

CS+ Series

Pure Sine Wave Inverter/Charger

User's Manual

Version 1.0 DIF



The CS+DIF range of Inverter /Chargers are powerful, robust and professional.

It includes in one unit three functions :

a powerful **sinewave Inverter**, **automatic Battery Charger** and a **bypass**

The CS+DIF makes **installation and use as easy as never**.

No more complex functions or settings but accessible ones, easy to operate by the user.

CS+DIF represents a very **energy efficient solution** for a majority of uses, the basic functionality is more than enough.

Battery charger function uses **advanced multi-stage** characteristics and is suitable for permanent connection to the battery. Adjustment is easily made via a selector switch to suit all battery types (AGM,GEL,FLOOD...).

The integrated Plug, up to 3600Va models, on the front panel allows an easy connection by the user if no permanent connection through hardwire is required.

An optional remote control is availabl

Main Features of the CS+ inverter/charger

- ❖ Smart Remote Control
- ❖ Designed to Operate under Harsh Environment
- ❖ DC Start & Automatic Self-Diagnostic Function
- ❖ Compatible with Both Linear & Non-Linear Load
- ❖ Easy to Install & Easy to Operate & Easy to Solve
- ❖ Low DC Voltage Supports Home & Office Appliances
- ❖ Powerful Charge Rate Up to 120Amp, Selectable From 0%-100%
- ❖ High Efficiency Design & “Power Saving Mode” to Conserve Energy
- ❖ Battery Priority Mode, Designates the Inverter-Preferred UPS Configuration
- ❖ Various Pre Set Battery Type Selector plus De-sulphation for Totally Flat Batteries
- ❖ 4-step Intelligent Battery Charging, PFC (Power Factor Correction) for Charger
- ❖ 8 ms Typical Transfer Time Between Utility & Battery, Guarantees Power Continuity
- ❖ 15s Delay Before Transfer when AC Resumes, Protection for Load when Used with Generator



WARNING!

This manual contains important instructions for CS+ series Inverter/Charger models that shall be followed during installation and maintenance of the inverter.

General Safety Precautions

- Do not expose the CS+ to rain, snow, spray, bilge or dust. To reduce risk of hazard, do not cover or obstruct the ventilation openings.
- Do not install the CS+ in a zero-clearance compartment. Overheating may result. Allow at least 30CM(11.81 inches) of clearance around the inverter for air flow. Make sure that the air can circulate freely around the unit. A minimum air flow of 145CFM is required.
- To avoid a risk of fire and electronic shock. Make sure that existing wiring is in good electrical condition; and that wire size is not undersized.
- Do not operate the CS+ with damaged or substandard wiring.
- This equipment contains components which can produce arcs or sparks. To prevent fire or explosion do not install in compartments containing batteries or flammable materials or in locations which require ignition protected equipment. This includes any space containing gasoline-powered machinery, fuel tanks, or joints, fittings, or other connection between components of the fuel system.
- Do not dis-assemble the CS+. It contains no user serviceable parts. Attempting to service the Inverter/Charger yourself may result in a risk of electrical shock or fire. Internal capacitors remain charged after all power is disconnected.
- To reduce the risk of electrical shock, disconnect both AC and DC power from the CS+ before attempting any maintenance or cleaning. Turning off controls will not reduce this risk

CAUTION: Equipment damage

The output side of the inverter's AC wiring should at no time be connected to public power or a generator. This condition is far worse than a short circuit. If the unit survives this condition, it will shut down until corrections are made.

Installation should ensure that the inverter's AC output is, at no time, connected to its AC input.

Warning: Limitations On Use

SPECIFICALLY, PLEASE NOTE THAT THE CS+ SERIES INVERTER/CHARGER SHOULD NOT BE USED IN CONNECTION WITH LIFE SUPPORT SYSTEMS OR OTHER MEDICAL EQUIPMENT OR DEVICES.

Precautions When Working with Batteries

- If battery acid contacts skin or clothing, wash immediately with soap and water.
- If acid enters eye, immediately flood eye with running cold water for at least 20 minutes and get medical attention immediately.
- Never smoke or allow a spark or flame in vicinity of battery or engine.
- Do not drop a metal tool on the battery. The resulting spark or short-circuit on the battery or other electrical part may cause an explosion.
- Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery produces a short-circuit current high enough to weld a ring or the like to metal, causing a severe burn.
- To reduce the risk of injury, charge only rechargeable batteries such as deep-cycle lead acid, lead antimony, lead calcium gel cell, absorbed mat, NiCad/NiFe or Lithium battery. Other types of batteries may burst, causing personal injury and damage.

Appliances

Your Inverter/charger CS+ can supply various equipment such as :

Power tools—circular saws, drills, grinders, sanders, buffers, weed and hedge trimmers, air compressors.

Office equipment – computers, printers, monitors, facsimile machines, scanners.

Household items – vacuum cleaners, fans, fluorescent and incandescent lights, shavers, sewing machines.

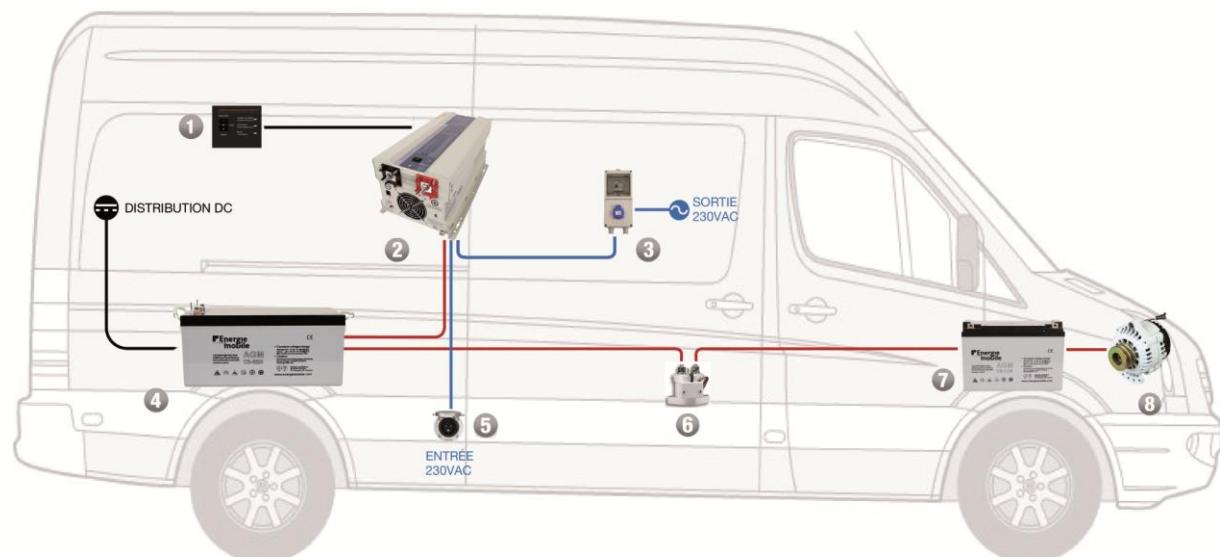
Kitchen appliances – coffee makers, blenders, ice makers, toasters.

Industrial equipment – metal halide lamp, high – pressure sodium lamp.

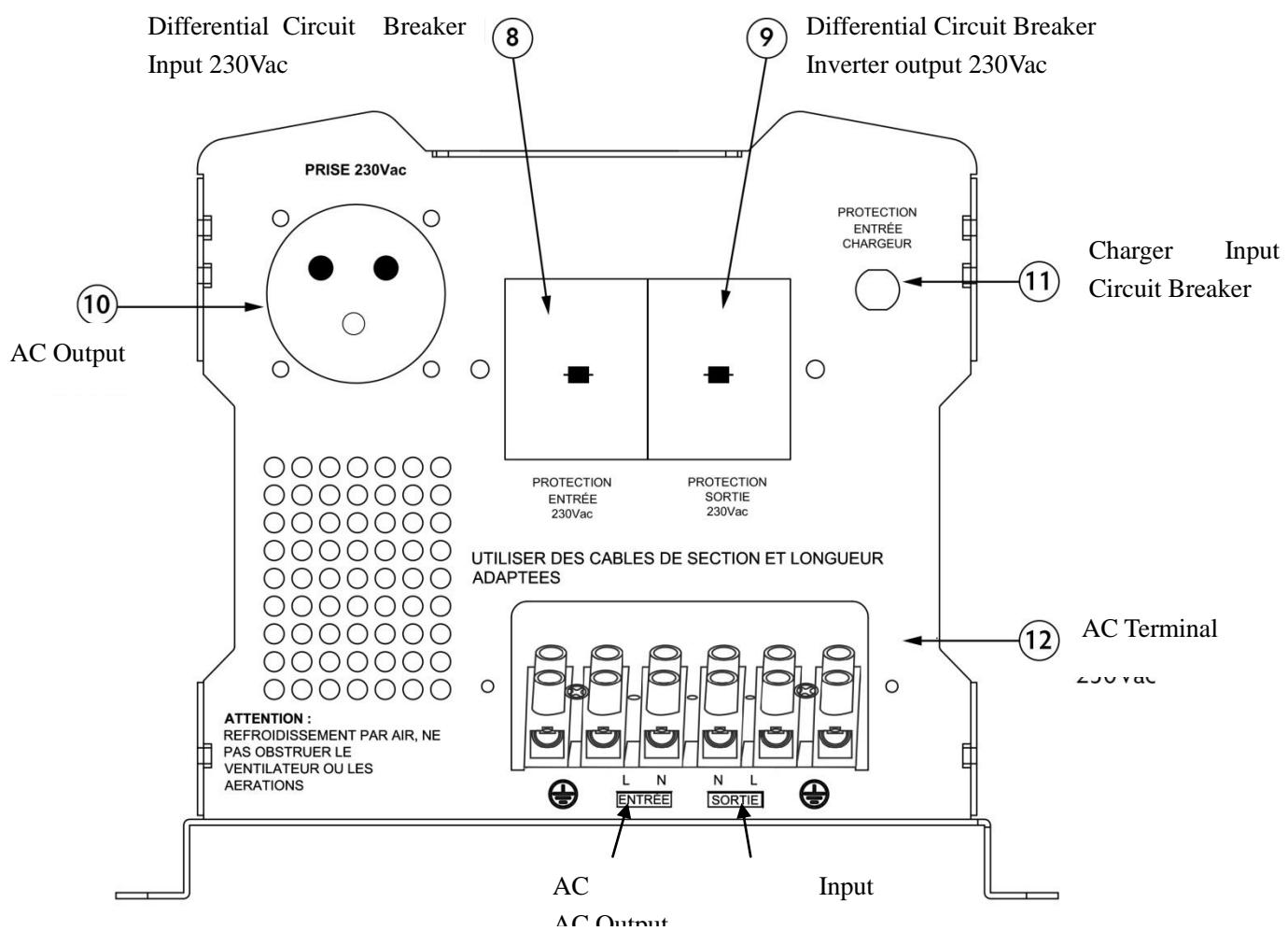
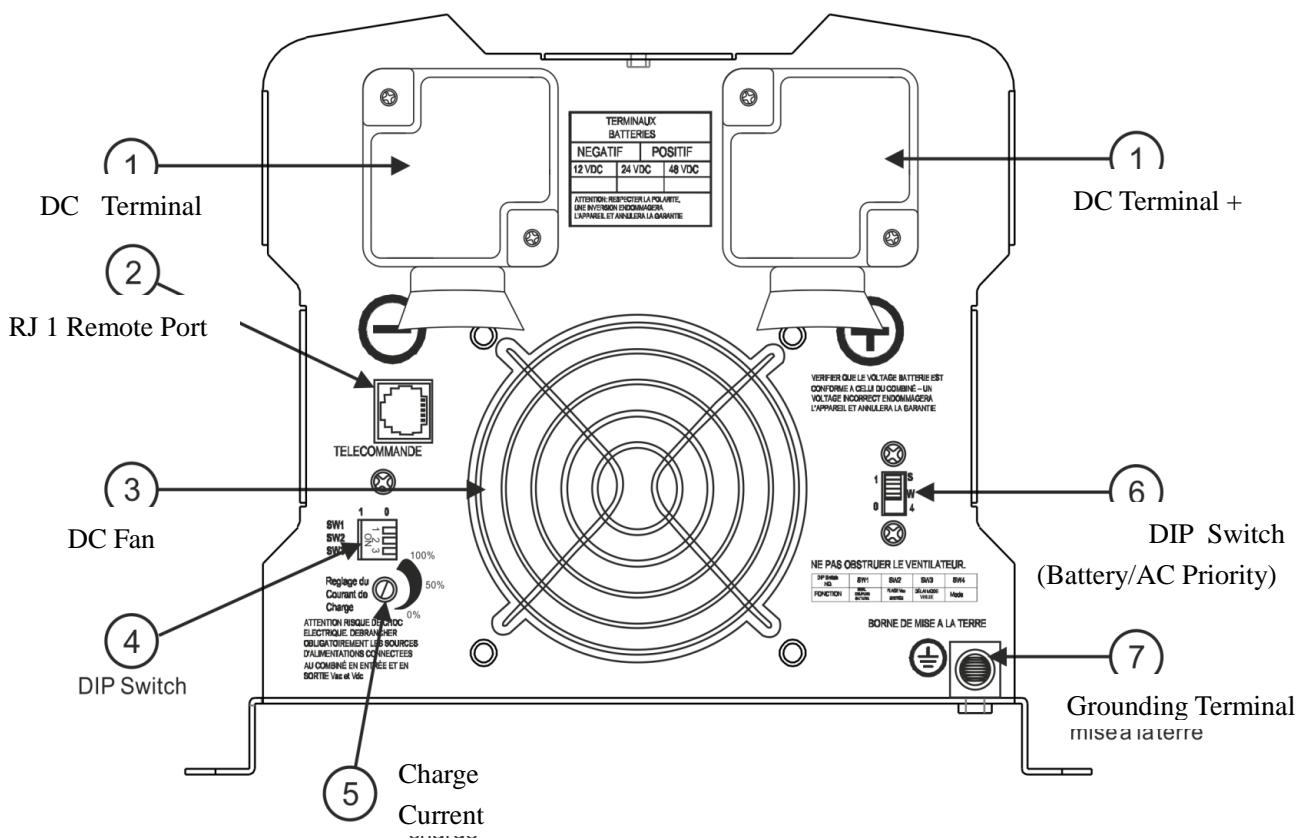
Home entertainment electronics – television, VCRs, video games, stereos, musical instruments, satellite equipment.

Example of installation in a vehicle

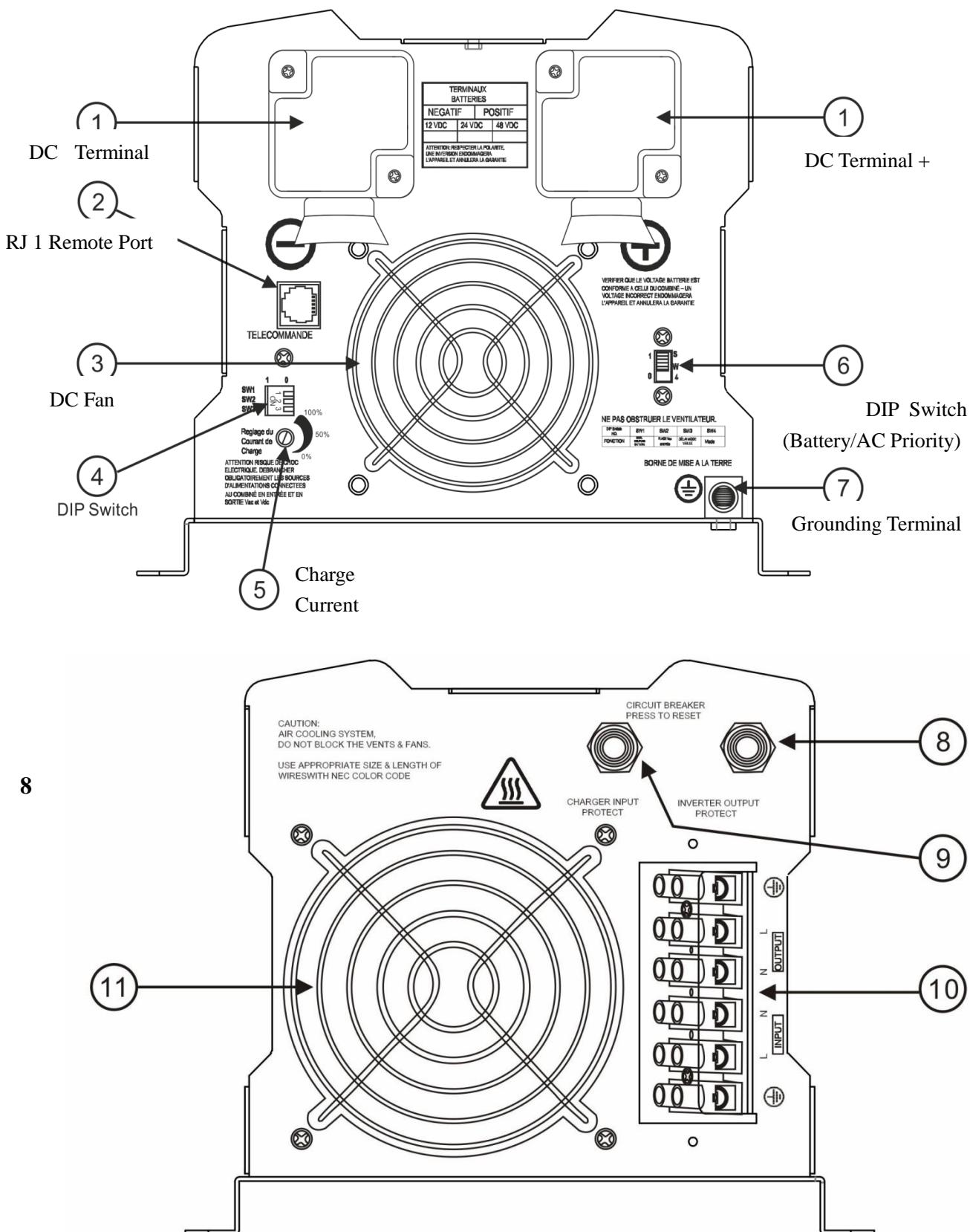
1 = REMOTE CONTROL	2 = INVERTER/CHARGER
3 = OUTPUT 230Vac	4 = AUXILIARY BATTERY
5 = INPUT PLUG 230Vac	6 = SEPARATOR
7 = MOTOR BATTERY	8 = ALTERNATOR



Front and rear panel description 1400-3600 :



Front and rear panel description 5000-7000 :



Inverter Output Protection Circuit Breaker

9 Charger Input Protection Circuit Breaker

10 AC Terminal Block

11 AC Fan

Electrical Performance

Inverter

Topology

The CS+ inverter/charger is built according to the following topology.

Inverter: Full Bridge Topology.

AC Charger: Isolate Boost Topology

Because of high efficiency Mosfets and 16bit, 4.9MHz microprocessor and heavy transformers, it outputs PURE SINE WAVE AC with an average THD of 10% (Min5%, Max 15%) depending of load connected and battery voltage.

The peak efficiency of CS+ series is 90%.

Overload Capacity

The CS+ series inverters have different overload capacities, making it ideal to handle demanding loads.

1 For $110\% < \text{Load} < 125\% (\pm 10\%)$, no audible alarm in 14 minutes, beeps 0.5s every 1s in the 15th minute, and Fault(Turn off) after the 15th minute.

2 For $125\% < \text{Load} < 150\% (\pm 10\%)$, beeps 0.5s every 1s and Fault(Turn off) after the 1 minute.

3 For $300\% \geq \text{Load} > 150\% (\pm 10\%)$, beeps 0.5s every 1s and Fault(Turn off) after 20s.

AC Charger

CS+ Series is equipped with an active PFC (Power Factor Corrected) multistage battery charger. The PFC feature is used to control the amount of power used to charge the batteries in order to obtain a power factor as close as possible to 1.

Unlike other inverters whose max charging current decreases according to the input AC voltage, CS+ series charger is able to output max current as long as input AC voltage is in the range of 164-243VAC

The CS+ series inverter is with a strong charging current and the max charge current can be adjusted from 0%-100% via a liner switch at the right of the battery type selector. This will be helpful if you are using our powerful charger on a small capacity battery bank. Fortunately, the liner switch can effectively reduce the max charging current to 20% of its peak.

Choosing “0” in the battery type selector will disable charging function.

There are mainly 3 stages:

Bulk Charging: This is the initial stage of charging. While Bulk Charging, the charger supplies the battery with controlled constant current. The charger will remain in Bulk charge until the Absorption charge voltage (determined by the Battery Type selection) is achieved.

Software timer will measure the time from A/C start until the battery charger reaches 0.3V below the boost voltage, then take this time as T0 and $T0 \times 2 = T1$.

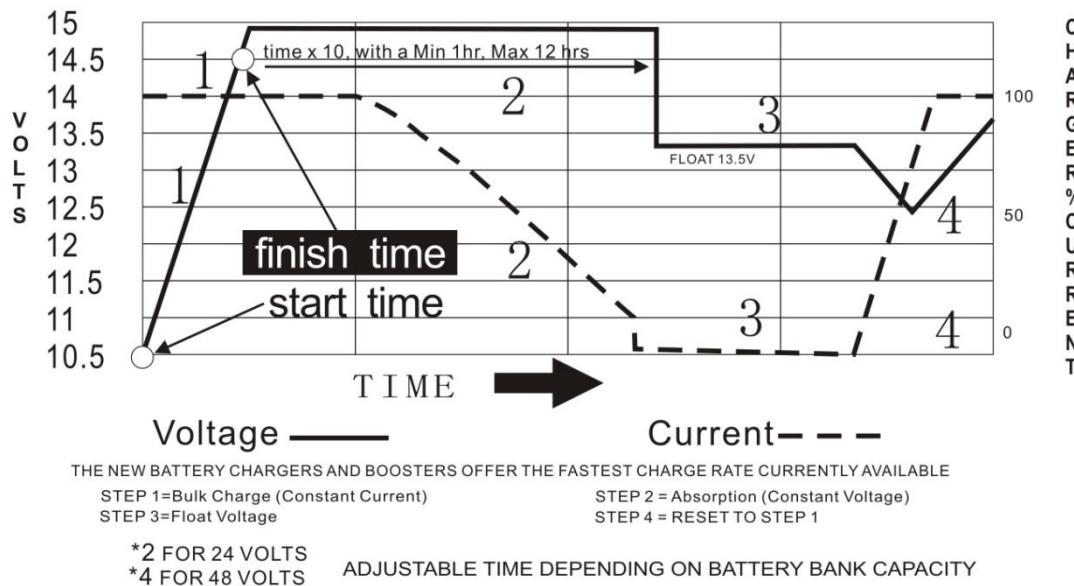
Absorb Charging: This is the second charging stage and begins after the absorb voltage has been reached. Absorb Charging provides the batteries with a constant voltage and reduces the DC charging current in order to maintain the absorb voltage setting.

In this period, the inverter will start a T1 timer; the charger will keep the boost voltage in Boost CV mode until the T1 timer has run out. Then drop the voltage down to the float voltage. The timer has a minimum time of 1 hour and a maximum time of 12 hours.

Float Charging: The third charging stage occurs at the end of the Absorb Charging time. While Float charging, the charge voltage is reduced to the float charge voltage (determined by the Battery Type selection*). In this stage, the batteries are kept fully charged and ready if needed by the inverter.

If the A/C is reconnected or the battery voltage drops below 12Vdc/24Vdc/48Vdc, the charger will reset the cycle above. If the charge maintains the float state for 10 days, the charger will deliberately reset the cycle to protect the battery.

Battery Charging Processes



Battery Type Selector

Switch Setting	Description	Fast Mode / VDC	Float Mode / VDC
0	Charger Off		
1	Gel USA	14.0	13.7
2	AGM 1	14.1	13.4
3	LiFePO4	14.6	13.7
4	Sealed Lead Acid	14.4	13.6
5	Gel EURO	14.4	13.8
6	Open Lead Acid	14.8	13.3
7	Calcium	15.1	13.6
8	De-sulphation	15.5 (4 Hours then Off)	

For 12Vdc Mode Series (*2 for 24Vdc Mode ; *4 for 48Vdc Mode)

De-sulphation

The de-sulphation cycle on switch position 8 is marked in red because this is a very dangerous setting if you do not know what you are doing. Before ever attempting to use this cycle you must clearly understand what it does and when and how you would use it.

What causes sulphation? This can occur with infrequent use of the batteries(nor), or if the batteries have been left discharged so low that they will not accept a charge. This cycle is a very high voltage charge cycle designed to try to break down the sulphated crust that is preventing the plates taking a charge and thus allow the plates to clean up and so accept charge once again.

Charging depleted batteries

The CS+ series inverter allows start up and through power with depleted batteries.

For 12VDC model, after the battery voltage goes below 10V, if the switch is still (and always) kept in "ON"

position, the inverter is always connected with battery, and the battery voltage does not drop below 2V, the inverter will be able to charge the battery once qualified AC inputs are present.

Before the battery voltage goes below 9VDC, the charging can be activated when the switch is turned to “Off”, then to “ON”.

When the voltage goes below 9VDC, and you accidentally turn the switch to OFF or disconnect the inverter from battery, the inverter will not be able to charge the battery once again, because the CPU loses memory during this process.

The charging capacity will go to peak in around 3 seconds. This may cause a generator to drop frequency, making inverter transfer to battery mode.

It is suggested to gradually put charging load on the generator by switching the charging switch from min to max, together with the 15s switch delay, our inverter gives the generator enough time to spin up. This will depend on the size of the generator and rate of charge.

AC Transfer

While in the Standby Mode, the AC input is continually monitored. Whenever AC power falls below the VAC Trip voltage (154 VAC, default setting for 230VAC), the inverter automatically transfers back to the Invert Mode with minimum interruption to your appliances - as long as the inverter is turned on. The transfer from Standby mode to Inverter mode occurs in approximately 8 milliseconds. And it is the same time from Inverter mode to Standby mode.

Though it is not designed as a computer UPS system, this transfer time is usually fast enough to keep your equipment powered up.

There is a 15-second delay from the time the inverter senses that continuously qualified AC is present at the input terminals to when the transfer is made. This delay is built in to provide time for a generator to spin-up to a stable voltage and avoid relay chattering. The inverter will not transfer to generator until it has locked onto the generator's output. This delay is also designed to avoid frequent switching when input utility is unstable.

Protections

The CS+ inverter is equipped with extensive protections against various harsh situations/faults.

These protections include:

AC Input over voltage protection/AC Input low voltage protection

Low battery alarm/High battery alarm

Over temperature protection/Over load protection

Short Circuit protection (1s after fault)

Back feeding protection

When Over temperature /Over load occur, after the fault is cleared, the master switch has to be reset to restart the inverter.

The Low batter voltage trip point can be customized from defaulted value 10VDC to 10.5VDC thru the SW1 on DIP switch.

The inverter will go to Over temp protection when heat sink temp. $\geq 105^{\circ}\text{C}$, and go to Fault (shutdown Output) after 30 seconds. The switch has to be reset to activate the inverter.

The CS+ Inverter has back feeding protection which avoids presenting an AC voltage on the AC input terminal in Invert mode.

After the reason for fault is cleared, the inverter has to be reset to start working.

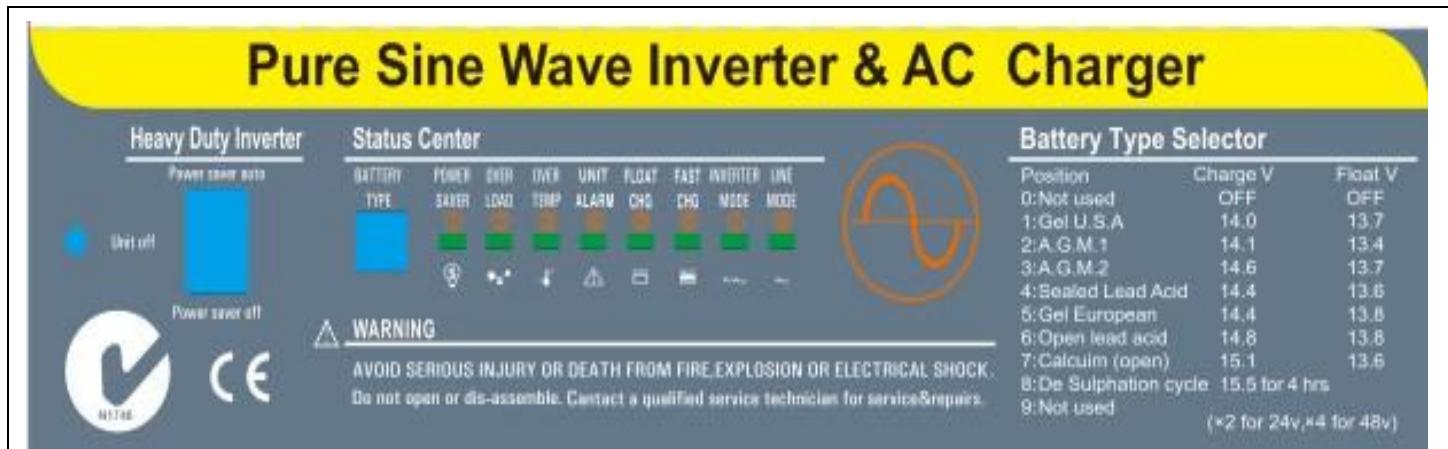
Remote control (Optional)

Apart from the switch panel on the front of the inverter, an extra switch panel connected to the RJ11 port at the DC side of the inverter thru a standard telephone cable can also control the operation of the inverter. The Max length of the cable is 10 meters.



Never cut the telephone cable when the cable is attached to inverter and battery is connected to the inverter. Even if the inverter is turned off. It will damage the remote PCB inside if the cable is short circuited during cutting.

UNIT LEDs INDICATIONS



Status	L.E.D.s Function	L.E.D.s on main unit								L.E.D.s on remote Alarm		
		①	②	③	④	⑤	⑥	⑦	⑧	①	②	③
Charge function	Constant current charge					on	on			on	on	on
	Constant voltage charge					flash	on			on	on	on
	Float				on		on			on	on	on
	Standby						on			on	on	on
Inverter mode	Inverter on						on				on	
	Power saver on	on										
Alarms	Battery low voltage			on		on		beep 0.5 s every 5 s		on	on	
	Battery high voltage			on		on		beep 0.5 s every 1 s		on	on	
	Over load (inverter mode)	on		on		on		beep 0.5 s every 5 s		on	on	
	Over temp (inverter mode)		on	on		on		beep 0.5 s every 1 s		on	on	
	Over temp (line mode)		on	on	on	on	on	beep 0.5 s every 1 s	on	on	on	
	Over charge			on	on	on	on	beep 0.5 s every 1 s	on	on	on	
Fault mode	Fan lock							beep continuous				
	Battery high voltage						on	beep continuous			on	
	Inverter mode overload	on						beep continuous				
	Over temperature		on					beep continuous				

Audible Alarm

Battery Voltage Low	Inverter green LED lit, and the buzzer beeps 0.5s every 5s.
Battery Voltage High	Inverter green LED lit, and the buzzer beeps 0.5s every 1s and Fault after 60s.
Invert Mode Over-Load	(1) $110\% < \text{load} < 125\% (\pm 10\%)$, No audible alarm in 14 minutes, Beeps 0.5s every 1s in 15 th minute and Fault after 15 minutes; (2) $125\% < \text{load} < 150\% (\pm 10\%)$, Beeps 0.5s every 1s and Fault after 60s; (3) $\text{Load} > 150\% (\pm 10\%)$, Beeps 0.5s every 1s and Fault after 20s;
Over Temperature	Heatsink temp. $\geq 105^\circ\text{C}$, Over temp red LED Lighting, beeps 0.5s every 1s;

FAN Operation

Condition	Enter condition	Leave condition	Speed
HEAT SINK TEMPERATURE	$T \leq 60^\circ\text{C}$	$T > 65^\circ\text{C}$	OFF
	$65^\circ\text{C} \leq T < 85^\circ\text{C}$	$T \leq 60^\circ\text{C} / T \geq 85^\circ\text{C}$	50%
	$T > 85^\circ\text{C}$	$T \leq 80^\circ\text{C}$	100%
CHARGER CURRENT	$I \leq 15\%$	$I \geq 20\%$	OFF
	$20\% < I \leq 50\%$	$I \leq 15\% / I \geq 50\%$	50%
	$I > 50\%$	$I \leq 40\%$	100%
LOAD% (INV MODE)	$\text{Load} < 30\%$	$\text{Load} \geq 30\%$	OFF
	$30\% \leq \text{Load} < 50\%$	$\text{Load} \leq 20\% / \text{Load} \geq 50\%$	50%
	$\text{Load} \geq 50\%$	$\text{Load} \leq 40\%$	100%

Allow at least 30CM of clearance around the inverter for air flow. Make sure that the air can circulate freely around the unit.

Variable speed fan operation is required in invert and charge mode. This is to be implemented in such a way as to ensure high reliability and safe unit and component operating temperatures in an operating ambient temperature up to 50°C.

- Speed to be controlled in a smooth manner as a function of internal temperature and/or current.
- Fan should not start/stop suddenly.
- Fan should run at minimum speed needed to cool unit.
- Fan noise level target <60db at a distance of 1m.

DIP Switches

On the rear panel of inverter, there are 4 DIP switches which enable users to customize the performance of the device.

CS+ Dip Switch Function Setting

Switch NO	Switch Function	Position: 0	Position: 1
SW1	Low Battery Trip Volt	10.0VDC	10.5VDC
		*2 for 24VDC, *4 for 48VDC	
SW2	AC Input Range	184-253VAC	154-264VAC(40Hz+)
SW3	Load Sensing Cycle	30 seconds	3 seconds
SW4	Battery/AC Priority	Utility Priority	Battery Priority

SW1:Low Battery Trip Volt:

For 12VDC model, the Low Battery Trip Volt is set at 10.0Vdc by typical deep cycle lead acid battery. It can be customized to 10.5Vdc using SW1 for sealed car battery, this is to prevent batteries from over-discharging while there is only a small load applied on the inverter.(*2 for 24VDC, *4 for 48VDC)

SW2:AC Input Range:

There are different acceptable AC input ranges for different kinds of loads.

For some relatively sensitive electronic devices, a narrow input range of 184-253VAC is required to protect them.

While for some resistive loads which work in a wide voltage range, the input AC range can be customized to 154-253VAC, this helps to power loads with the most AC input power without frequent switches to the battery bank.

SW3:Power Saver Auto Setting :

The inverter is factory defaulted to detect load for 250ms in every 5 seconds. This cycle can be customized to 3 seconds through the SW3 on the DIP switch.

SW4:Battery/AC Priority:

Our inverter is designed with AC priority by default. This means, when AC input is present, the battery will be charged first, and the inverter will transfer the input AC to power the load. Only when the AC input is stable for a continuous period of 15 days, the inverter will start a battery inverting cycle to protect the battery. After 1 cycle normal charging and ac through put will be restored.

The AC Priority and Battery Priority switch is SW4. When you choose battery priority, the inverter will inverting from battery despite the AC input. Only when the battery voltage is reaches low voltage alarm point(10.5V for 12V), the inverter transfers to AC Input, charges battery, and switches back to battery when battery is charged full. This function is mainly for wind/solar systems taking utility power as back up.

Other features

Battery voltage recover start

After low battery voltage shut off (10V for 12V model/20V for 24V model/40V for 48V model), the inverter is able to restore operation after the battery voltage recovers to 13Vdc/26Vdc/52Vdc (with power switch still in the “On” position). This function helps to save the users extra labor to reactivate the inverter when the low battery voltage returns to an acceptable range in the renewable energy systems. The built in battery charger will automatically reactivate as soon as city/generator ac has been stable for 15 seconds.



WARNING

Never leave the loads unattended, some loads (like a Heater) may cause accident in such cases.

It is better to shut everything down after low voltage trip than to leave your load on, due to the risk of fire.

Auto Gen Start(optional)

The inverter can be customized to start up a generator when battery voltage goes low.

When the inverter goes to low battery alarm, it can send a signal to start a generator, and turn the generator off after battery charging is finished.

The auto gen start feature will only work with generators designed to work with this feature. There is an open/close relay that will short circuit the positive and negative cable from a generator. The input DC voltage can vary, but the Max current the relay can carry is 16Amp.

Conformal Coating

The entire line of inverters have been processed with a conformal coating on the PCB, making it water, rust, and dust resistant.

While these units are designed to withstand corrosion from the salty air, they are not splash proof.

DC & AC Wiring recommendation

It is suggested the battery bank be kept as close as possible to the inverter. The following able is a suggested wiring option for 1 meter DC cable.

Please find the following minimum wire size. In case of DC cable longer than 1m, please increase the cross section of cable to reduce the loss.

Ref	AC	DC in mm ² / Fuse advised Amps		
	230VAC	48VDC	24DC	12VDC
CS+800DIF	1.5mm ²	—	—	16mm ² / 120A
CS+1400DIF	2.5mm ²	—	16mm ² / 100A	25mm ² / 200A
CS+2000DIF	2.5mm ²	—	25mm ² / 150A	35mm ² / 300A
CS+2500DIF	2.5mm ²	—	25mm ² / 200A	50mm ² / 400A
CS+3600DIF	4mm ²	25mm ² / 150A	35mm ² / 250A	70mm ² / 500A
CS+5000DIF	4mm ²	35mm ² / 200A	50mm ² / 400A	90mm ² / 700A
CS+7000DIF	6mm ²	50mm ² / 300A	70mm ² / 500A	—

Please note that if there is a problem obtaining for example 90mm² cable, use 2*50mm² or 3*35mm².

One cable is always best , but cable is simply copper and all you require is the copper, so it does not matter if it is one cable or 10 cables as long as the square area adds up. Performance of any product can be improved by thicker cable and shorter runs, so if in doubt round up and keep the length as short as possible.



WARNING

The output voltage of this unit must never be connected in its input AC terminal, overload or damage may result.

Always switch on the inverter before plugging in any appliance.

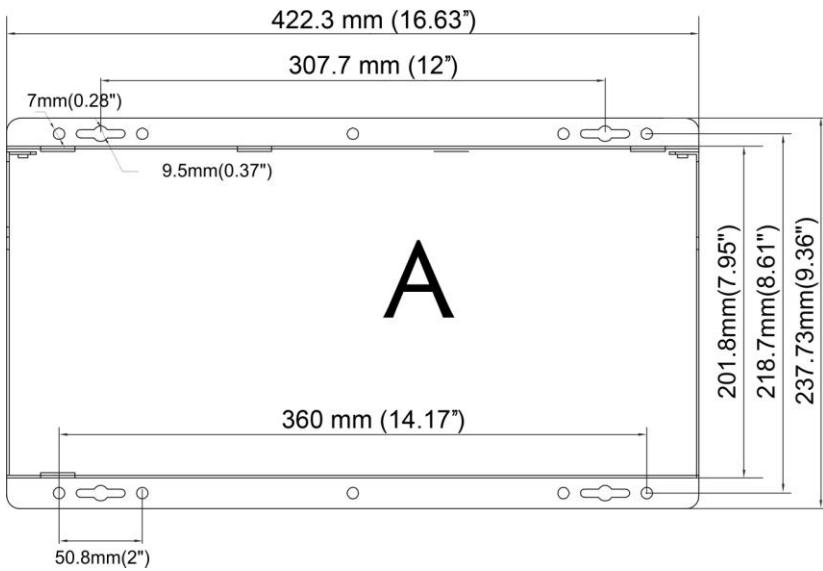
4 Troubleshooting Guide

Troubleshooting contains information about how to troubleshoot possible error conditions while using the CS+ Inverter & Charger.

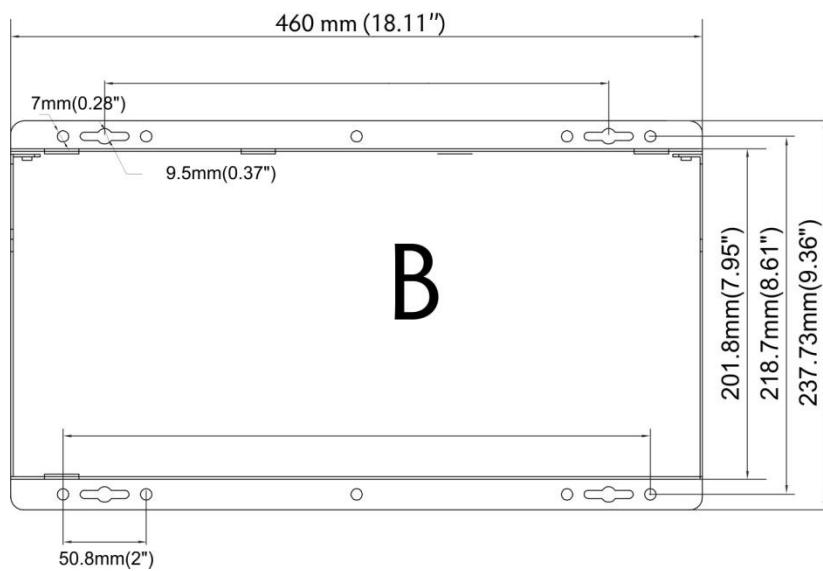
The following chart is designed to help you quickly pinpoint the most common inverter failures.

Symptom	Possible Cause	Recommended Solution
Inverter will not turn on during initial power up.	Batteries are not connected, loose battery-side connections. Low battery voltage.	Check the batteries and cable connections. Check DC fuse and breaker. Charge the battery.
No AC output voltage and no indicator lights ON.	Inverter has been manually transitioned to OFF mode.	Press the switch to Power saver on or Power saver off position.
AC output voltage is low and the inverter turns loads OFF in a short time.	Low battery.	Check the condition of the batteries and recharge if possible.
Charger is inoperative and unit will not accept AC.	AC voltage has dropped out-of-tolerance	Check the AC voltage for proper voltage and frequency.
Charger is supplying a lower charge rate.	Charger controls are improperly set. Low AC input voltage. Loose battery or AC input connections.	Refer to the section on adjusting the “Charger Rate”. Source qualified AC power.. Check all DC /AC connections.
Charger turns OFF while charging from a generator.	High AC input voltages from the generator.	Load the generator down with a heavy load. Turn the generator output voltage down.
Sensitive loads turn off temporarily when transferring between grid and inverting.	Inverter's Low voltage trip voltage may be too low to sustain certain loads.	Choose narrow AC voltage in the DIP switch, or Install a UPS if possible.
Noise from Transformer/case*	Applying specific loads such as hair drier	Remove the loads

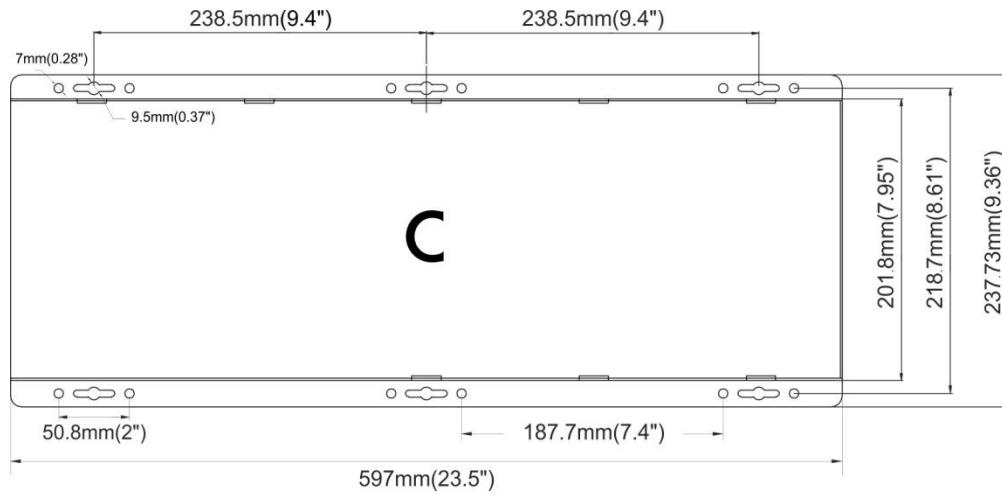
DIMENSIONS CS+DIF 1400/2000



DIMENSIONS CS+DIF 2500/3600



DIMENSIONS CS+DIF 5000/6000/7000



Références	Input battery (Vdc)	Output Voltage (Vac)	Output Power (Va)	Surge Power (Va)	By pass (A)	Input Voltage (Vac)	Charge Current (A)	Dimensions (Lxlxh) mm	Weight (kg)
	Convertisseur				Bypass	Chargeur			
CS+12-1400DIF	12	230	1400	4200	30	184 à 270	40	460x241x198	16
CS+12-2000DIF	12	230	2000	6000	30	184 à 270	50	460x241x198	18
CS+12-2500DIF	12	230	2500	7500	30	184 à 270	70	460x241x198	19
CS+12-3600DIF	12	230	3600	10800	30	184 à 270	90	460x241x198	21
CS+12-5000DIF	12	230	5000	15000	40	184 à 270	125	597x241x198	36
CS+24-1400DIF	24	230	1400	4200	30	184 à 270	25	460x241x198	16
CS+24-2500DIF	24	230	2500	7500	30	184 à 270	35	460x241x198	19
CS+24-3600DIF	24	230	3600	10800	30	184 à 270	50	460x241x198	21
CS+24-5000DIF	24	230	5000	15000	40	184 à 270	70	597x241x198	36
CS+24-7000DIF	24	230	7000	21000	40	184 à 270	90	597x241x198	46
CS+48-3600DIF	48	230	3600	10800	30	187 à 270	30	460x241x198	21
CS+48-7000DIF	48	230	7000	21000	40	184 à 270	60	597x241x198	46

Warranty

We offer a 1 year limited warranty.

The following cases are not covered under warranty.

1 DC polarity reverse.

The inverter is designed without DC polarity reverse protection. A polarity reverse may severely damage the inverter.

2 Wrong AC wiring

3 Operating in a wet environment.

4 Operating with an undersized generator or generator with unqualified wave form.