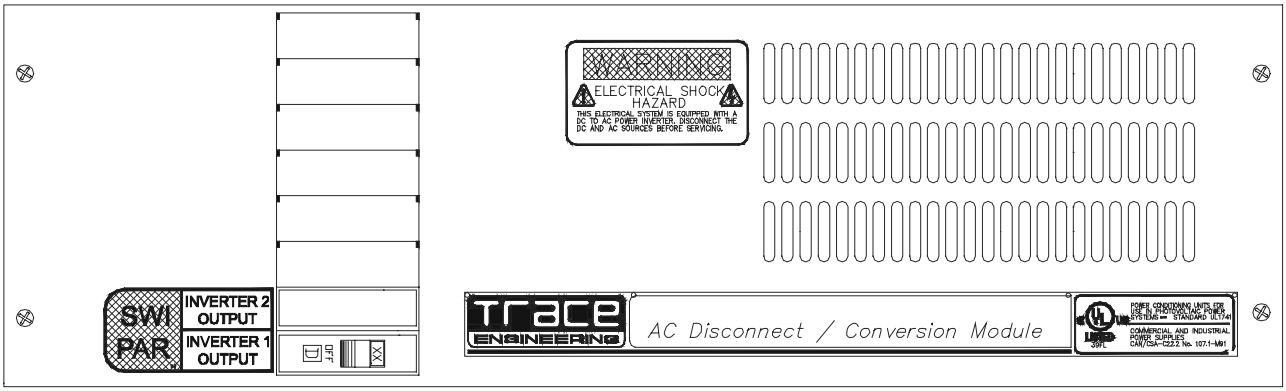
Owner's Manual

Version 1.3

Parallel Stacking Interface

for SW series Inverter / Chargers



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Quick Start Instructions

Parallel Stacking Interface for SW series Inverter / Chargers

These quick start instructions are to assist with the start-up and testing of SW series inverters being connected in parallel for higher output capacity. These instructions are intended to supplement the standard inverter manual. The important safety instructions in the SW series inverter / charger manual should be reviewed prior to installing and operating the equipment.

The parallel stacking interface allows twice the continuous and surge capacity to be available on a single output circuit from two inverters. The pass-through capacity is also doubled when connected to a AC source such as a fuel powered generator or a utility grid. The inverter's operate in parallel and split the loads between them. The inverters must be identical models and must have software version REV 4.01 or higher software. The inverters must be connected to the same battery bank with equivalent cabling (both in length and in cable size). The inverter negative terminals of the inverters must be connected together either at the inverters or at a location close to the inverters (within 36 inches / 1 meter).

The parallel interface requires the following components:

- The paralleling interface enclosure with the balancing transformer and AC input breakers
- The special stacking interface cable (which is NOT the same as the SWI "series" interface cable).
- These instructions to enable proper connection and the required software settings for the inverter/charger systems.
- Two SW series inverter charger of the same model number and both with REV 4.01 software.
- Appropriate DC and AC overcurrent protection.

Installation Instructions

The specific installation procedures is as follows:

1. Mount the inverters. Mounting location should take into consideration conduit paths and accessibility to both the AC terminals and the stacking interface port locations. The mounting method must be able to support the weight of the inverter which can reach up to 150 pounds (approximately 75 kg.)
2. Mount the paralleling interface enclosure in a convenient location near the AC (left) end of the inverters. Mount the enclosure with the transformer located at the top of the enclosure. This will result in the circuit breakers located in a vertical orientation with the “ON” position at the top.
3. Make the DC connections to the inverters. The DC terminals of the inverter are on the right side on the 5/16” stud terminals. Be certain of the DC polarity before making the connections to the batteries or closing the DC overcurrent protection. Reverse polarity will cause failure of the inverters.
4. Make the AC input connection to the inverters from the AC source (either generator or utility grid, or both). The AC input disconnect should be a two pole type to allow protection of each inverter and the AC input wiring individually. Two separate disconnects can be used if available. The wiring must be sized to handle the amount of current available from the AC source or to match the ratings of the overcurrent protection used.
5. Make the AC output connections from the inverter outputs to the paralleling interface input terminals. The paralleling interface includes AC circuit breakers for protection and isolation of the inverter outputs. The enclosure should be located near the inverters (within 6 feet / 2 meters).
6. The AC inputs to the two inverters must be the same voltage, phase & frequency and be from the same AC source.
7. The AC neutrals terminals of the inverters must be connected together at the inverters with a relatively short conductor of the same capacity as the other AC wiring of the system. This should be done at the inverter terminals in addition to any other points in the system that also occurs.
8. Make the AC output connection from the paralleling interface enclosure to the load center / distribution panel. Note that this circuit will be carrying twice the current and must be sized larger than the other wiring of the system.
9. Install the parallel stacking interface cable between the two stacking ports of the inverters. Secure the cables with the screws provided to ensure good connections.
10. Apply DC to the inverter’s DC terminals by closing the DC disconnect. After a short delay the inverter should start up. It is normal to hear some small clicks during this process. Once the inverter has turned on the display will be illuminated. No AC output will be present until the control panel has been used to turn on the inverters.
11. Press the red ON/OFF button twice so that the word ON is underlined on both inverters. Both inverters will be off until they both have the ON position selected. Do not select SEARCH except momentarily. If one of the inverter operates, indicates an ERROR, or overcurrent trips when the ON position is selected and the other is in the OFF position, the interface cable may be installed incorrectly or one inverter may have a bad stacking port. Contact Trace for assistance.
12. With the AC input circuit breakers in the paralleling enclosure in the OFF position, measure the voltage between the output hot conductors of the two inverters. The voltage should not exceed 15 volts AC for 105 to 120 VAC models, or 30 volts AC for 220 to 240 VAC models. The voltage difference should be relatively stable while the inverters are not powering loads and the battery is at rest. If the voltages vary by a greater amount, or the voltage difference is not stable, switch the parallel interface cable end-for -end to switch the master / slave configuration and retest. The lowest voltage difference is the preferable arrangement.
13. Close the AC input breaker on the paralleling enclosure, but leave the all AC loads off. The inverters should operate as normal without a significant change in the noise level. Check the AC amperage meters on each inverter. They should both display zero amps.

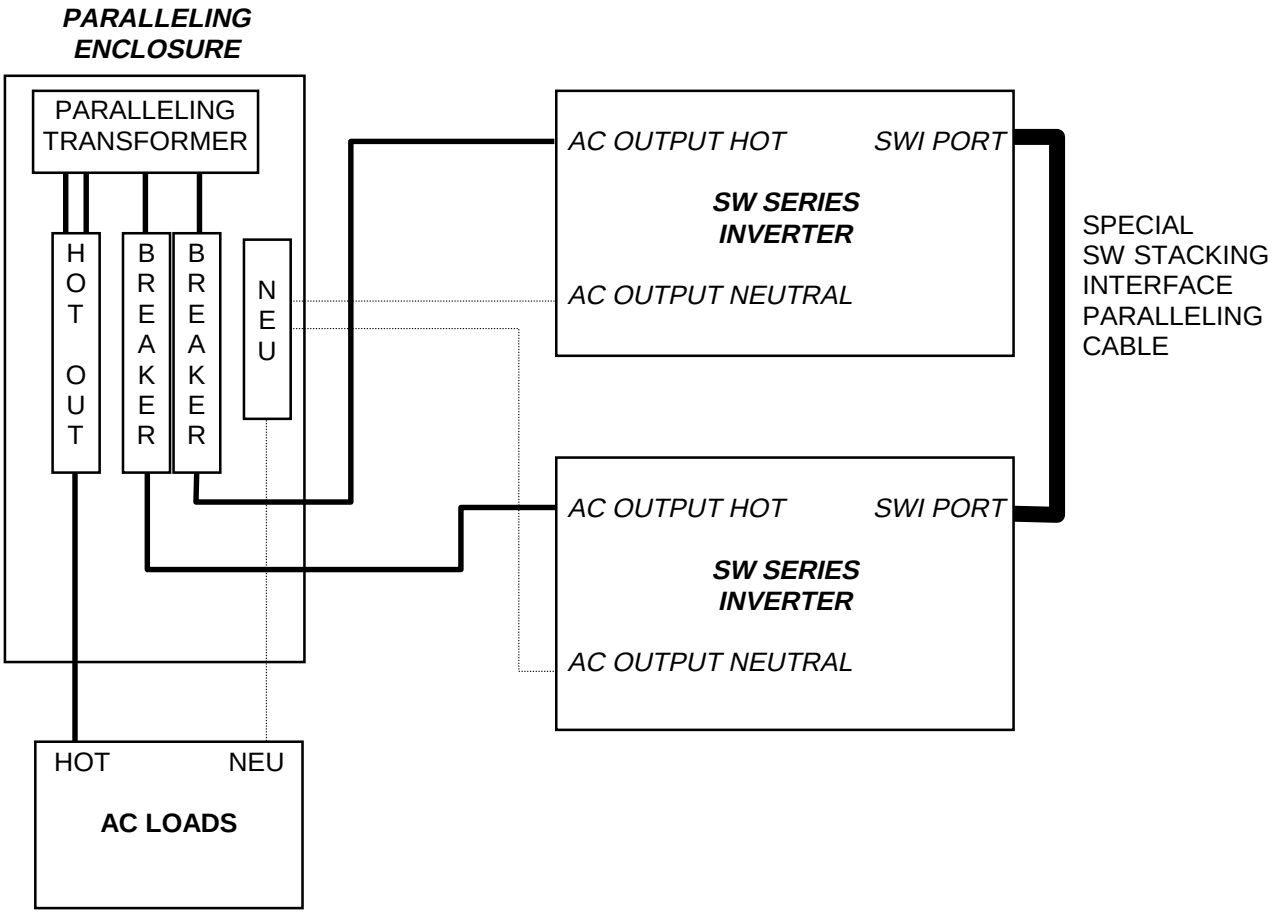
14. If the amperage meters show a few amps and no loads are connected, check the wiring between the units and the paralleling interface. No other connection from AC output of the inverter should be present except for the wires to the paralleling enclosure. Check the wiring for proper polarity and possible ground loops.
15. Close the load AC circuit breakers and operate some AC loads. The inverters should split the loads equally between them while running with a stable loads. The amperage meters on the inverters should agree within one amp or better while operating.
16. Go to the programming section of the manual and set-up the AC input voltage window and warm-up periods as described. You'll need to know which inverter is the MASTER and which is the SLAVE unit for proper operation to occur. The units are made MASTER and SLAVE by the labeling and direction of the parallel stacking cable's connection - otherwise the inverters are the same. If the cable is reversed during installation, the programming needs to be changed accordingly.
17. Apply AC power to the AC input 2 (generator) of both inverters and allow them to connect. The MASTER inverter should connect first, then the SLAVE. It is normal to hear a small thump from the paralleling transformer 10 seconds before the MASTER inverter connects. This is the inverter phase shifting to synchronize with the AC source. After the MASTER connects, the SLAVE should transfer after an additional 5 seconds. Once the inverters are connected to the AC source, they will start battery charging and powering the AC loads through the inverters. When the inverters connect the green AC2 in LED should stop flashing and turn solid green.
18. Do not use the AC input 1 terminals without consulting with Trace Engineering for additional assistance. The parallel stacking interface system is recommended for use only with the AC input 2 at the present time. Operation of inverters in parallel in the utility interactive mode has not been fully evaluated at this time.
19. Turn off the AC source and allow the inverters to resume inverting. The inverters should transfer from the AC source to inverting without overcurrent tripping or having an error condition. If the units trip off during the transfer, check the LOWER LIMIT VOLTS AC setting in the inverter SETUP menus. The MASTER inverter must have its lower limit set lower than the SLAVE inverter's lower limit. Try increasing the difference between the LOWER LIMIT VOLTS AC setting if the units trip off.
20. The best transfer will occur when a generator is stopped by using the inverter control panel or the automatic generator control system. The SLAVE inverter can only be used for generator control - **DO NOT CONNECT THE GENERATOR START SYSTEM ON THE MASTER UNIT**. This is required due to the cool down system in the generator control. When the inverter signals the generator to stop, the SLAVE inverter will first disconnect itself from the generator. After a short period of time, the SLAVE inverter will turn off the generator. The MASTER inverter will then drop the generator and start inverting.
21. If the system overcurrent trips or glitches when the generator is turned off, add a high current rated two pole contactor between the generator and each of the inverters AC HOT 2 inputs. The coil of the contactor needs to be connected to the generator control system such that closes when the generator is running and opens when the generator is told to stop. This will result in both inverters dropping the generator at the same time. Two separate contactors can also be used with the coils connected in parallel.

AC Wiring Hook Up Diagram

The parallel stacking interface cable simply plugs into the stacking port on the left end of each inverter. The paralleling enclosure is connected to each of the inverter's outputs and is also connected to the AC loads being powered.

The hook-up depends upon the other components included in the system and whether it was ordered as only inverters, a power panel system, or a power module system. With the power module system the paralleling enclosure is eliminated and all of the wiring is completed for you. With the individual inverters and the power panel system, the paralleling enclosure and parallel stacking interface cable must be installed on site.

The following shows the hook-up for both a 220 / 240 VAC and 105 / 120 VAC system. Both versions are similar except the 105 / 120 version includes 60 amp AC input breakers and the 220 / 240 version includes 25 amp AC input breakers.



Each inverter should have its own DC overcurrent protection device (breaker or fuse). The DC negative terminals of the inverter should be connected close to the inverters (within 36" / 1 meter of cable). This is important for proper operation of the intercommunication system of the inverters. If longer battery cables are required, add another heavy cable between the two inverters DC negative terminals as short as possible.

Operation

The parallel stacking interface allows the two inverters to operate as a single inverter. The interface method is based on the series stacking system offered for the SW series inverters since the product's introduction for the North American market. The parallel stacking system operates the inverters in phase by having one of the inverters operate as the MASTER and the other as a SLAVE. When an AC source is connected, the MASTER first synchronizes to the AC source, then connects to it and battery charges. Since the SLAVE follows the master and is user programmed with a longer warm-up delay, the SLAVE inverter is already synchronized when it transfers the loads and starts battery charging. This allows very smooth transitions from inverter mode to charger mode.

The parallel stacking interface system allows doubling of the AC pass through capacity. This is useful when large generators are used. Both inverter will battery charge as allowed by the settings in each of the inverters.

At this time the paralleled inverters are intended to operate as a single unit. Operation on a single unit is not supported when they are connected with the parallel stacking interface system. In the event of a inverter fault or error condition, both inverter turn off as one. When the error has been corrected, the inverter will automatically or manually reset depending upon the type of error condition.

If an inverter failure occurs, the parallel stacking interface can be manually bypassed by moving a few wires in paralleling transformer enclosure and disconnecting the special parallel stacking interface cable to allow temporary operation on one unit.

For proper operation the inverter must be programmed as described in the following section. It is critical that the settings be followed exactly, or unpredictable operation may occur.

Required Special Programming of the MASTER and SLAVE units

The following settings must be made exactly as shown. You must clearly understand which inverter is the MASTER and which is the SLAVE to complete this programming. The parallel stacking interface cable indicates which is which by the labeling attached to the cable ends. The following instructions apply only for REV 4.01 software - use of earlier software versions is not recommended.

The changes to the settings are required for the both the MASTER and the SLAVE unit. If other changes are made to the MASTER inverter's settings, the same changes should be made to the SLAVE. Both inverters should have the same battery charging settings in particular. Do not use the search mode when connected in parallel.

To access the SETUP MENU, press both the RED and GREEN buttons at the same time from one of the numbered menu headings. See the SW series manual for more information on the settings.

Required Programming of the MASTER and SLAVE inverters

The following settings are recommended to be followed. Some adjustment of the settings may be required for your application - for example, if your generator does not maintain regulation well, then you should widen the AC input voltage window for both inverters, but you must maintain the relationship as shown here between the master and the slave unit. If your generator needs to warm-up longer, increase both the MASTER and SLAVE warm-up periods, but keep the SLAVE's warm-up period set longer than the MASTER.

AC INPUTS 11

The AC INPUT menu heading determines when the inverter allow power to flow from the AC source. The MASTER inverter needs to have a wider range of acceptable AC input power than the SLAVE by at least 5 volts AC (for 220 to 240 VAC output versions, the difference must be at least 10 volts AC).

SET INPUT LOWER LIMIT VAC 108

The value shown is the default value and is acceptable for the SLAVE inverter. A lower value can be used if required, but the MASTER should be set 5 volts AC lower than the SLAVE (10 volts AC lower for 220 to 240 VAC units).

Set INPUT UPPER LIMIT VAC 132

The value shown is the default value and is acceptable for the SLAVE inverter. A higher value can be used if required, but the MASTER should be set 5 volt AC higher than the SLAVE (10 volts higher for 220 to 240 VAC units).

GEN STARTING DETAILS 13

GEN STARTING DETAILS 13

SET GEN WARMUP SECONDS 20

The warm-up period on the MASTER unit must be set shorter than the slave to allow the MASTER to synchronize and connect first. This allow the SLAVE to follow the MASTER into sync and prevents conflicts between the two inverters. The SLAVE inverter should have the warm-up period increase at least 10 seconds longer than the MASTER inverter.

Generator Start Settings

It is recommended that only the SLAVE inverter be used to control the generator. This is required because the generator control system includes a cool down timer that causes the controlling inverter to disconnect from the generator before it turns the generator off. If the MASTER controls the generator, then the SLAVE may not stay in sync with the MASTER during the cooldown period since it will remain in sync with the generator and not follow the MASTER. There currently is no adjustment for the cooldown period, so restricting the generator control to the SLAVE is the only solution available at this time.

The SLAVE also must be set with a longer warm-up period than the MASTER in order to prevent them from trying to synchronize to the generator at the same time. When the MASTER syncs first, the SLAVE will automatically be sync after its warm-up period passes. This also makes the transfer from inverter to generator smoother and less noticeable.

Troubleshooting the Parallel Stacking Interface System

The following problems may occur with the parallel stacking interface system. Please let us know if other problems are encountered.

The inverters overcurrent trip when transferring from generator to inverter power

This is usually caused by the inverters trying to charge from each other's AC inputs when the AC source (generator) is dropped. It is more likely to be encountered when the generator is equipped with a output contactor to allow it to shed the loads and cool down before turning off. This is more often a standard item on larger, more expensive generators.

This problem is caused by the inverters sensing each other once the generator's output has been suddenly removed. This is not usually seen when the contactor is not included since a normal generator's output goes out of regulation (either voltage or frequency) when it is turned off. Since the contactor opens before the generator dies, the power remains acceptable right up to the moment the AC source is lost.

To eliminate the problem either remove the contactor and allow the inverters to follow the generator out of regulation when it turns off. A better solution is to install a second contactor in parallel to the standard one. The two contactors supply the inverters the AC power individually, preventing the inverters from 'seeing" each other when the generator is turned off. This eliminates the problem in our testing.

This problem can also be encountered when opening a disconnect between the generator and the inverters. To fix this problem, use a two pole disconnect instead, with each pole feeding one inverter AC HOT 2 INPUT individually.

This problem can also be caused by not setting the MASTER input AC voltage window wider than the SLAVES input AC voltage window. Check the settings and retest. If the problem persists, try a larger difference in the settings and retest.

Another possible cause can be due to having the MASTER inverter control the generator. When the MASTER disconnects itself from the generator to allow it to cooldown, the SLAVE will continue to operate in sync with the generator, while the MASTER inverter will not. This will cause the inverters to operate out of sync and results in one or both overcurrent tripping. Be sure that you are not using the MASTER to control the generator and that it has a longer WARM-UP period and a tighter AC input voltage window.

One of the inverter has ERROR LED on and the inverter runs at a low frequency

This is caused by either a bad stacking interface cable, incorrect hook-up or a bad stacking port input. The only solution is to check the wiring for damage and correct hook-up. If nothing is found, switch the stacking interface cable's orientation and retest. If the problem remains with the same inverter, the stacking port is bad and the inverter will need to be repaired or replaced. If the problem moves to the other inverter, then the stacking cable is bad and it needs to be checked.

The second inverter will not turn on after one is started and it shows an ERROR condition

The problem depends upon the error condition found. If the unit is overcurrent tripping when the second unit is turned on, then the load is to large or the output wiring is shorted. Disconnect the loads and try to restart the inverters.

If the ERROR condition is AC SOURCE WIRED TO OUTPUT then the problem is either a bad stacking interface cable or a bad stacking port on one of the inverters. Try to turn on the other inverter first. If this doesn't work, try switching the orientation of the parallel stacking interface cable. This might allow proper operation to occur. Remember to reset the settings wince the orientation of the MASTER and SLAVE inverters has been switched.

The inverters overcurrent trip before or right when it connects to the generator

This problem is caused by not setting the SLAVES warm-up period longer than the MASTER's warm-up period. Check the settings and make sure the MASTER **IS** the MASTER inverter. If the problem continues and the settings are correct, increase the timing difference between the two units by setting the SLAVE warm-up to a higher value.

If the problem still occurs, try switching the parallel stacking interface cable orientation and resetting the warm-up period to match the new MASTER and SLAVE positions.

If this problem continues, test each of the inverters individually without the paralleling enclosure connected and the parallel stacking interface cable removed. If they operate correctly, reassemble the parallel inverter system and retest.

Also try disconnecting the AC output wiring from the paralleling enclosure. If the inverters overcurrent trips without the load connected, test the inverter by itself.