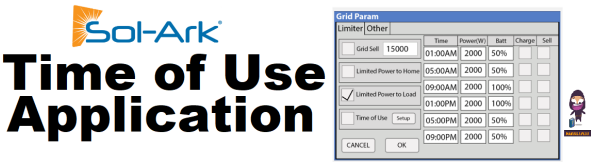

Sol-Ark Time of Use Application User Guide

Contents

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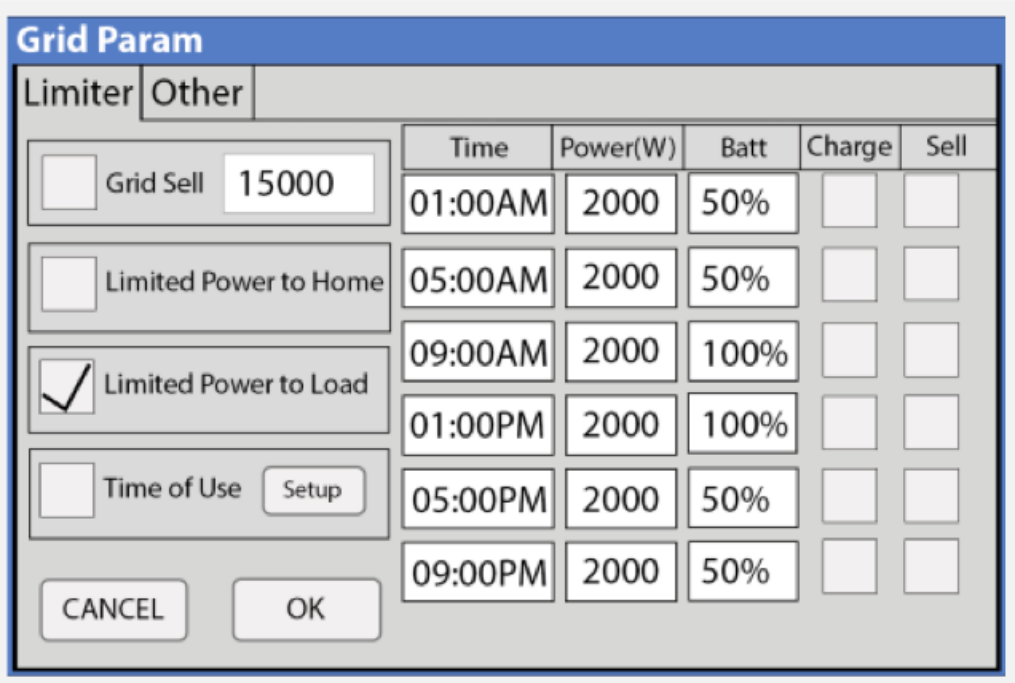
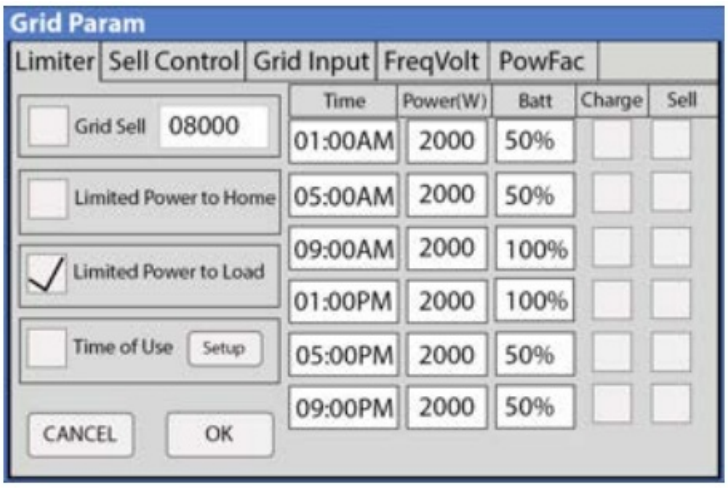


Overview

- Time of Use (TOU) are settings in the Grid Setup menu to control battery charge and discharge while the inverter is connected to grid power or other AC power sources.
- It is most common to use these Time of Use settings to discharge the battery to cover the load while connected to the grid. This will allow the use of the batteries beyond emergency backup purposes.
- There are limited use cases for off-grid applications involving generator controls as well.



Time

- The Time setting in each box is the starting time for each time block. The last time block wraps around from time 6 back to time 1.
- These Time settings must be in chronological order from 0000 to 2400 and you can change the times to AM/PM by going to the Basic Setup menu → Display.

Power(W)

- These settings are the maximum allowable power discharged from the battery in each time block.

- If your load exceeds the Power(W) setting and no solar is available, your Sol-Ark inverter will use other available power such as grid power to cover loads not provided by the battery.

Batt

- These settings control battery discharge/charge during the specified time slot. This will be in Voltage or % based on the Batt Setup setting.
- The meaning of this value changes depending on which (if any) checkboxes are selected (Charge or Sell); All possible meanings will be explained in this document later.

Charge

- Allow the inverter to charge the battery from an AC source (Grid, Generator, or AC coupled input) connected to the Sol-Ark inverter at a specified time block until the Batt setting is reached.
- PV will always charge the battery regardless of whether Charge is selected or not.

Sell

- Allow the inverter to discharge the battery and push battery power back to the Grid breaker or the grid at the rate of the Power(W) setting until the Batt setting is met.
- DO NOT ENABLE BOTH CHARGE AND SELL BOXES AT ANY GIVEN TIME BLOCK AS IT MAY CAUSE UNINTENDED BEHAVIOR.

Different Operating Mode Affecting Time of Use

Grid Sell + Time of Use

- This combination will use available PV and battery power to push the set amount of Power(W) back through the Grid breaker.
- If PV production is enough to cover the Max Sell amount (the number next to Grid Sell), the battery will not be discharged.
- In this combination, Charge boxes do not need to be checked to sell battery power back to the grid breaker as the inverter will always sell the programmed Power(W) amount back to the Grid breaker until either the Max Sell amount is met or the battery SOC reaches Batt setting for the time block.
- Not all power pushed back to the grid breaker will be sold to the grid, it may be consumed by loads in the main service panel.
- If you wish to monitor the amount of power that is sold to the grid, please use “Limited Power to Home” mode with supplied CTs.

Limited Power to Home + Time of Use

- This combination requires CT sensors to be installed at the correct location with the correct polarity.
- In this combination, PV will be used to charge the battery and power the whole home’s load when available. The battery will be used to cover the whole home’s load when PV is no longer available or is not producing

enough for the whole home's load amount;

- This will continue until the battery SOC reaches the Batt setting at or below the rate of the Power(W) setting for the appropriate time slot. If PV and the battery cannot cover the loads, the inverter will then draw from the grid to power remaining loads.
- Charge boxes in this combination will use the grid to charge the battery and Sell boxes will sell battery power back to the grid until battery SOC reaches the Batt setting at the rate of the Power(W) setting.

Limited Power to Home + Time of Use + Grid Sell

- This combination requires CT sensors to be installed at the correct location with the correct polarity.
- Very similar to Limited Power to Home + Time of Use. Instead of PV production trying to match the whole home's load, PV will produce as much power as possible.
- Using the generated PV production to power the load, charge the battery, and sell any remaining power back to the grid.

Limited Power to Load + Time of Use

- In this combination, PV will be used to charge the battery and power the critical load sub-panel connected to the Load breaker on the Sol-Ark inverter when available. Battery will be used to cover the critical load sub-panel on the Load breaker when PV production is no longer available or not producing enough to cover the critical load sub-panel until battery SOC reaches the Batt setting at or below the rate of the Power(W) setting for the time slot.
- If neither the PV nor the battery can power the loads, the inverter will draw from the grid to power the critical load panel.
- Charge boxes in this combination will use the grid or a generator to charge the battery and Sell boxes will send battery power back to the grid breaker until battery SOC reaches the Batt setting at the rate of the Power(W) setting.
- Not all power pushed back to the grid breaker will be sold to the grid, it may be consumed by loads in the main service panel.
- If you wish to monitor the amount of power that is sold to the grid, please use "Limited Power to Home" mode with proper CTs.

Limited Power to Load + Time of Use + Grid Sell

- Very similar to Limited Power to Load + Time of Use. Instead of PV production trying to match the critical load sub-panel, PV will produce as much power as possible.
- Using the generated PV production to power the critical load sub panel, charge the battery, and sell any remaining power back to the grid.
- Not all power pushed back to the grid breaker will be sold to the grid, it may be consumed by loads in the main service panel.
- If you wish to monitor the amount of power that is sold to the grid, please use "Limited Power to Home" mode with proper CTs.

Off-Grid Generator Control Function

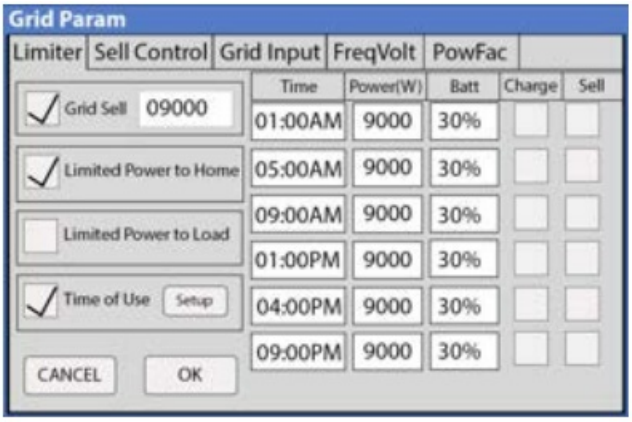
- Although TOU is not generally used in off-grid situations, TOU could be used for precise generator control when charging batteries. When using TOU settings off the grid with a 2-wire auto start generator, with the Charge boxes checked, the generator control relay will open the circuit to shut down the generator as the battery SOC reaches the Batt setpoint. Generator start will still follow the charge setpoints (Batt Setup menu → Charge), not any TOU settings despite the Charge checkboxes being checked.
- All Charge checkboxes need to be checked to ensure the generator can turn on any time slot to charge the battery if needed.

Grid Peak Shaving

- If you are utilizing the Grid Peak Shaving option on the inverter, TOU will automatically turn on; TOU is required to be on while utilizing the Grid Peak Shaving.
- Please do not make any changes to the TOU setup menu when you are using Grid Peak Shaving as it may introduce unexpected issues to the normal operation of the Sol-Ark inverter.

TOU Setup Examples – Most Common Applications

- **On-Grid:** Off-set Loads Overnight, Charge During the Day Without Buying from Grid, and Sell Excess PV

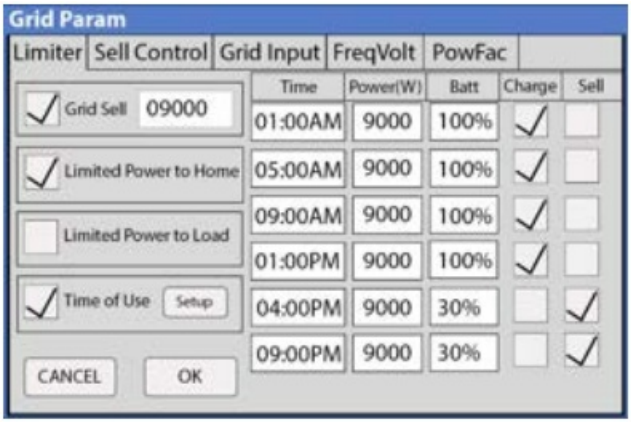


- This is the most common application for TOU, using the Sol-Ark inverter to limit the amount of power being imported from the grid.
- The Time value can be adjusted to better line up with your location's sunrise/sunset for efficiency, while the Power(W) setting will depend on the Ah rating of your battery bank.
- If your Max A Charge/Discharge (Batt Setup menu → Batt) is 185A, then you may set the Power(W) value to 9000W, for example.
- The Batt value (V or %) will depend on the Ah rating of the battery bank and the recommendation of the battery manufacturer. Generally, lithium (LiFePo4) batteries can be deep-cycled deeply daily without issue (hence the 30% in the example image), but lead acid or flooded battery chemistries cannot handle a daily discharge of this amount. For lead acid batteries, do not discharge below 70% SOC (or equivalent voltage) daily to extend battery life considerably.
- The battery manufacturer will always have the last say, so if unsure, please contact them to verify their stance and ensure you are operating within (if any) warranty restrictions.
- We recommend using the same SOC% or Voltage for all time slots, this will ensure that PV power is shared between any loads and charging the battery simultaneously. If you set the Batt value to 100% (or float voltage), then PV power will flow as much as possible to the batteries and the grid will provide power to the loads until the battery reaches 100%. If the Batt value keeps the same %/V throughout the day (30% in our example) then

the PV will cover all loads first and charge the batteries with excess power, and finally, power will be sent to the grid if any is available.

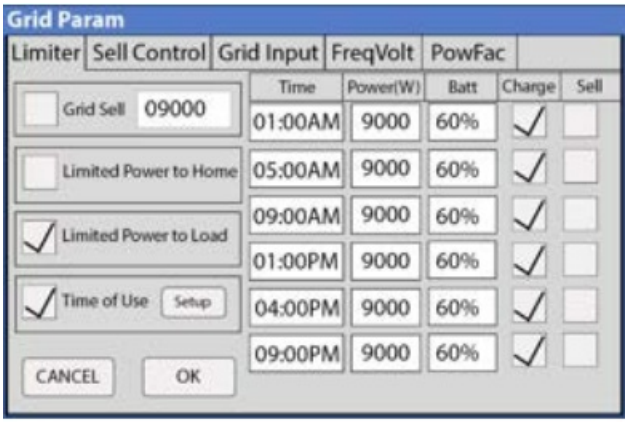
- If the Charge checkbox is selected during a time, then either the grid or a generator will charge the batteries until the chosen SOC% or V is reached. If the batteries are below the Batt value when the charge period begins, then the Grid will immediately begin charging the battery until the Batt value is reached. Generators will only begin charging the battery once the Gen/Grid Start %/V (Batt Setup → Charge) value is reached but will charge the battery until the Batt value is reached. Within the same time, the grid nor the generator will be called to charge the battery if the Batt value has already been reached unless the Gen/Grid Start %/V is reached once more, or a new time slot begins with the battery under the Batt value
- We do not recommend enabling the Sell checkbox for this use case.

On-Grid: Utility Charges Rates Based on Worst Hours (4 pm-9 pm); Sell Power from Batteries to Ensure No Grid Import at Chosen Time



- This application is most commonly used in California where some utility providers charge their customers based on consumption during a specific time (i.e., 4 – 9 pm).
- The Time value can be adjusted to better line up with your utility provider's charge period.
- The Power(W) setting will depend on the Ah rating of your battery bank; If your Max A Charge/Discharge (Batt Setup menu → Batt) is 185A, then you may set the Power(W) value to 9000W, for example.
- The Batt value (V or %) will depend on the Ah rating of the battery bank and the recommendation of the battery manufacturer. Generally, lithium (LiFePo4) batteries can be cycled deeply daily without issue (hence the 30% in the example image), but lead acid battery chemistries cannot handle a daily discharge of this amount. For lead acid batteries, do not discharge below 70% SOC (or equivalent voltage) daily to extend battery life considerably.
- The battery manufacturer will always have the last say, so if unsure, please contact them to verify their stance and ensure you are operating within (if any) warranty restrictions.
- We recommend using the same SOC% or Voltage for all time slots you are being charged at the higher rate and using 100% (float voltage) for the remaining time slots with Charge checkboxes selected.
- This will ensure that the battery bank will be charging/full when it is not needed.
- The Batt value for the Sell checkbox periods should correspond with recommendations from your battery manufacturer if you intend to take the batteries down to their lowest value.

Off-Grid: Precise Generator Control to Conserve Fuel



- This application is used in off-grid installations incorporating a generator into either the Grid or Gen breaker of the Sol-Ark.
- Using TOU allows for precise control of when the generator will turn on and turn off (given the generator is two-wire start compatible).
- The Time value can be adjusted to better line up with your preference, while the Power(W) setting will depend on the Ah rating of your battery bank.
- If your Max A Charge/Discharge (Batt Setup menu → Batt) is 185A, then you may set the Power(W) value to 9000W, for example.
- The Power(W) rating does not impact the rate at which the generator will charge the batteries, this is controlled by the Gen/Grid Start A (Batt Setup menu → Charge).
- The Batt value will depend on preference since this is the cutoff for generator charging.
- The battery will always discharge down to the Shutdown %/V (Batt Setup menu → Discharge) while off-grid. In the above example, the generator will cut off at 60% battery SOC.
- DO NOT select the Sell checkbox for any time as this will cause the Sol-Ark to push battery power into the generator if it is on the grid breaker.

TOU Tips for Success

These are some miscellaneous tips for TOU:

- TOU only controls the battery's discharge while the grid is available. If there is a grid loss event or you are off-grid, the battery will always discharge down to the Shutdown %/V (Battery Setup menu → Discharge).
- If you intend to use your batteries to offset as many loads as possible while the grid is available, then you will likely set your Batt value in TOU to be equal to the Low Batt %/V value (Batt Setup menu → Discharge). Low Batt is the lowest possible value that batteries are allowed to be discharged down to while the grid is available.
- If you intend to use the batteries as a backup power source in a grid loss event, set your Batt value in TOU accordingly. If you set the Batt value to be equal to the Low Batt %/V, then times become possible where the battery is at the Low Batt value and only has a minimal amount of room until the Shutdown %/V is reached. The less room between these values, the smaller your battery bank, and the larger your loads, the quicker you will reach the Shutdown value and experience a fault (causing inverter shutdown).
- These types of faults will usually happen in a grid loss event during inclement weather or in the middle of the night.

Author/Editor	Changelog	Version	Latest Software Version Upon Release
Fernando & Vincent	Document Clean Up	1.2	MCU XX10 || COMM 1430

Documents / Resources

	Sol-Ark Time of Use Application [pdf] User Guide Time of Use Application, Application

References

- User Manual