
Conext™ SW Inverter/Charger Documentation Update

976-0315-01-01
Rev C

DANGER

RISK OF FIRE, ELECTRIC SHOCK, EXPLOSION, AND ARC FLASH

This Documentation Update is in addition to, and incorporates by reference, the relevant product manuals for each product in the Conext SW Inverter/Charger. Before reviewing this Documentation Update you must read the relevant product manuals. Unless specified, information on safety, specifications, installation, and operation is as shown in the primary documentation received with the product. Ensure you are familiar with that information before proceeding.

Failure to follow these instructions will result in death or serious injury.

Purpose

The purpose of this Documentation Update is to explain new features of the Conext SW (CSW) unit. It supplements the Conext SW Owner's Guide (Document Number: 975-0636-01-01).

Audience

This Documentation Update is intended for users and operators of the Conext SW Inverter/Charger.

Summary of Updates

- Conext SW New Features
- Accessing the New Features by SCP
- Load Shave Setting
- AC Support Mode Setting
- Enhanced AC Support Setting

Conext SW New Features

Load Shaving

Load shaving (**Load Shave**) allows the CSW to support (or assist) the AC source in powering local loads during a defined window of time (**LoadShaveStart** and **LoadShaveStop**). See “Time-of-Use Metering” on page 3. It allows the inverter to control how much current can be drawn from the AC source. When the CSW inverter detects that the AC input current is over a set limit called **Load Shave Amps**, it uses battery power to limit the peak load on the AC Input by providing the difference in amps between the actual load current and the current limit set in **Load Shave Amps**.

When **Load Shave** is enabled and within **LoadShaveStart** and **LoadShaveStop** times, it will automatically transition into and out of load shaving operation.

- To transition into the load shaving state, the inverter must first detect that the AC Input current exceeds the **Load Shave Amps**. It will then turn on the inverter and source current so that the AC Input current matches exactly the current in **Load Shave Amps**.
- To transition out of the load shaving state, the inverter detects that the input current is below the **Load Shave Amps** and it no longer needs to support the loads with power from the battery.

In a grid-interactive backup system Load shaving combined with time-of-use metering helps reduce utility peak demand surcharges.

In an off-grid system with generator Load shaving can be used to support the generator. If the generator is unable to provide enough current to run loads in the system, load shaving ensures that the system does not exceed the generator's current rating. This is done by matching the generator's manufacturer recommended current rating with the **Load Shave Amps** setting.

See “Load Shave Setting” on page 14 for a sample scenario.

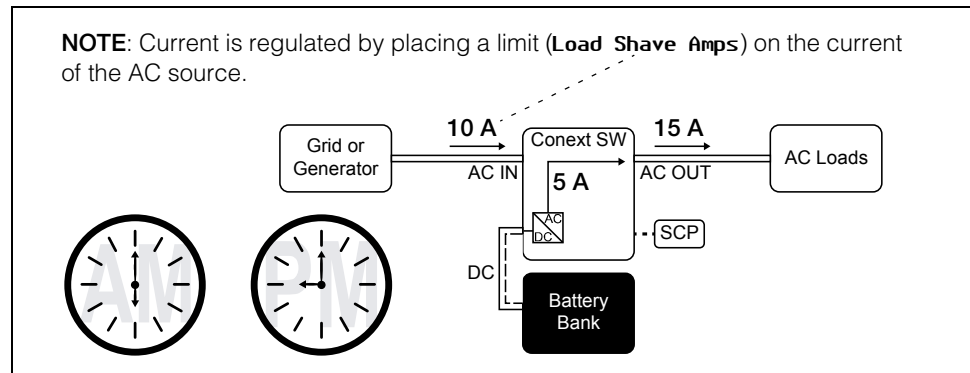


Figure 1 Load Shaving in Action

Time-of-Use Metering Utilities use time-of-use metering to set utility charges during peak usage hours and to impose a surcharge. The CSW can be configured (using the **LoadShaveStart**, **LoadShaveStop** and charger block [see the CSW Owner's Guide] settings) to overcome these peak charges by using utility power to charge the battery bank during the inexpensive energy hours and consuming the battery energy during expensive energy hours.

For example, if charger block is set between 9:00 AM and 10:00 PM and load shaving is set between **LoadShaveStart**=6:00 PM and **LoadShaveStop**=9:00 PM, charging on AC Input stops at 9:00 AM and the inverter continues to pass utility AC through to the loads. If charging is required during the charger block period then CSW can use an alternative external renewable energy source such as an MPPT solar charge controller to charge the battery bank. The inverter connects to the utility grid at 6:00 PM and supports running the loads using the batteries. The inverter continues to run the loads until 9:00 PM.

The CSW then stops supporting the utility grid and passes utility AC through to the loads at 9:01 PM. At the end of charger block at 10:00 PM utility AC begins maintaining the batteries based on charger settings.

The above example allows an external renewable energy source to be utilized as a primary charging source during a desired time window. The charger (using utility power connected to AC Input) can then be used to supplement battery charging when the utility rates are low.

When using the system for time-of-use metering, the system should be designed with a battery capacity large enough to support loads during the entire peak rate period without reaching the low battery cut out (**Low Batt Cut Out**) setting.

Load shaving can also be used with time-of-use metering and enhanced AC support feature (see "Enhanced AC Support" on page 4 and "Enhanced AC Support Setting" on page 17) to support self-consumption.

AC Support

AC Support is similar to load shaving because in both cases the CSW inverter supplements AC current. However, unlike load shaving, AC Support ensures that no current comes from the AC Input connection of the CSW as long as the battery's state-of-charge (SOC) or battery voltage conditions allow it. AC Support allows the CSW to support local loads by converting excess power from external DC sources connected to its battery bank. Examples of external DC sources are MPPT solar charge controllers. When local loads demand more energy from the external DC sources then extra current can be pulled in from the AC source as a last resort. When operating without a solar charge controller in the system, set the battery charge cycle to **2StgNoFloat** to allow AC Support to function immediately after the absorption charge stage.

AC Support behaves three different ways depending on the type of equipment that is installed in the Xanbus network with the CSW.

- SOC - Xanbus-enabled battery monitor is installed
- Enhanced - Xanbus-enabled MPPT solar charge controller is installed
- Regular - neither Xanbus-enabled battery monitor nor MPPT solar charge controller is installed

AC Support Mode using SOC

With AC support on SOC (**AC Supp on SOC**) enabled, CSW maximizes power utilization using stored energy in a battery bank within a grid-interactive backup power system. AC support mode allows the CSW to accurately determine when grid power can be used to supply energy to the loads by knowing the state-of-charge (SOC) of the battery bank.

The SOC of a battery bank is monitored by using a Xanbus-enabled battery monitor. SOC entry and exit points are determined by the user. The SOC entry point (**AC Supp Start Soc**) which is a high percentage value determines when AC support mode is engaged and the SOC exit point (**AC Supp Stop Soc**) which is a low percentage value determines when AC support mode is disengaged. See “AC Support Mode Setting” on page 16.

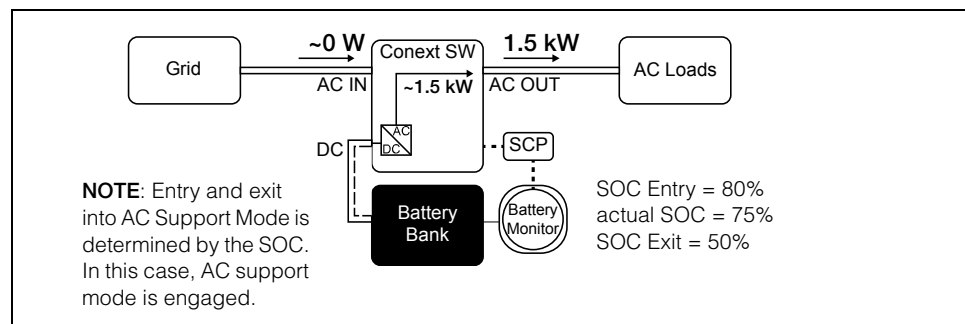


Figure 2 AC Support Mode using SOC

Enhanced AC Support

Enhanced AC Support (**EnhancedACSup**) works when power systems are DC coupled with a Xanbus-enabled MPPT Solar Charge Controller. This means that DC power from a renewable source such as an MPPT Solar Charge Controller is used to charge the battery bank while simultaneously utilizing its power (by way of inverting) to power loads. Entry and exit to enhanced AC support are controlled by the MPPT charger so that they can control the state-of-charge of the batteries. AC power from the grid is utilized only when load demand exceeds power available from the MPPT charger for charging and supplying the loads.

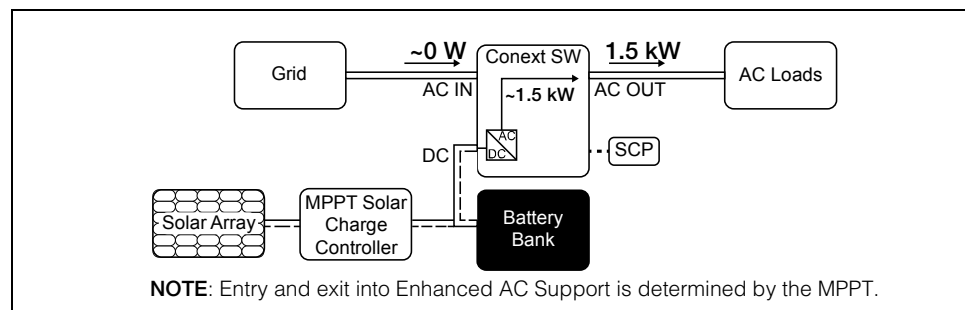


Figure 3 Enhanced AC Support

When enhanced AC support mode is enabled, the CSW automatically tracks the MPPT solar charge controller's charging voltage as it transitions from bulk to absorption to float. By tracking the voltage, the CSW is then able to execute and finish the charging cycle using DC power from the solar charge controller while converting its excess DC power to AC power to support the grid by supplying more current. CSW only uses excess DC power not required by the battery to support the grid thus, it prioritizes charging the battery before supporting the loads. Battery health is improved because the system always executes a three stage charging of the battery that ensures battery SOC is as close as possible to 100% at all times. Systems that use a fixed voltage for AC support (or similar) start to support loads sooner and may not fully charge the battery bank, leaving the battery in a partial SOC. Prolonged periods of partial SOC can degrade battery performance. Enhanced AC support limits this degrading effect.

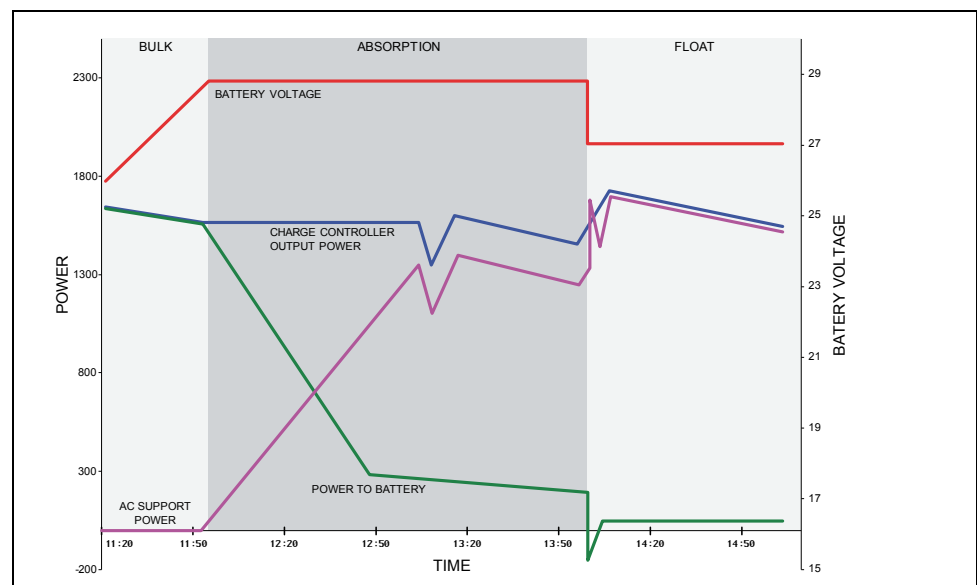


Figure 4 Enhanced AC Support Charge Cycle

Enhanced AC Support Charging Stages

- **BULK Phase** - During this phase, all PV energy from the charge controller is diverted to the battery for maximum charging. During this phase, the CSW does not engage AC support.
- **ABSORPTION Phase** - Once the charge controller is in absorption phase, the charge controller output is split between the battery and CSW for supporting AC loads. As the battery approaches full charge, more power from the charge controller is diverted to CSW for AC support.
- **FLOAT Phase** - Once the battery is full and the charge controller transitions to float phase, almost all the charge controller output is used by CSW to support AC loads. The battery only receives a trickle charge to maintain a healthy state of charge.

See "Enhanced AC Support Setting" on page 17.

Regular AC Support without Xanbus devices

If no Xanbus-enabled devices, such as an MPPT charge controller, are connected to the power system, then entry and exit into AC support mode is based solely on battery voltage monitored by CSW. If the battery voltage is above a set limit (**AC Supp Volts**), then AC support mode is engaged.

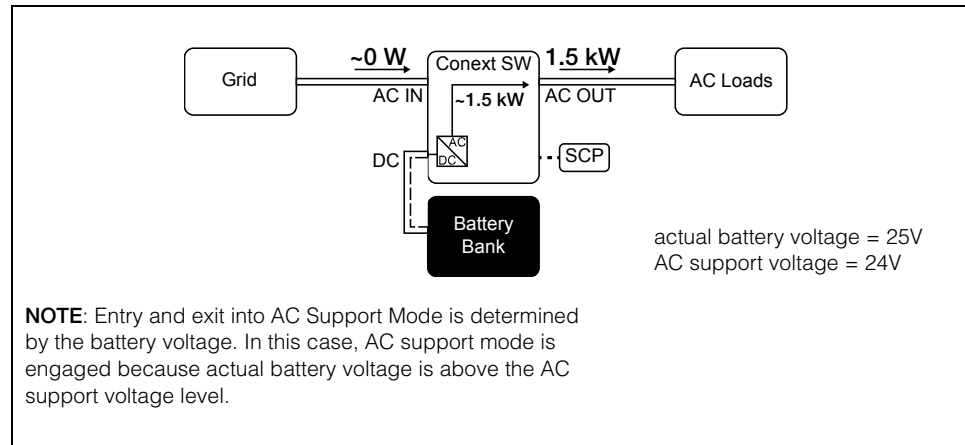


Figure 5 Regular AC Support without Xanbus Devices

With its charger enabled, the CSW enters AC support mode only after completing a charge cycle when it is first powered up or reconnected to the grid.

For regular AC support mode set the CSW's battery charge cycle to **2StgNoFloat** to allow AC Support feature to function immediately after the absorption charge stage.

Grid-Interactive Delay Feature

CSW has a delay feature that postpones the engagement of two grid-interactive features, namely load shaving and AC support, until a connected MPPT solar charge controller has had a chance to charge the battery for two hours in Float mode. The delay feature is called **PLSDelay** in SCP. The delay feature prioritizes the MPPT solar charge controller's ability to sufficiently charge the battery bank. The feature works by inhibiting grid-interactive operation for two hours from the time the charge controller transitions from Absorption to Float charging. This allows the battery to be fully charged before either load shaving or AC support mode is engaged. This feature is useful in applications where battery micro-cycling is to be minimized in order to maximize battery life. See below.

Example: **Load Shave = Enabled**
 LoadShaveStart = 10:00AM
 PLSDelay = Enabled

Absorption to float charging starts at 7:00 AM and load shaving is set to start at 10:00 AM. Absorption transitions to float at 9:00 AM but because **PLSDelay** is enabled, the 2-hour delay inhibits load shaving to actually start at 10:00 AM. Because of the 2-hour delay, load shaving does not start until 11:00 AM. See "Load Shaving 2-Hour Delay Example" on page 7.

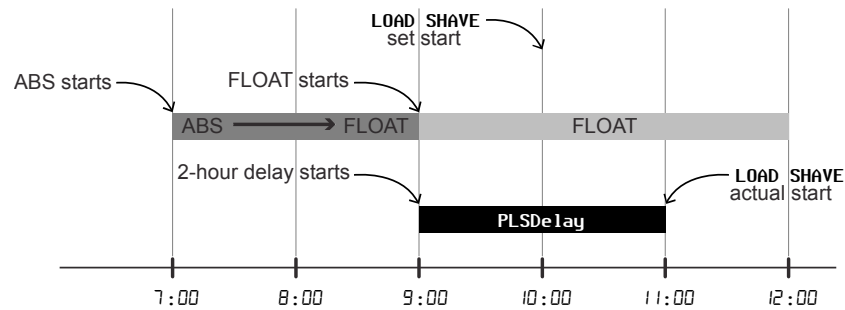


Figure 6 Load Shaving 2-Hour Delay Example

The feature also ensures that self-consumption of harvested solar energy is optimized. The 2-hour delay works only under the following conditions:

- CSW's battery charge cycle must be set to **2StgNoFloat**
- **PLSDelay** must be set to **Enabled**
- an MPPT solar charge controller must be connected and detected in the Xanbus network
- the feature must not have been activated within that day

This configuration can be enabled or disabled in “New Advanced Features Setting” on page 12. The default setting for **PLSDelay** is **Disabled**.

AC Coupling

Off-grid AC Coupled system architecture is often used to create a stand-alone grid. Commonly this means that PV inverters are connected to the output of a battery-based inverter/charger putting both on the same AC bus along with the AC loads. In this scenario, the battery powered inverter charger provides the necessary frequency and voltage to enable the PV inverter to produce power. This type of system must be able to maintain power generation in balance with power consumption at all times. If there is more power being generated than can be consumed by the loads, power will flow to the inverter/charger and be converted to DC power which flows into the battery. Once the battery reaches capacity, power generation by the PV inverter must be curtailed to maintain the balance between generation and consumption. As the battery bank reaches capacity, CSW curtails PV inverter generation by raising the AC line frequency causing compatible PV inverters to reduce their power output in an orderly manner. This is called Active Frequency Shift Power Curtailment.

During a grid outage even a home with a grid-tie PV inverter system will be without power because PV inverters cannot produce power without the presence of a reference voltage and frequency. To enable the PV inverter to provide power during a grid outage the CSW is retrofitted in front of the PV inverter. The PV inverter is rewired from the grid connection to a critical load (sub) panel and the AC Couple is on the CSW AC Output port.

Consult the manufacturer's specifications to determine if your PV inverter is compatible with Active Frequency Shift Power Curtailment. CSW's AC coupling function is enabled by default (see "New Advanced Features Setting" on page 12).

NOTICE

AC COUPLED PV INVERTER COMPATIBILITY

AC power generated by AC coupling PV inverters with CSW must be consumed by AC loads or used to charge batteries. As an alternative, the excess power produced from a PV inverter can be routed to dump loads. Do not AC couple PV inverters with the CSW that are unable to reduce, derate or cease the excess PV inverter power in response to the changes in AC line frequency controlled by the CSW. Consult the manufacturer's specifications of your PV inverter and confirm compatibility.

Failure to follow these instructions can result in equipment damage.

The AC coupling advanced setting should remain enabled except in cases when the DC voltage level is allowed to have large variations and the line frequency needs to remain constant.

Further details about AC Coupling can be found in the document "*AC Coupling Solutions Guide (Document Number: 976-0240-01-01)*" available at www.SEsolar.com.

Storing the State of the Inverter Mode

You can enable or disable a feature called **StoreInvState** which, when enabled remembers the state of the inverter mode prior to a power down (that is, when AC and DC power sources are disconnected). When the CSW is powered up again, the inverter mode reverts back to its prior state.

See "New Advanced Features Setting" on page 12.

NoLoadVD

The No Load Voltage Derating (**NoLoadVD**) feature further reduces tare loss by adjusting output voltage by +4%/-5% of nominal, over the full load range. That means at 50% load, the output voltage is at nominal but 5% below nominal at No Load. The feature results in slight increase on overall operating efficiency but may result in visible flicker of incandescent or similar lights during large sudden load changes.

See "New Advanced Features Setting" on page 12.

Low Battery Cut Out Hysteresis

Low battery cut out (**Low Batt Cut Out**) (LBCO) preserves battery life by stopping the inverter when battery voltage drops down to the LBCO value for a few seconds (see **LBCO Delay** below), then battery charging commences. When charging starts, the voltage level jumps a little but enough that inverting might resume abruptly. Then, battery voltage goes down again and charging starts abruptly. To prevent the inverter from switching abruptly between inverting and charging, the **LBCO Hysteresis** value is added to the LBCO value to allow the battery voltage to reach a sufficient energy capacity level before inverting resumes. This feature contributes to battery health.

See “New Advanced Inverter Settings” on page 13.

LBCO Delay

LBCO Delay (**LBCO Delay**) is the amount of time in seconds before inverting is interrupted due to low battery voltage.

See “New Advanced Inverter Settings” on page 13.

Lithium Ion Battery Type

Further details about Lithium Ion support can be found in the document “*Lithium Ion Application Note (Document Number: 503-0246-01-01)*” available at www.SEsolar.com.

WARNING

BATTERY TYPE HAZARD

When using Lithium Ion batteries, ensure that the battery pack being used includes a Battery Management System (BMS) with safety protocols.

Failure to follow these instructions can result in property damage, death or serious injury.

Accessing the New Features by SCP

The Advanced Settings option gives you access to the full range of CSW settings, including everything displayed on the Basic menu. As a safeguard against unintended Advanced configuration, the SCP displays the Basic settings by default. To view the Advanced settings, you must perform a special keypress.

NOTICE

RISK OF DAMAGE TO CONNECTED DEVICES

The advanced settings are intended for qualified installation/service personnel only. Before changing advanced settings, you must be familiar with the settings and the system-wide impact of changing those settings. Setting parameters incorrectly could damage connected equipment (such as batteries) or could severely affect the performance of your system. Incorrect charging configuration can lead to battery damage.

Failure to follow these instructions can result in equipment damage.

To select the Advanced Settings menu:

- 1. On the **Select Device** menu, select a CSW device.
- 2. Press Enter. The **Setup** menu screen appears.
- 3. Press Enter + up arrow + down arrow at the same time.

NOTES:

- This keypress (Enter + up arrow + down arrow) enables the Advanced settings for every device in the system.
- After performing the keypress, “Advanced Settings” appears at the top of the Setup menu (see Figure 7).

- 4. From the Setup menu, with Advanced Settings highlighted, press Enter. See Figure 7.

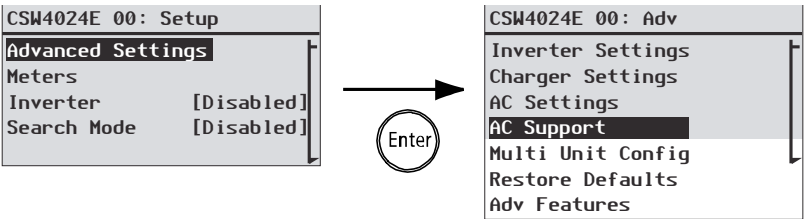
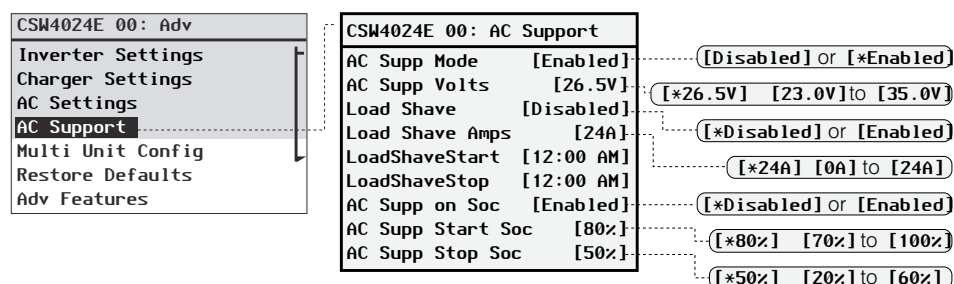


Figure 7 Selecting Advanced Settings

AC Support Settings

New feature

AC Support settings contain configuration options for grid-interactive operation including AC support mode, load shaving (also applicable to generator only AC source), and enhanced AC support for DC coupled systems.



Follow procedures on the Conext SW Owner's Guide to change the settings.

Figure 1-1 AC Support Menu Screen

Table 1-1 AC Support Menu Description and Values^a

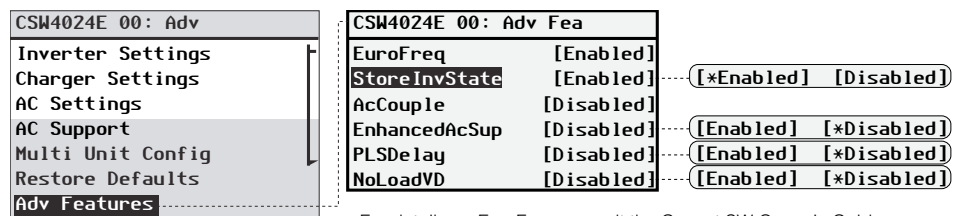
Setting	Description	Default	Range
AC Supp Mode	Turns AC Support Mode feature on and off.	Enabled	Disabled, Enabled
AC Supp Volts	Battery voltage threshold in order to engage regular AC Support Mode.	26.5V	23.0V to 35.0V cannot be set below Low Batt Cut Out + 2 volts
Load Shave	Enables or disables the load shaving feature. When in this mode, the CSW operates until the batteries discharge to the Low Batt Cut Out threshold, after which the unit starts charging the batteries. The charger is automatically blocked during the load shaving time window.	Disabled	Disabled, Enabled
Load Shave Amps	Sets the maximum amount of current that can be drawn from the AC source input by the loads and battery charger combined. This setting determines the amperage level at which the inverter starts drawing power from the batteries to add to the power to meet load demands. Typically, this value is set to the peak usage surcharge threshold imposed by the utility, if applicable.	24A	0A to 24A

Table 1-1 AC Support Menu Description and Values^a

Setting	Description	Default	Range
LoadShave Start	Sets the time for when load shaving is engaged.	12:00 AM	Setting the Load Shave Start and Load Shave Stop to the same time disables scheduling.
LoadShave Stop	Sets the time for when load shaving is disengaged.	12:00 AM	
AC Supp on Soc	Enables or disables the SOC monitoring for AC Support Mode. This setting must be enabled for AC Supp Start Soc and AC Supp Stop Soc to take effect.	Enabled	Disabled, Enabled
AC Supp Start Soc	Sets the high percentage value of the SOC of the battery for AC Support Mode to engage. Applicable only when AC Supp on Soc is enabled.	80%	70% to 100%
AC Supp Stop Soc	Sets the low percentage value of the SOC of the battery for AC Support Mode to disengage. Applicable only when AC Supp on Soc is enabled.	50%	20% to 60%

a. Applies to all CSW models.

New Advanced Features Setting



For details on EuroFreq, consult the Conext SW Owner's Guide.

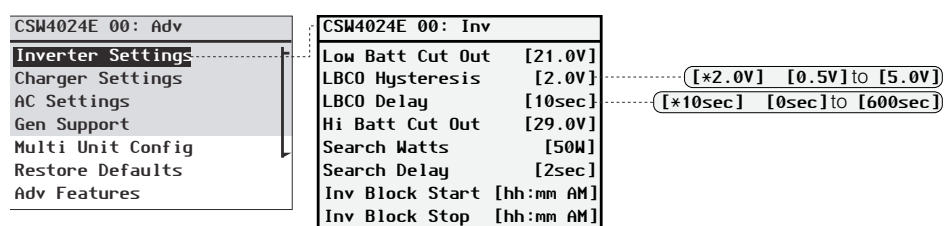
Figure 8 Adv Features Menu Screen**Table 1-2** Adv Features Description and Values

Item	Description	Default	Range
StoreInv State	See "Storing the State of the Inverter Mode" on page 8.	Enabled	Enabled, Disabled
AcCouple	For information on this feature refer to the <i>AC Coupling Solutions Guide</i> .	Disabled	Enabled, Disabled
Enhanced AC Sup	See "Enhanced AC Support" on page 4.	Disabled	Disabled, Enabled

Table 1-2 Adv Features Description and Values

Item	Description	Default	Range
PLSDelay	Delays load shaving and AC support features until the MPPT has charged the battery in float mode for 2 hours. See "Grid-Interactive Delay Feature" on page 6.	Disabled	Disabled, Enabled
NoLoadVD	See "NoLoadVD" on page 8.	Disabled	Enabled, Disabled

New Advanced Inverter Settings



For details on older settings, consult the Conext SW Owner's Guide.

Figure 9 Advanced Inverter Settings Menu Screen**Table 1-3** Advanced Inverter Settings Description and Values^a

Item	Description	Default	Range
LBCO Hysteresis	See "Low Battery Cut Out Hysteresis" on page 9.	2.0V	0.5V to 5.0V
LBCO Delay	See "LBCO Delay" on page 9.	10sec	0sec to 600sec

a. Applies to all CSW models.

Load Shave Setting

For Load shaving to be effective, all loads must be connected to the inverter. For large loads, stacked CSW inverters may be required. To help the batteries supplement the power requirements of the connected load, an additional source of power (like solar, wind, or hydroelectric) is recommended but not required.

To demonstrate a scenario where load shaving takes effect on the CSW, the following settings are programmed into the SCP.

Scenario **Settings:** **Load Shave=Enabled**

 LoadShaveAmps=10A

 LoadShaveStart=6:00AM

 LoadShaveStop=9:00PM

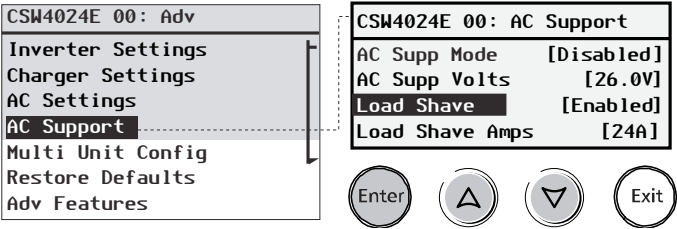
 PLSDelay=Enabled

To use the Load Shaving feature:

- 1. Enable load shaving.

Go to Advanced Settings -> AC Support
-> Load Shave

Press Enter, then select **Enabled** using the up and down arrow buttons. Press Enter.



- 2. Set the load shaving amps.

From AC Support -> Load Shave Amps

Press Enter, then select a value of **10** using the up and down arrow buttons. Press Enter.



- 3. Set the load shaving start and stop times.

From AC Support -> LoadShaveStart

Press Enter, then a time of **6:00 AM** using the up and down arrow buttons. Press Enter.

From AC Support -> LoadShaveStop

Press Enter, then a time of **9:00 PM** using the up and down arrow buttons. Press Enter.



4. Enable the grid-interactive delay feature.

Go back to Advanced Settings
-> Adv Features -> PLSDelay

Press Enter, then select **Enabled** using the up and down arrow buttons. Press Enter.

CSW4024E 00: Adv

Inverter Settings

Charger Settings

AC Settings

AC Support

Multi Unit Config

Restore Defaults

Adv Features

CSW4024E 00: Adv Fea

StoreInvState [Disabled]

AcCouple [Disabled]

EnhancedAcSup [Disabled]

PLSDelay [Enabled]

Enter

Up

Down

Exit

In this scenario, load shaving is only entered and exited as programmed within the time window (from 6 AM to 9 PM).

Additionally, with these scenario settings, the CSW would enter load shaving within the configured time and also only if the battery has been charged from an MPPT charge controller in Float (including Absorption) for 2 hours.

NOTE: In the absence of an MPPT charge controller, charger block stop and start settings must be set at the same times as the load shaving stop and start settings. Otherwise, charging may start even during load shaving.

AC Support Mode Setting

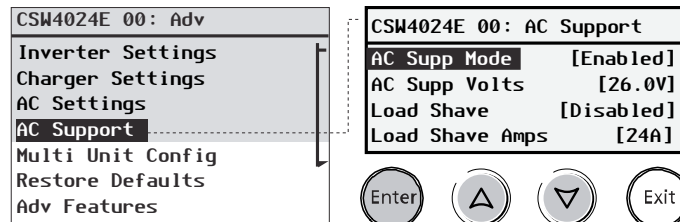
When **AC Support Mode** is enabled, the CSW does not ordinarily draw a large amount of current from the grid. If the CSW is drawing more current than expected, notice that it cannot distinguish between real power and reactive power. Large current draw will only affect reactive power and not real power, and utility companies generally only charge by real power consumed.

When **AC Support Mode** is enabled, the CSW primarily supplies local loads by converting capacity from its battery bank and then only utilizing grid power when the loads demand more capacity. In addition to **AC Support Mode**, the CSW also has the enhanced AC support feature. See “Enhanced AC Support Setting” on page 17.

To use the AC Support Mode feature:

1. Enable AC support mode. AC support mode is enabled by default. Check only to see if it is enabled. If not, enable it.

Go to Advanced Settings -> AC Support
-> AC Supp Mode

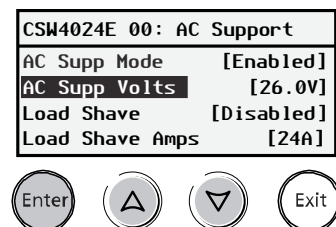


2. Set the battery voltage threshold for AC support mode to engage.

NOTE: Applicable only when there are no Xanbus devices attached as described in “Regular AC Support without Xanbus devices” on page 6.

From AC Support -> AC Supp Volts

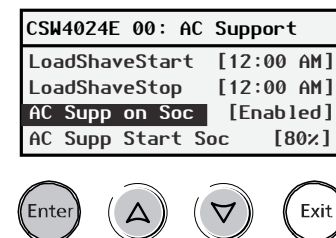
Press Enter, then select a value using the up and down arrow buttons. Press Enter.



3. Enable state-of-charge (SOC) monitoring if you have a Conext Battery Monitor installed. AC support on SOC is disabled by default.

From AC Support -> AC Support on SOC

Press Enter, then select Enabled using the up and down arrow buttons. Press Enter.



- Set the battery SOC thresholds for when AC support mode is engaged.

From AC Support -> AC Supp Start Soc

Press Enter, then select a value using the up and down arrow buttons. Press Enter.

From AC Support -> AC Supp Stop Soc

Press Enter, then select a value using the up and down arrow buttons. Press Enter.

CSW4024E 00: AC Support	
LoadShaveStop	[12:00 AM]
AC Supp on Soc	[Enabled]
AC Supp Start Soc	[80%]
AC Supp Stop Soc	[20%]



Enhanced AC Support Setting

Self-consumption

The goal of the enhanced AC support (**EnhancedACSup**) feature is to make sure that the power system self-consumes the power it harvests from a PV array. It does this by keeping the battery bank charged up and ready to supply power to the loads.

When **EnhancedACSup** is enabled, the CSW supports local loads by converting excess capacity from external DC sources connected to its battery bank. An example of an external DC source is the Conext MPPT solar charge controller like the MPPT 80 600.

To use the Enhanced AC Support feature:

- Enable AC support mode. AC support mode is enabled by default. Check only to see if it is enabled. If not, enable it.

Go to Advanced Settings -> AC Support
-> AC Supp Mode

CSW4024E 00: Adv	
Inverter Settings	
Charger Settings	
AC Settings	
AC Support	
Multi Unit Config	
Restore Defaults	
Adv Features	

CSW4024E 00: AC Support	
AC Supp Mode	[Enabled]
AC Supp Volts	[26.0V]
Load Shave	[Disabled]
Load Shave Amps	[24A]



- Enable enhanced AC support.

Go back to Advanced Settings
-> Adv Features -> EnhancedAcSup

Press Enter, then select Enabled using the up and down arrow buttons. Press Enter.

CSW4024E 00: Adv	
Inverter Settings	
Charger Settings	
AC Settings	
AC Support	
Multi Unit Config	
Restore Defaults	
Adv Features	

CSW4024E 00: Adv Fea	
StoreInvState	[Disabled]
AcCouple	[Disabled]
EnhancedAcSup	[Enabled]
PLSDelay	[Enabled]



Documentation Update

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