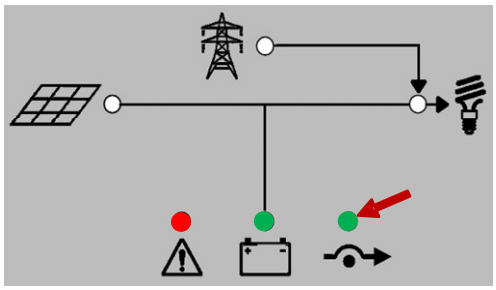
		MEMORY FAILURE	Memory storage faults
		SPI COMM FAILURE	SPI communication fault
		NO SYSTEM FAULTS	System OK – No faults
19	Menu: Priority Setting	PRIORITY: GRID	System priority set to Grid
		PRIORITY: SOLAR	System priority set to PV
20	Menu: Ah Setting	BATTERY RATING 200Ah	Battery Ah Setting – ranges from 70Ah to 200Ah, in increments of 10Ah and directly goes from 200Ah to 300Ah.
21	Menu: Battery Type Setting	BATTERY TYPE SMF	Battery type setting set to Sealed Maintenance Free (SMF)
		BATTERY TYPE FLOODED	Battery type set FLOODED battery
22	Solar PV Savings	TARIFF: 8.0/UNIT SAVED: 5045	Tariff is a user setting and the value can be set to a solar tariff, at the installed location.
23	Menu: Factory Reset	FACTORY RESET	Do a factory reset through ADMIN mode

24	Previous Critical Fault Register	NO PREVIOUS SYSTEM FAULTS	There were no previous critical faults
		PREV SYS FAULT AC O/P SHORT	Previous critical fault was AC output short
		PREV SYS FAULT PCU O/P SHORT	Previous critical fault was inverter output short
		PREV SYS FAULT PCU OVERLOAD	Previous critical fault was inverter overload cut-off
		PREV SYS FAULT AC OVERLOAD	Previous critical fault was AC overload cut-off
		PREV SYS FAULT BYPASS OVERLOAD	Previous critical fault was Bypass overload cut-off
25	Menu: Sleep Mode Switch	SLEEP MODE: ENABLED	Sleep mode is enabled
		SLEEP MODE: DISABLED	Sleep mode is disabled
26	Menu: UPS Mode Switch	UPS MODE: ENABLED	UPS mode is enabled
		UPS MODE: DISABLED	UPS mode is disabled
27	Menu: AVR Mode	AVR MODE: ENABLED	AVR mode is enabled
		AVR MODE: DISABLED	AVR mode is disabled

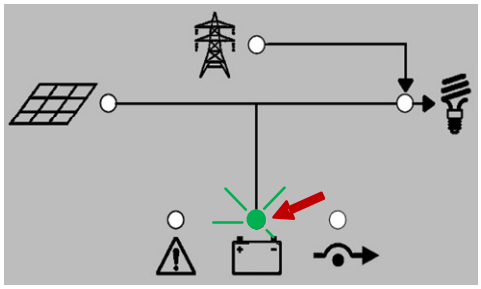
28	Menu: Equalization Mode (Only for Flooded Battery)	EQUALIZED: BAT. EQ.: OFF	Battery is equalized
		EQ. CHARGE DUE BAT. EQ.: ON	Battery equalization charge profile is about to begin
		EQ. IN PROGRESS BAT. EQ.: OFF	Battery equalization is in progress
29	Inverter Switch ON	PCU on GRID GRID: ON	Load is powered through grid
		PCU on INV GRID: ON/OFF	Load is powered through inverter and grid can either be in ON or OFF position

10 LED Indications

Indication	Comments
	There are 6 LEDs as shown in the image. All are OFF when battery is not connected.
	•  AC input LED is ON when grid is available and within limits •  AC output LED is ON when output is available from the grid bypass/AVR.
	•  PV LED is ON when solar input is available and is within limits.
	•  Alert LED is ON when there are any system fault. This may include any faults such as overload, short circuit, battery related faults, PV related faults or thermal sensor faults. Refer LCD Pages for more details on faults.



- Bypass LED is ON in grid mode when there are thermal sensor faults or overload faults. Note that fault LED would also be ON at this time.



- A flashing battery LED indicates Battery faults. Refer LCD Pages for more details on faults.

11 Buzzer Indication

The APCU provides an audible alarm for the system conditions, such as warnings and faults. Buzzing time and repetition rates helps to distinguish different conditions.

Fault condition	24V system	48V system
Low battery	Beep (buzzer) to start when battery low voltage indication reaches, 3sec beep ON (0.3sec interval); 2sec beep OFF – continuously until battery voltage reaches 21.5 +/- 0.2V	Beep (buzzer) to start when battery low voltage indication reaches, 3sec beep ON (0.3sec interval); 2sec beep OFF – continuously until battery voltage reaches 43 +/- 0.2V
Low battery cut –off (Deep Discharge)	Automatic shutdown with 9 beep interval of 0.3sec, with indication on LCD and with permanent output off. LCD display indication continues until inverter switched off on the front panels or power resumed through grid. No retry observed.	Automatic shutdown with 9 beep interval of 0.3sec, with indication on LCD and with permanent output off. LCD display indication continues until inverter switched off on the front panels or power resumed through grid. No retry observed.
Overload	Beep sound continuously, then inverter goes to shut down again inverter Turns ON if load is reduced within 3 retry.	Beep sound continuously, then inverter goes to shut down again inverter gets ON if load is reduced within 3 retry.
Short-circuit	Long beep continuously till inverter reset	Continuous long beep
Grid voltage is out of range.	Varying tone buzz	

Use the ‘OFF’ key to mute the buzzer when required.

12 Troubleshooting

Phenomenon	Confirmation Solution
Fault LED (Red) is blinking	  Battery is connected with reverse polarity – Fuse is blown as a result, please call customer care.
LCD display showing the alert, “SPV Reverse/OFF” Note: No LED indication	 Solar panel is connected with reverse polarity. Use multi-meter to check voltage and polarity of connection
LCD is OFF or Battery LED is OFF	 Ensure battery is connected properly. There might be a failure within the APCU. Ensure battery voltage is >22V (24V system) and >44V (48V system). Call customer care.
Grid power is normal but AC Input LED is OFF	  Check for any loose connection at AC input connections and service panel breakers. Be cautious while handling input breaker and AC cables. There might be a failure within the APCU. Call customer care.
PV LED is OFF on a bright day	  Check PV wiring. Please ensure all connections are proper.

		There might be a failure in the APCU. Call customer care.
Battery LED blinking LCD shows “BAT.: LOW VOLTAGE” or “BAT.: DEEP DIS.”		Battery is not in good condition – Battery is in low battery/deep discharge state. Ensure that PV is charging the battery or not in Solar Priority Mode. In case of a cloudy day, the priority can be changed to grid for uninterrupted output. Remember to revert to solar priority once the weather is normal.
AC Output LED is blinking		The system has entered sleep mode due to very low load. If there are loads at this power level, this feature can be turned OFF from the LCD page.
Battery LED blinking LCD shows “BAT.: OVER VOLTAGE” for more than 5-10 minutes		Unit is reading battery over voltage. Confirm the battery voltage measurement by external multi-meter. If battery voltage is > 32V for 24V battery and >64V for 48V battery. Switch OFF the unit or disconnect the battery.
AC Output LED is ON/OFF and Fault LED (Red) is ON with one of the following messages on LCD page. • AC OUTPUT SHORT • PCU O/P SHORT • PCU OVERLOAD		This is a load related fault condition which has resulted due to one of the following faults: • AC OUTPUT SHORT • PCU OUTPUT SHORT • PCU OVERLOAD (due to inductive load/ high inrush current) Reduce load within inverter rated limits. Then, turn it ON by pressing ‘ON’ key.

AC Output LED is ON, Fault LED (Red) is ON and Bypass LED is ON with buzzer and output available		System is in grid mode and more than rated load has taken system into bypass condition. Reduce load within inverter rated limits, the recovery is automatic.
Fault LED (Red) is ON and bypass LED is ON with buzzer and output-OFF. LCD shows “BYPASS OVERLOAD”		System is in grid mode and more than rated load has taken system into bypass condition. Prolonged bypass condition has tripped the output for safety. Reduce the load to less than rated power and press ‘ON’ key to start the unit again.
Any other fault information on LCD along with fault LED or buzzer		Call customer care immediately.
Frequent low battery conditions	 	The unit is set to solar priority and there is no solar availability to charge the battery sufficiently. On such weather condition, please switch to grid mode to avoid low battery conditions. Solar panel voltage (PV): battery voltage (BV) difference is > 4V is the ratio proportion. Call customer care for more clarification.
Lower than expected solar output	  	The days could be with lower solar insolation. The panels might require cleaning to remove dust and debris. The panel position is incorrect. There may be any shade from tress or weeds nearby casting shadow on the installation

		One of the parallel strings could have got disconnected. Condition of PV module may have degraded
Higher than expected grid bills		This could be because of improper use of the priority settings. Refer priority mode setting page-13 for more details
Unit is dead and need emergency bypass for load from grid power		Disconnect the grid input and output cable from the unit. Call customer service.

13 Technical Specification

	50Hz			60Hz			
Models	**APCU 1424**	**APCU 2648**	**APCU 3348**	**APCU 1424A**	**APCU 2648A**	**APCU 1424B**	**APCU 2648B**
Parameters	**Variant Specifications**						
Type	Single-phase solar power conditioning unit			Single-phase solar power conditioning unit			
Nominal Battery Voltage	24VDC	48VDC	48VDC	24VDC	48VDC	24VDC	48VDC
Nominal Power Rating(25°C)	1400VA	2600VA	3300VA	1400VA	2600VA	1400VA	2600VA
Nominal Output	230VAC/50Hz			120VAC/60Hz		220VAC/60Hz	
Electrical—Solar							
Charger Technology	MPPT						
PV Charge Controller Rating	1kWp	2kWp	2.5kWp	1kWp	2kWp	1kWp	2kWp
Battery Input Range	18VDC to 32VDC	36VDC to 64VDC	36VDC to 64VDC	18VDC to 32VDC	36VDC to 64VDC	18VDC to 32VDC	36VDC to 64VDC
Absolute Maximum VOC	55VDC	100VDC	100VDC	55VDC	100VDC	55VDC	100VDC
MPPT Range	26VDC to 40VDC	48VDC to 72VDC	48VDC to 72VDC	26VDC to 40VDC	48VDC to 72VDC	26VDC to 40VDC	48VDC to 72VDC
Panel High Voltage Cut-Off	>55VDC	>95VDC	>95VDC	>55VDC	>95VDC	>55VDC	>95VDC
Recommended PV Panel	72 & 60 cells solar panel*						
Recommended PV Panel Configuration	1 panel per string and 4 panels in parallel	2 panels in series per string and 4 panels in parallel		1 panel per string and 4 panels in parallel	2 panels in series per string and 4 panels in parallel	1 panel per string and 4 panels in parallel	2 panels in series per string and 4 panels in parallel
Maximum Charging Current	40ADC						
Charger Efficiency	>95%						
MPPT Tracking Efficiency	>99%						
Charging Modes	Four modes (bulk/absorption/float/equalization)						
Battery Type Selection	Default flooded or sealed maintenance-free (VRLA/GEL/AGM),selectable through front panel						
Battery High Cut-Off	>32VDC	>64VDC	>64VDC	>32VDC	>64VDC	>32VDC	>64VDC
Type of Cooling	Forced						

Models	APCU 1424	APCU 2648	APCU 3348	APCU 1424A	APCU 2648A	APCU 1424B	APCU 2648B
Parameters	**Variant Specifications**						
Electrical—Grid							
Input Voltage Range	145VAC to 275VAC	145VAC to 275VAC	145VAC to 275VAC	75VAC to 143VAC	75VAC to 143VAC	145VAC to 265VAC	145VAC to 265VAC
Input Frequency Range	42Hz to 58Hz	42Hz to 58Hz	42Hz to 58Hz	55Hz to 65Hz	55Hz to 65Hz	55Hz to 65Hz	55Hz to 65Hz
AVR Input Range (Beyond Given Input Range, AVR Output Regulation is ±20%)	165VAC to 275VAC	165VAC to 275VAC	165VAC to 275VAC	85VAC to 143VAC	85VAC to 143VAC	165VAC to 265VAC	165VAC to 265VAC
AVR Output Range	230VAC ± 10%	230VAC ± 10%	230VAC ± 10%	120VAC ± 10%	120VAC ± 10%	220VAC ± 10%	220VAC ± 10%
Typical Frequency	50Hz			60Hz			
Battery Charging Current from Mains	Up to 20ADC						
Transfer Time (Utility/Generator to Inverter)	<12ms						
Electrical—Inverter							
Output Voltage	230VAC	230VAC	230VAC	120VAC	120VAC	220VAC	220VAC
Frequency	50Hz ± 0.5Hz			60Hz ± 0.5Hz			
Output Wave Form	Pure sine wave						
Load Regulation	±2%						
Output Power Factor	0.8						
Peak Efficiency	>88%						
THD (Linear Load)	<3%						
Crest Factor	3:1						
Battery Low Alarm and Indication	21.9VDC	43.8VDC	43.8VDC	21.9VDC	43.8VDC	21.9VDC	43.8VDC
Low Battery Load Cut-Off	21.5VDC	43VDC	43VDC	21.5VDC	43VDC	21.5VDC	43VDC
Load Reconnect	>25VDC	>50VDC	>50VDC	>25VDC	>50VDC	>25VDC	>50VDC
Short Circuit	One retry followed by permanent shutdown: 0.1sec ON and 10sec OFF						
Overload Cut-Off	Three retries followed by permanent shutdown: 110-125% 60sec ON and 10sec OFF, 125-150% 10sec ON and 10sec OFF, 150-200% 3sec ON and 10sec OFF, 200-300% 0.5sec ON and 10sec OFF, 300% 0.1sec ON and 10sec OFF						
Instantaneous Power (100ms)	3600VA	7200VA	9000VA	3600VA	7200VA	3600VA	7200VA
Surge Power (0.5sec)	2400VA	4800VA	6000VA	2400VA	4800VA	2400VA	4800VA
Continuous Power Rating (25°C)	1400VA	2600VA	3300VA	1400VA	2600VA	1400VA	2600VA
Load Recovery	≤100% of nominal power output and manual reset after three retries						

Models	APCU 1424	APCU 2648	APCU 3348	APCU 1424A	APCU 2648A	APCU 1424B	APCU 2648B
Parameters	**Variant Specifications**						
Electrical—PCU							
Mode of Operation	Solar/grid priority, selectable through front panel						
Self-Consumption (Sleep Mode Inactive)	<26W	<45W	<45W	<26W	<45W	<26W	<45W
Self-Consumption(Sleep Mode Active) <10W	<10W						
No Load Shutdown (Sleep Mode Active, % of Rated Full Load Current)	<3%	<2%	<2%	<3%	<2%	<3%	<2%
No Load Recovery Time 4sec	4sec						
Mechanical							
Dimensions L x W x D (mm)	670 x 350 x 150						
Net Weight (kg)	22	32	32	22	32	22	32
Recommended Mounting	Wall-mount						
Cable Entry	Bottom						
AC Input Terminals	MCB & DIN RAIL feed through terminal 6U						
AC Output Terminals	MCB & DIN RAIL feed through terminal 6U						
Panel Terminals	DIN RAIL feed through terminal 10U						
Battery Terminals	DIN RAIL feed through terminal 35U						
Environmental							
Operating Temperature	0°C to 50°C						
Acoustic Noise	<56dB						
Relative Humidity Range (Non-Condensing)	5% to 95%						
Altitude	2000m above sea level						
Operating Environment	Indoor/protected						
Ingress Protection	IP21						
Environmental Protections	All PCB boards are conformal coated						

Models	APCU 1424	APCU 2648	APCU 3348	APCU 1424A	APCU 2648A	APCU 1424B	APCU 2648B
Parameters	**Variant Specifications**						
Protections							
Short Circuit	Input/output						
Reverse Polarity	Battery/panel						
Overload	Provided						
Battery Protection	High and low voltage						
Display	Alpha numeric LCD						
Configurable Parameters (Through Front Panel Keys)	Battery type, battery Ah selection, solar or grid priority, sleep mode enable/disable, factory reset, tariff per unit						
External Accessories							
Wall-Mount	Mounting bracket and accessories						
Regulations and Directives							
Compliance	IEC61683, IEC 60068-2 (1, 2, 14, 30)						
Display and LED Indications							
LED Green	Input, battery, mains, bypass, AC output						
LED Red (Fault Indication)	Short circuit, overload, over temperature, battery low, battery high						
LCD Display Parameters	Software versions, PCU power, output frequency, PCU output current, SPV input power, load bypass, no load shutdown, battery Ah %, Grid charger ON /Grid charger OFF, PCU load %, SPV voltage and current, battery voltage and current, panel low, system off, priority (solar/grid), tariff per unit, battery type (tubular/SMF), savings, alarm status, factory reset, sleep mode ON/OFF, AVR ON/OFF, Over temperature, SPV NTC fail						
Warranty	2 years						

14 Appendix

14.1 Temperature de-rating

Figure 20. Temperature derating curves of 50Hz APCU models.

14.2 Efficiency Graph

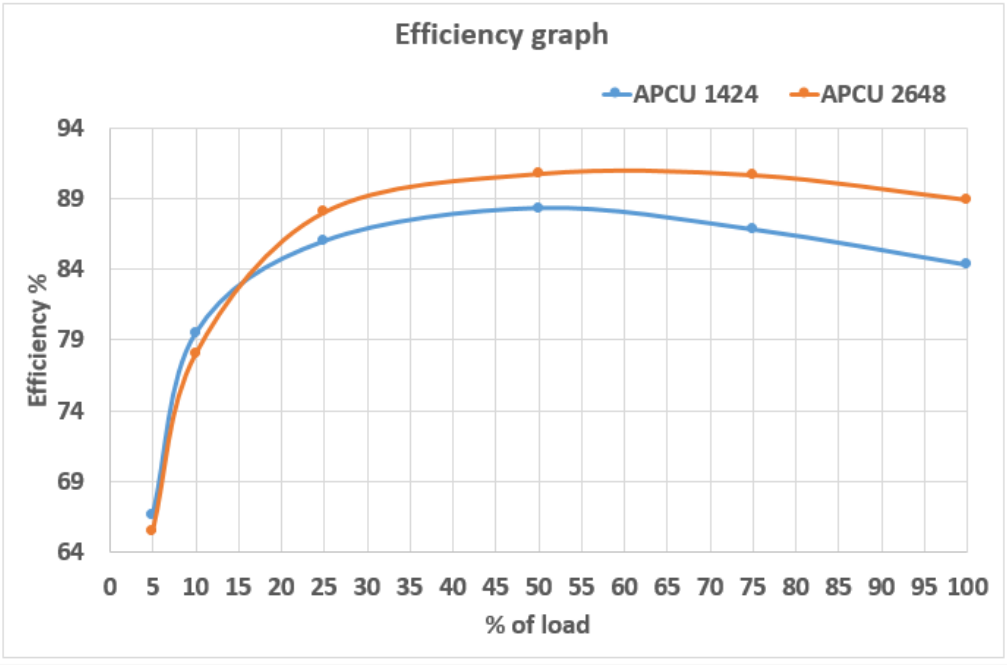


Figure 21. Efficiency vs. load

Alino by OutBack Power

Call for Assistance

If you require any assistance, kindly contact our customer support team at,

Technical support: 10 AM - 5 PM IST Telephone: +91-080-41283446 Email: support@navsemi.com Website:www.navsemi.com	8 AM - 5 PM CST T: + 52 55-5543-1114 T: + 52 55-5543-1115 Sin Costo: 01-800-0082-886

Disclaimer

All hardware and software procedures described in this document are subjected to change without prior notice.

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