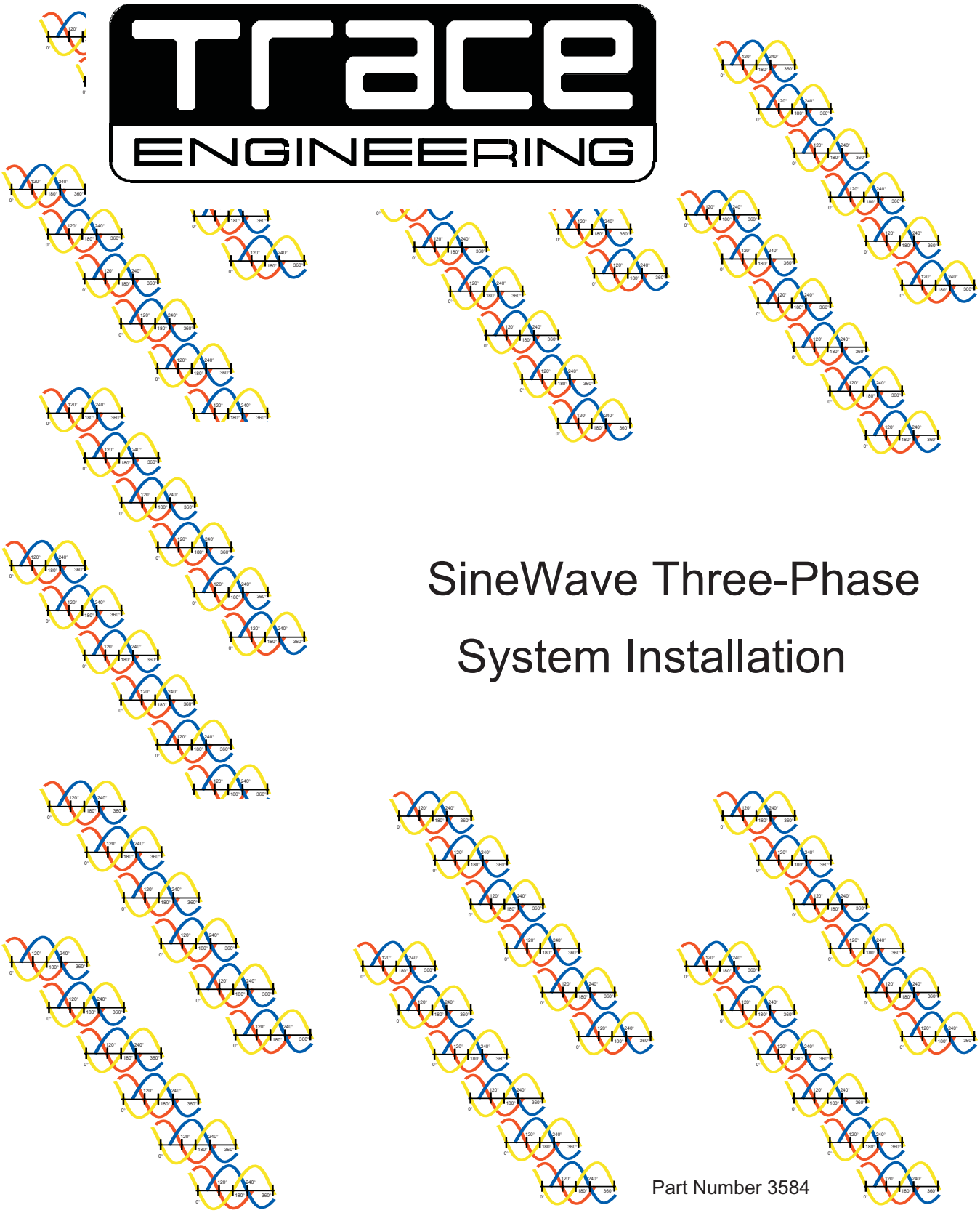

SineWave Three-Phase System Installation

Part Number 3584

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Table of Contents

1.0 General Items

1.1 Important Safety Instructions

1.11 UL™ Listing Statement

The rainproof, modular enclosure containing the three phase power system is UL™ listed to specification 1741(draft) (Photovoltaic Power Systems) as an accessory.

The SW series inverter/charger(s) are ETL™ listed to UL™ specification 1741(draft) -- *Power Conditioning Units for Use In Residential Photovoltaic Power Systems*.

1.12 General

To prevent the risk of injury, follow these safety practices:

- Completely read and understand the owner's manuals for all components of the three phase system. This includes the inverter/charger, battery bank, phase monitor, and all wiring, disconnects, and AC/DC sources.
- Only a qualified electrician familiar with three phase power systems should perform installation and/or maintenance of this system.
- Do not attempt to install or maintain this system without first completely disconnecting all sources of AC and DC power.
- Observe proper grounding practices to reduce risk of inadvertent electric shock.
- Observe all national and local electrical codes.
- Use proper tools and common sense when installing and/or maintaining this three phase power system.
- The individual components of the three phase system are heavy. Observe proper lifting techniques and have someone help when installing these items.

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1.2 Customer Service and Support

For questions or comments regarding installation of this equipment, or for suggestions on how to improve this product, contact Trace Engineering by phone, FAX, mail, or e-mail.

Trace Engineering, Inc

5916 195th St. NE

Arlington, WA 98223 USA

Phone: 360 435 8826

FAX: 360 435 2229

E-mail: www.traceengineering.com

1.3 Warranty Repair Returns

Should a product need to be returned to Trace Engineering for service, contact Trace by one of the methods listed above, and request a Return Merchandise Authorization (RMA) number. Send the product to Trace at the above address with the number written clearly on the outside of the shipping box.

1.4 Product Materials Package

The following items should be present in the three-phase system packages shipped from Trace Engineering:

- ✓ three (3) identical model Trace SW Series inverter/chargers with three-phase software;
- ✓ one (1) mounted three-phase monitor and the associated manual;
- ✓ one (1) three-phase stacking interface cable;
- ✓ one pre-assembled Phase A Power Module system with door and lid;
- ✓ one pre-assembled Phase B Power Module system with door;
- ✓ one pre-assembled Phase C Power Module system with door and feet;
- ✓ one tube RTV silicone sealer;
- ✓ four individual packages of fasteners; one for fastening the inverters to the enclosures, one for fastening the lid to the modules, one for fastening the enclosures together, and one for fastening the screens to the bottom enclosure;
- ✓ a length of black 1” wide adhesive-backed foam tape to be used around all door and lid openings to prevent insects from entering;
- ✓ owner’s guides for the inverter/chargers, controllers, and phase monitor are packaged with the individual units. Review these thoroughly.

If any of the above items are missing or arrived in unsatisfactory condition, contact Trace Engineering Customer Service at 360-435-8826 or by FAX at 360-435-2229.

1.5 Tools Required for Installation

A wide variety of tools may be required depending on the complexity of the installation being performed. Since installations vary greatly, it is impossible to list every tool that may be required, however the following basic tools will be needed:

- 7/16" (11_{mm}), 5/16" (8_{mm}) ½" (12_{mm}) and 5/8" (16_{mm}) open/box end wrench
- 3/16" (5_{mm}), ¼" (7_{mm}), flat blade screwdriver
- #2 Philips head screwdriver
- Wire strippers suitable for up to #6 AWG
- Torque wrench (resolution as low as 12 in-lbs)
- Allen head wrenches or Allen bits - 3/16" to 3/8"

Any other tooling required for custom installation

1.6 Torque Values for Fasteners

Description of Fastener	*Tool Required*	*Torque Value*
DC Disconnects	15/16" Allen Head	275 inch-pounds
By-Pass Breaker	#2 Flat Blade Driver	45 inch-pounds
By-pass Breaker Terminal Splice	#2 Flat Blade Driver	30 inch-pounds
Neutral Block (Isolated)	3/16" Allen Head	216 inch-pounds
Neutral Block (Isolated)	Small Flat blade	30 inch-pounds
#3191 Carriage Bolts	5/16" Socket	60 inch-pounds
3/8" Negative Shunt Bolt	5/8" Socket	204 inch-pounds
Inverter Terminal Block	3/16" Flat Blade Driver	12 inch-pounds
1/4-20 Cap Screws	7/16" Socket	80 inch-pounds

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2.0 System Description

The Three-Phase System from Trace Engineering has been carefully designed to provide years of service when installed and operated according to these and the inverter instructions, National Electrical Codes, and best electrical installation practices. Read the instructions carefully before beginning any installation. Never handle 'live' electrical wiring. Always take appropriate steps to ensure safety. If in any doubt, consult a licensed electrical contractor or contact Customer Service at Trace Engineering.

The three-phase system consists of three SineWave inverters equipped with special software and connected by a three-phase stacking interface cable. All other necessary components are available from Trace Engineering, or may be provided by the customer.

2.11 Three-Phase System

A typical three-phase system is illustrated in the diagram on Page 2-3. Required components include three SineWave inverters with three-phase software, the special three-phase stacking interface, 2/0 or 4/0 positive and negative DC battery cables with ring terminals, neutral and ground bonding, and AC wiring in appropriate sizes. Most installations will also require DC disconnects, 3-phase AC disconnects, and one or more phase monitors, all of which are included with Power Modules systems.

The inverters are connected with a special three-phase system interface cable. This cable carries a clocking signal to provide the phasing information from one MASTER inverter to the two SLAVE inverters. The MASTER and SLAVES are selected by the connectors of the interface cable (this is different than the arbitrary mastering of the normal 120/240 VAC stacking system). No other information is communicated between the three inverters - each operates independently.

The over-current trip protection system in the inverters is slightly modified to allow automatic resetting of the faulted inverter after the three-phase monitor has disconnected the three phase AC loads.

Some modification of the default battery charger settings and generator start system are required when used in hybrid generator systems. This is necessary to ensure that the inverter which starts the generator because of a low DC voltage condition reaches the float stage first and turns off the generator (only two wire start type generators should be controlled by this system).

This system has not been tested for use selling power back into the utility grid from a DC source such as a PV array. Prior to use with this type of system, consult Trace Engineering for results of testing, recommended settings and installation requirements

The inverters can be connected only in a WYE (also called STAR) configuration. In all case, the metal chassis of all three inverters **MUST** be connected together to prevent potentially dangerous shock hazards. Connect the three chassis also to earth ground.

The battery negative terminals of all three inverters must be connected together to close to the inverters as possible, i.e. at the DC bonding block (within 3 feet [1 meter] - not at the battery). This ensures proper communication of the clocking signals and prevents damage of the stacking ports (this applies to all stacked systems). A three-pole, normally-open contactor must be connected between the inverter output and the AC loads. If multiple load circuits are present, several three-phase monitors can be used to allow load shedding or a staged restart of the loads after a fault or at startup.

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For a WYE system, the AC output terminals are connected together with the neutral terminals of all three connected together and the hot terminals of each becoming the A, B & C phases. The neutral also needs to be connected to a ground rod. The special three-phase stacking cable connector labeled as “A” must be connected to the inverter that is to be the clocking master. The other two connectors are plugged into the “B” and “C” units. The three-phase monitor must also be connected with the appropriate terminals (A, B & C) to each of the inverters.

When used in a hybrid system with a generator, the generator must also be connected with the A, B & C phase matched to the inverter’s designation and the generator’s neutral must be connected to the all three of the inverter’s neutral terminals. DELTA output (3 wire) generators must be connected via a DELTA to WYE transformer to provide the neutral conductor.

Warning: Operation without the neutral may damage the inverters and will cause unpredictable operation.

Some three-phase AC loads (such as motors) do not require the neutral conductor to operate. This is acceptable and will not affect the performance of the inverters, three-phase monitor or AC loads.

Notes on the three-phase inverter system programming.

Only the slave inverters can be used to start a generator. Use of the master may result in the system losing synchronization and overcurrent tripping upon stopping of the generator.

The absorption time on the inverter that controls the generator should be set shorter than the other units. Ten minutes is recommended.

The bulk and float values should all be the same and all units must either have or not have the battery temperature sensor connected.

Two-wire start generators are recommended but are not absolutely required.

Search mode should not be used if any three phase loads are connected. If only single-phase loads are being powered by each inverter individually, then search mode can be used.

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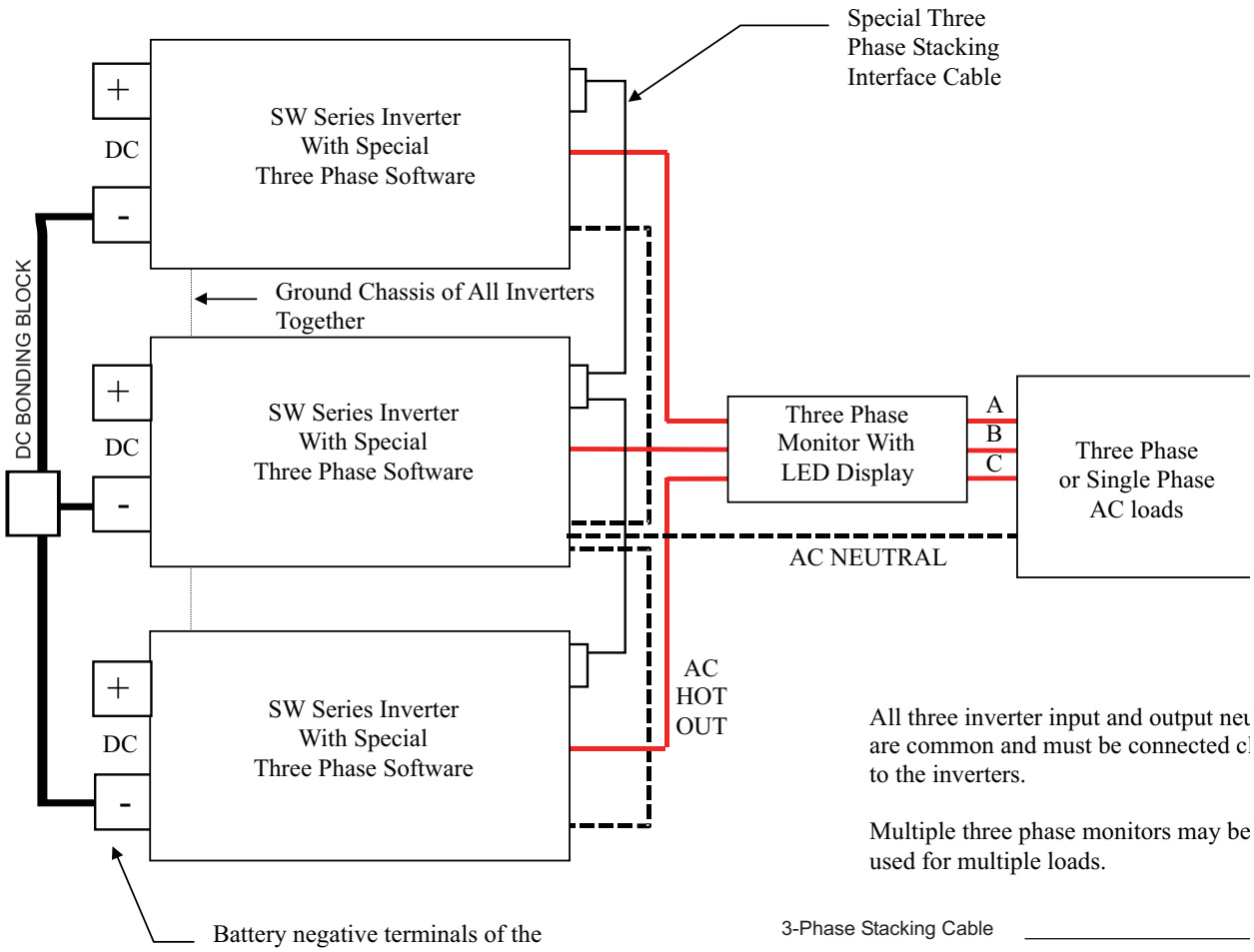

Typical Three-Phase Configuration

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2.12 Three-Phase Power Module System

The three-phase system consists of three weather-resistant aluminum enclosures equipped with doors, a lid, mounting feet, lockable breaker covers, AC and DC circuit breakers and disconnects, a special three-phase interface cable, a phase monitor, a PC interface cable (SWCA), and three Trace SineWave inverters equipped with special three-phase software. Equipment options include PV array breakers, battery cabling, PV ground fault protection, and just about anything else you might want to mount in this system. Each system meets Underwriter Laboratories' stringent requirements, but *only* when these installation instructions are followed.

Typical Three-Phase Installation

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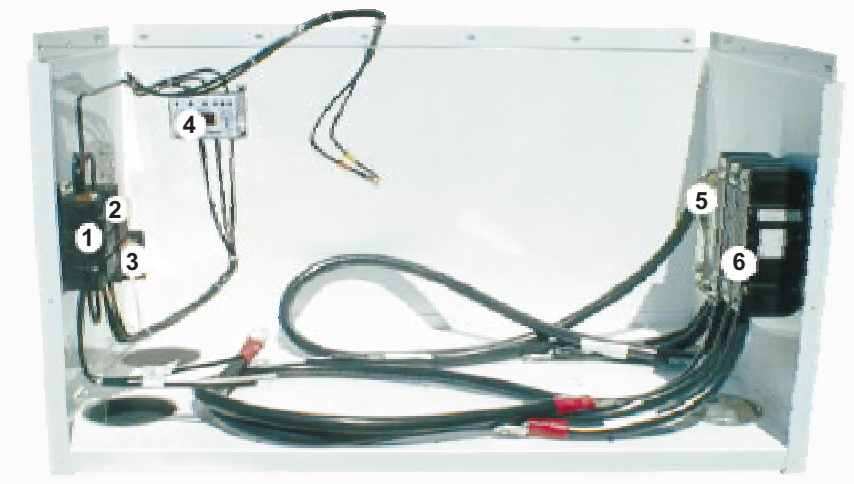
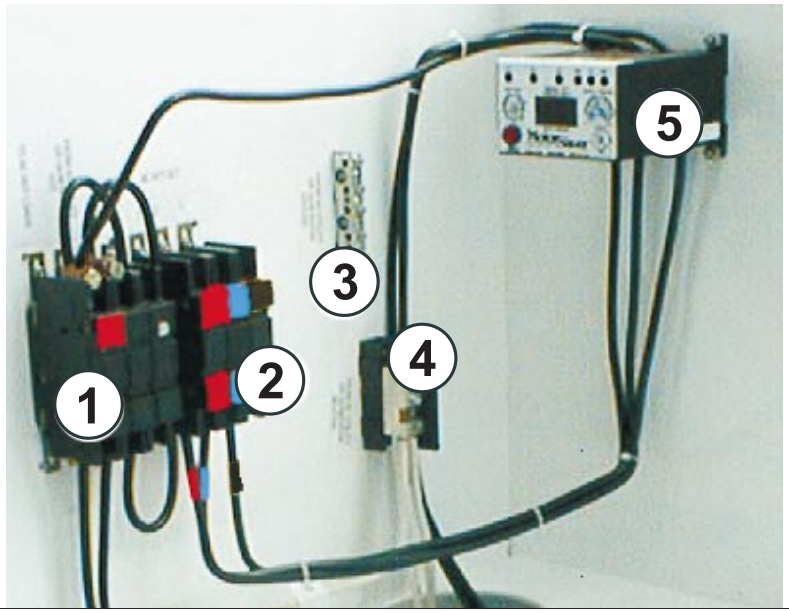
2.2 Phase A Module Description

Phase A module of the three-phase system encloses the Phase A inverter, which is the control or master inverter of the system, plus the system's three-phase AC breaker, the Phase A inverter-bypass breaker, the system's AC neutral and ground bonding blocks, the phase monitor, DC breakers for all three of the inverters, and the DC ground bonding block, to which all three inverter negatives are bonded. Optional equipment that may also be mounted in the Phase A module includes the 3-phase monitor, charge controllers, PV ground fault protection, and PV circuit breakers.



Phase A module showing 1) AC bypass breaker for phase A inverter; 2) 3-phase AC breaker; 3) Neutral and ground bonding blocks; 4) optional 3-phase monitor; 5) DC ground bonding block; 6) DC positive inverter breakers.

All DC cables provided are 4/0 AWG THW stranded copper cable. AC cables are 6 AWG THHN. Both AC and DC breakers are protected with lockable, weather- resistant plastic covers. Unused breaker openings are closed with sliding aluminum covers. The cable alleys in the floor of each module are provided with vinyl edge- guards to prevent chaffing the cables that pass through them. Wire-ties bundle parallel cables together for orderly routing. All cables are clearly labeled to provide easy identification. Ring terminals on the DC cables are crimped-on and protected with color-coded shrink tubing for polarity identification. Cabinets are white powder-coated aluminum to prevent corrosion. All cabinet fasteners are provided with 'star' washers which penetrate the powder-coating to provide electrical continuity (ground bonding). Each kit comes with enough self-adhesive closed-foam tape to seal the all facing edges of the cabinets, plus a tube of RTV sealer to completely seal them.



Phase A left wing panel showing 1) AC bypass breaker for phase A inverter; 2) 3-phase AC breaker; 3) AC ground bonding block; 4) AC neutral bonding block; 5) phase monitor.

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2.3 Phase B Module Description

Phase B module includes a standard enclosure with a door, a blank to seal any unused breaker opening in the right side-panel, and a breaker cover and slider for the left breaker openings. The standard module also includes the Phase B inverter, which is a slave to the Phase A inverter. Also mounted in the Phase B module are the AC bypass breakers (IOX60) for both the Phase B and the Phase C inverter. Optional equipment commonly mounted in the Phase B module includes charge controllers and PV array disconnect DC breakers.

Phase B module shown installed above the Phase C module.

Detail of the Phase B module left side-panel showing the Phase B and Phase C bypass breakers (IOX60)

2.4 Phase C Module Description

Phase C module typically encloses only the phase C inverter. The Phase C module includes a door and the mounting feet to secure the system to a concrete or timber foundation. This is necessary to meet UL requirements and to ensure that the system is not damaged in the event of an earthquake, vandalism, or accidental collisions with factory machinery, etc. The breaker opening on both the left and the right side-panels are usually sealed with covers and RTV sealant.Due to the limited space between the bottom of the module and its foundation or pad, there is inadequate room to reach the fasteners securing the inverter to the enclosure. That's why it is necessary to mount the inverter in the enclosure before securing the enclosure to the foundation. There is adequate clearance under the enclosure to allow drainage and prevent trapping moisture under the unit.

The cable alleys in the floor of the Phase C module are equipped with stainless-steel mesh screens to prevent the entry of insects and/or other vermin. It is also a good idea to use a good bedding compound between the mounting brackets and the concrete or timber pad that supports the system in order to prevent distorting the cabinets due to unevenness. This also prevents the accumulation of corrosive moisture or other chemicals under the brackets and around the fasteners.2

Phase C Module

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2.5 Three Phase Monitor

A three-phase power monitor is standard equipment on the TPPM to protect three-phase loads in the event one or more of the inverters shut down due to overload or fault conditions. The monitor features a nine-pin, sub-D connector configured to the RS-485 communications standard, which allows up to 99 three-phase monitors to be monitored from a single remote PC. Additional software is required from Symcom to support this application.

Features of the three phase monitor include:

- ✓ Inverter output monitoring detects imbalance, phase loss, and phase reversal faults.
- ✓ Adjustable imbalance level and trip delay with regards to under/over voltage conditions
- ✓ Adjustable imbalance level and trip delay for three phase output current
- ✓ Automatic disconnect and reconnect of AC loads allowing fault recovery of the faulted inverter.
- ✓ Built-in AC output contactor and failure detection
- ✓ Auxiliary relay (N.O.) allows an external alarm (not included) to indicate a fault condition.

Motor Saver Model 777 Monitor by Symcom, Inc

- ✓ RS-485 9-pin sub D connector for remote monitoring with a PC.
- ✓ The monitor displays the following information:
  - ⇨ Line to line voltage between each phase
  - ⇨ Average voltage
  - ⇨ Output current of each phase
  - ⇨ Average current
  - ⇨ Last fault encountered (recorded for trouble shooting)

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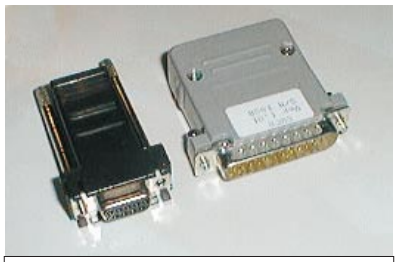
2.6 SW Communications Adapter (3-Phase systems)



SWCA Adaptor Set

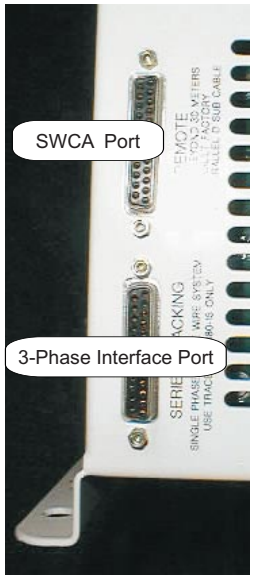
Each SW inverter is equipped with an LCD remote control panel. You can control and configure each SW inverter / charger by this control panel, or you can configure and control them remotely with an IBM-compatible personal computer (PC) using an adaptor and a program that simulates the SW series control panel.

Before attempting to use the SWCA, first disconnect the SW remote control on the inverter.

The SineWave Communications Adapter (SWCA) is uninstalled standard equipment on the TPPM system. The SWCA connects each of the three SW series inverter / chargers to a serial port on a personal computer directly or via a telephone modem. This enables you to monitor and control your TPPM over long distances via telephone, and to conveniently configure all three inverters in the system.

The SWCA three-phase package includes:

- three SW communications adapters (gray plastic housing with green LED, RJ11 phone jack and a male DB25 25-pin connector)
- one serial-port adapter (DB-9 nine-pin connector to RJ11 telephone jack)
- a 25-foot, four-conductor phone cable (with RJ11 jack tabs on the same side of the cable)
- a four-to-one RJ11telephone jack splitter / combiner
- a 3.5” floppy disk with the DOS program SWCPS.EXE, which simulates the inverter’s control panel
- owner’s manual



DB25 connectors on a SW Inverter

The male DB25 25-pin connector on each of the gray SWCA adaptors plugs into the Remote port on the end panel of each SW inverter. Three SWCA’s are provided; one for each inverter.

All SWCA’s are shipped with the same ID number: 1. Before using, the Phase B and Phase C adaptor’s ID number’s must be changed. See the instructions in the SW Communication Adaptor Owner’s Manual to install the program on your PC and configure your PC. Then follow the instructions below to change the ID number on two of the SWCA adaptors.

Step 1: Disconnect the SW remote control on the top of each SW inverter.

Step 2: Connect a gray SWCA adaptor to the Remote Control port on the left panel of the Phase B inverter. Connect a telephone-type cable (provided) between the this SWCA and the RJ11 splitter/combiner. Connect the RJ11 to your PC serial port with the telephone-type cable provided.

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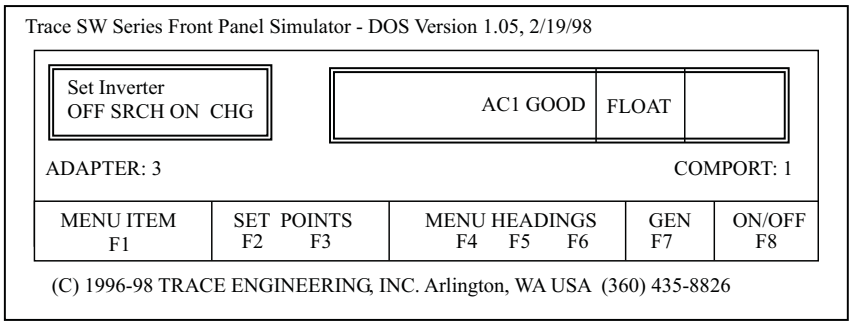
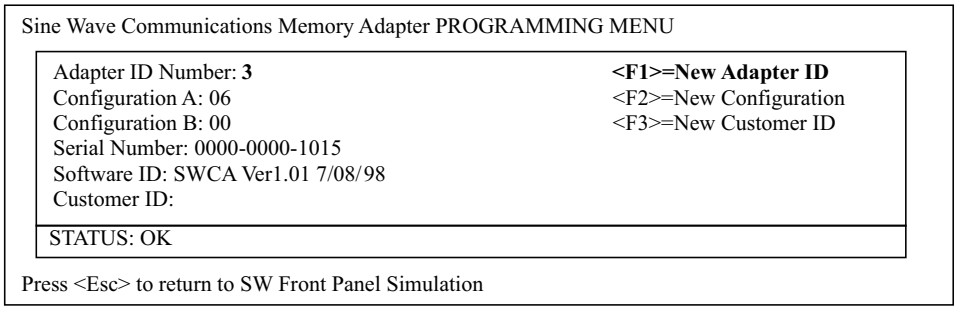
Step 3: With the PC connected to one (and only one) SWCA, invoke the SWCPS.EXE program. A virtual control panel will be displayed:



Step 4: Press ALT+ P to invoke the Programming menu. A display similar to the one below will appear.



Step 5: Press the F1 function key and enter the new adapter ID number (from 1 to 8). Press Esc to return to the control panel simulator screen.

Use a new SWCA adaptor for the Phase A inverter. Since the factory default adaptor ID number is 1, the Phase A inverter will ID will be 1. Configure the Phase B inverter ID as number 2, and the Phase C inverter adaptor as number 3. When finished, plug all of the adaptors into the splitter/combiner, which is already plugged into your PC.

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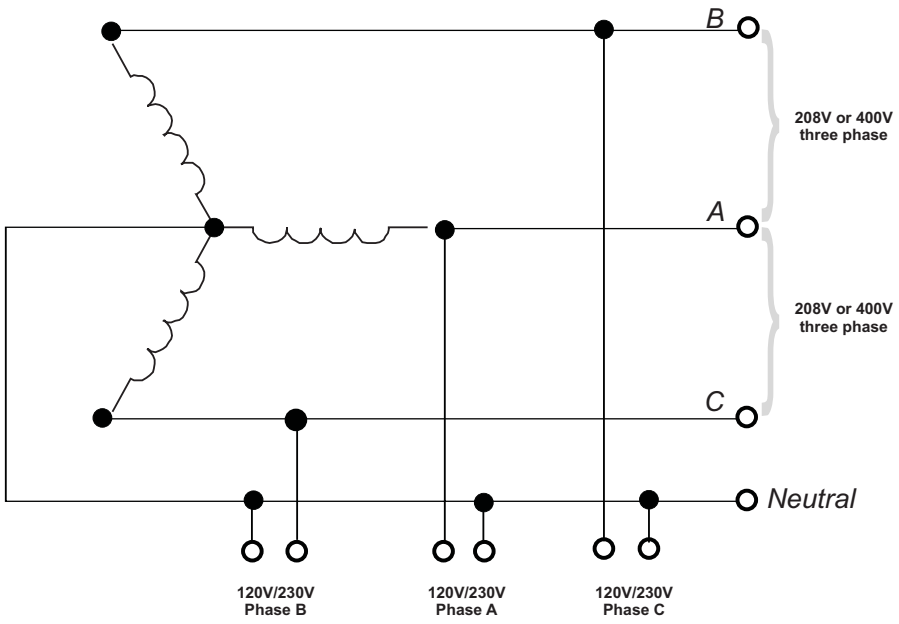
3.0 Three-Phase Theory

The heart of the system is Trace Engineering's time-proven SineWave Series inverter / charger. Custom software and interface cabling allows the three SW series inverters to produce three-phase power output in a WYE (sometimes called STAR) topology consisting of four-wires (Phase A, B, C and neutral). Two configurations are available:

120Y208 WYE 60 Hz utilizing the SW4048-3PH or SW5548-3PH inverters or

230/400 WYE 50 Hz utilizing the SW3048E-3PH or SW4548E-3PH



WYE four-wire output diagram illustrating three 120/230-volt, single phase taps and two 208/400-volt three-phase taps with neutral conductor.

Three-phase power is typically generated by an alternator or generator with a stator armature with three windings equally spaced around the circle. The three armature windings generate output voltages 120º out of phase with each other. Each of the three output lines, when paired with the neutral, provide single-phase 120/230 Vac power. Across any two of the three lines, excluding the neutral, 208/400 Vac is available. The advantage of three-phase power is more uniform and efficient distribution of power, because the total duration of peak voltage is longer than with single-phase power. In the Trace Three-Phase Power Module System, the neutral is always connected between all three of the inverters.

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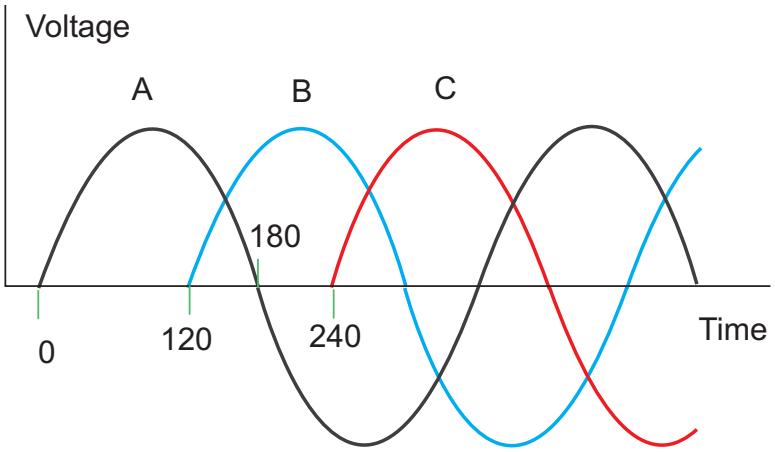
The Trace three-phase system has a standard WYE output of 120/208 Vac, 60 Hz (230/400 Vac, 50Hz for export models). A standard four wire configuration (A,B,C, and neutral) provides both three-phase legs and three legs of single-phase power. The system is designed to power large three-phase loads (pumps and compressors) and single-phase loads (coffee pots, light bulbs, etc) at the same time. Each of the three inverters may be operated at different power levels without concern of imbalance or loss of regulation. If no three-phase loads are present in the system, three-phase power is not required.

By regulating the timing of the sine-wave produced by each of the SW inverters, three-phase, four-wire, 120/208 Vac, 60 Hz (230/400 Vac, 50Hz for export models) power is produced by the Power Module system from 12, 24, or 48-volt DC energy. The special stacking interface cable allows the three inverter's to maintain the 120 degree phase difference characteristic of three phase power. The cable carries only clocking signals, the inverters remain independent of one another. No other information is communicated between the three inverters. A 'master' inverter is hardware selected via the stacking cable.

The illustration below illustrates the relationship between the three sine waves produced by the three inverters.



Typical sine-wave representation of three-phase power system.
Each sine-wave is 120° out-of-phase with the others.

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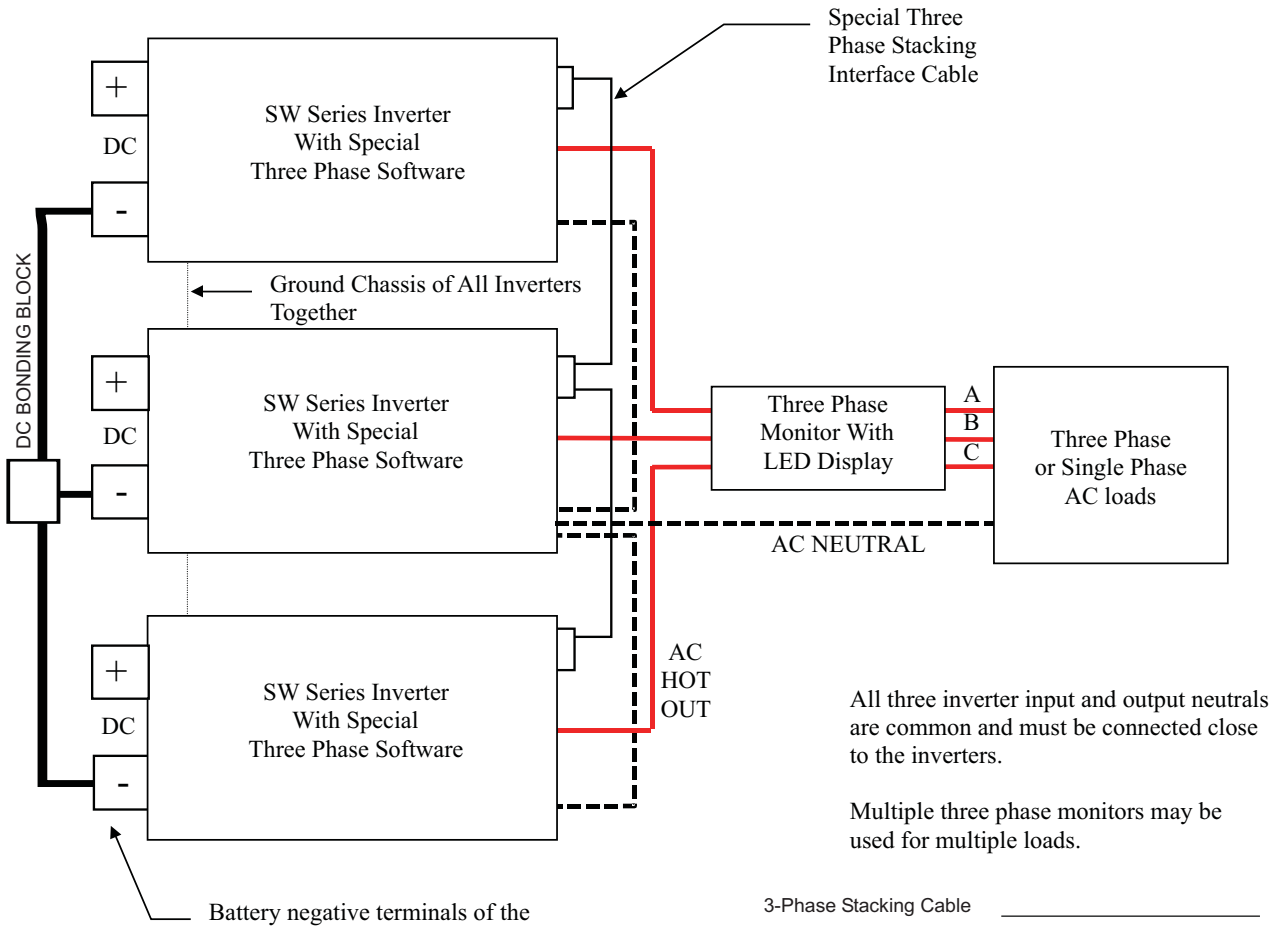
The diagram below graphically illustrates the hookup of the three-phase system. Phase A (top) inverter is always the master inverter, providing the clocking signal to which the other two inverters align at 120 degrees early or late. All of the inverter's chassis grounds must be tied together and grounded to an earth ground. Each inverter's neutral must also be connected with the others as close to the inverter as possible as it is wired.



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4.1 Fastener Description and Application

The fasteners used to assemble a Power Module are listed by their application as shown in the table below.

Table 1, Fastener Description and Application

Where Used	Trace PN	Description	Quantity
Inverter to PM	425	1/4-20 x 3/4" SS bolt	6
	468	1/4" SS flat washer	12
	2147	1/4" SS external star washer	12
	444	1/4-20 SS hex nut	6
PM-FEET	3191	#10-24 x 1" SS carriage bolt	14
	485	1/4" SS internal star washer	14
	442	#10-24 SS hex nut	14
	465	#10 SS flat washer	14
PMO-ADD	3190	#10-24 x 1/2" SS carriage bolt	14
	485	1/4" SS internal star washer	14
	2147	1/4" SS external star washer	14
	465	#10 SS flat washer	14
	442	#10-24 SS hex nut	14
PM-LID	3191	#10-24 x 1" SS carriage bolt	6
	485	1/4" SS internal star washer	6
	2147	1/4" SS external star washer	6
	465	#10 SS flat washer	6
	3329	#10-24 SS wingnut	6

Table 2, Fastener Torque Values

Trace PN	Description	Torque value
3190	#10-24 x 1/2" SS carriage bolt	25 in-lbs
3191	#10-24 x 1" SS carriage bolt	25 in-lbs
465	#10 SS flat washer	N/A
442	#10-24 SS hex nut	25 in-lbs
3329	#10-24 SS wingnut	Finger tight
425	1/4-20 x 3/4" SS cap screw	80 in-lbs
468	1/4" SS flat washer	N/A
485	1/4" SS internal star washer	N/A
2147	1/4" SS external star washer	N/A
444	1/4-20 SS hex nut	80 in-lbs

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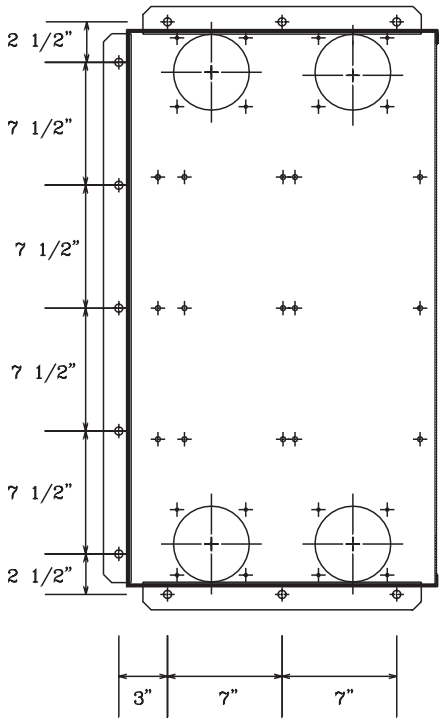
4.2 Mounting Guidelines

When installing the system, take time to consider the weight bearing capabilities of the mounting location. Bases such as wood and secondary floors may not handle the weight. Local and national codes regarding structural de-ratings for earthquakes, fatigue, etc. may affect the ability to safely mount the system without modification to existing structures. If in doubt as to the integrity of the mounting location, consult a certified structural engineer.

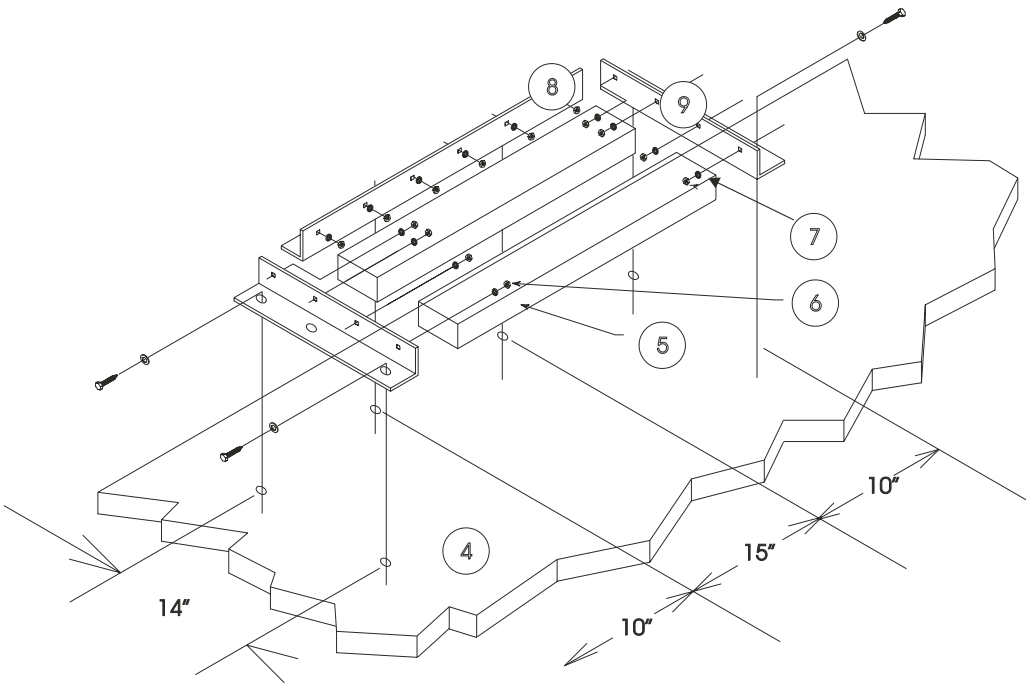
4.2.1 Base Mounting Instructions

1. Use a 4” concrete slab or treated 4x4 timbers supported by a gravel base as a pad upon which to mount the modules. If the PM will be mounted outdoors, insure that there is adequate drainage or install a perforated pipe in gravel around the pad leading to a drain field. Be sure that the slab or base is strong enough to support the total weight of the modules and prevent the modules from being overturned. Special consideration should be given to flooding and earthquake prone installations. It may be necessary to raise the modules or to fasten them to a supporting wall.

2. Mount Feet to the bottom of the module using 3190, 485, 465 and 44 fasteners.



Base Mounting Pattern



3. Using the mounted feet as a template, mark six holes for the lag bolts in the concrete or wood platform. A minimum of two bolts should be located on each foot. Alternatively, layout the holes according to the plan shown here.

Typical Module Base Assembly Pattern

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4.2.2 External-Tooth Star Washers

External tooth star washers have a sharp side and a dull side. The sharp side must be placed against the mounting surface in all cases. This assures that the washer breaks through the powder coating and makes a good ground with the chassis.

4.3 Module Assembly Instructions

Perform the instructions that follow in the order presented to assembly the three modules into a single system.

4.3.1 Mount Phase C Module

Mount Phase C inverter into Phase C enclosure **prior** to securing the module to the pad or platform. This is necessary because the space below the module is inadequate to allow tightening the fasteners. Phase C module includes only the inverter, FEET, two BLANKs, a door and four screens. Secure the inverter to the enclosure through the six holes on the inverter mounting flanges. Through each hole place bolt #425, with an external tooth star washer #2147 under the head. On the underside place star washer #2147, and secure with nut #444. Once all six fasteners are in place, torque to 80 inch-pounds. See fastener assembly diagram on the following page.

Phase C Enclosure with SW Inverter Installed

4.3.2 Mount Phase C Module to Floor, Pad, or Platform.

Phase B Module Installed atop Phase C Module

With the inverter in place and all inverter bolts torqued down, mount the Phase C module to the pad or platform. Use a minimum of ½" diameter bolts or lag screws through all holes of the mounting flanges on the module. Do NOT leave the base enclosure unsecured! This can lead to overturning and damaging valuable equipment. Use only mounting hardware appropriate to the mounting scheme.

4.3.3 Mount Phase B Module atop Phase C Module

Phase B module is labeled with a decal on the front edge of the platform. Phase B module include the bypass breakers (IOX60) for both Phase B inverter and Phase C inverter and associated AC cables. Optional

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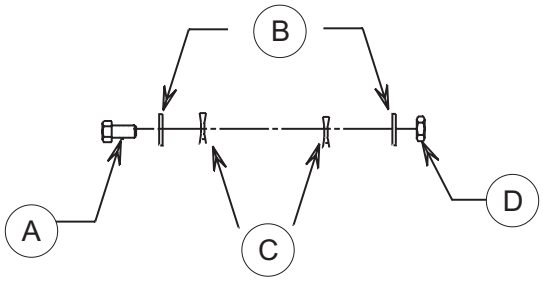
PV array DC breakers, additional AC breakers, charge controllers, or other equipment may also be mounted in the Phase B module.

Step 1: Place Phase B enclosure over the top rim of the Phase C enclosure. Note that the top edge of the bottom enclosure has a flange that mate with the base of the enclosure above it.

Step 2: Bolt the modules together with 14 each #3190 carriage bolts (A) through the 14 square holes around the bottom perimeter of Phase B module. The head of the bolt must be on the *outside* of the enclosure for security. Under the head place a #465 flat washer (B), followed by an #485 internal tooth star washer (C). Secure the bolt from inside the enclosure with a #2147 external tooth star washer (C), then #465 flat washer (B), and #3192 nut (D). Torque to 25 inch-pounds.



Module Fastener Sequence Diagram.
Module goes between C left and C right

4.3.4 Route Phase C AC Wiring

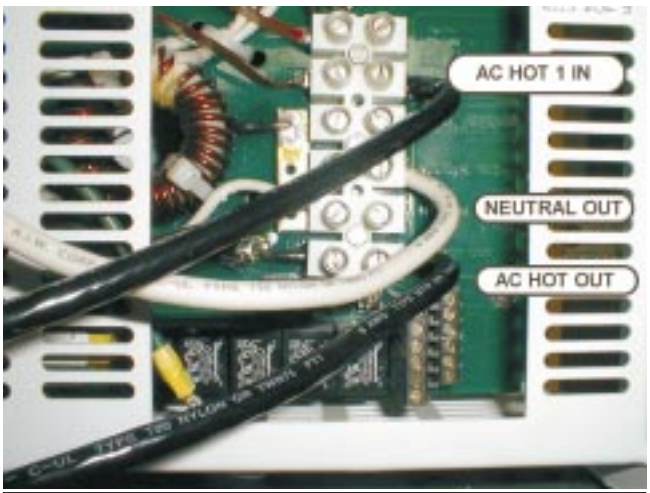
The Phase C module bypass breaker set is located in the Phase B module and clearly labeled “Phase C.” A long, blue 6 AWG THHN cable is inserted into the bottom of the center breaker of this breaker set. Route this cable, and the cable adjacent to its left, down through the wire alley in the left front of the enclosure to the AC wiring block of the Phase C inverter. Insert this cable into the connector labeled “AC HOT 1 In” on the wiring block and secure. The adjacent long, blue #6 AWG THHN cable is labeled “AC HOT OUT.” Insert this cable into the connector labeled “AC Hot Out” on the AC wiring block of the Phase C inverter and tighten to 12 inch-pounds.

Phase B Bypass Breakers

4.3.5 Mount Phase B Inverter

Mount the Phase B inverter on the floor of the Phase B enclosure.

4.3.6 Connect Phase B AC Cabling



Sinewave Inverter AC Terminal Board

The Phase B module bypass breaker set is also located in the Phase B module and clearly labeled “Phase B.” A Red # 6 AWG THHN cable is inserted into the bottom of the center breaker of this breaker set. Insert this cable into the connector labeled “AC HOT 1 In” on the AC wiring block of the Phase B inverter and tighten to 12 inch-pounds.

The adjacent Red #6 AWG THHN cable is labeled “AC HOT OUT.” Insert this cable into the connector labeled “AC Hot Out” on the AC wiring block of the Phase B inverter and tighten to 12 inch-pounds.

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4.3.7 Mount the Phase A Module on top of the Phase B module

Secure with all 14 fasteners.

4.3.8 Route AC Neutral Cabling

Neutral Bonding Block

The Phase A module also contains the AC Neutral and Ground bonding blocks. Three, white 6 AWG THHN AC cables are pre-cut and attached to the neutral bonding block. Route the longest of these white cables through the cable alley at the rear of the Phase A and Phase B modules to the AC connector marked “NEUTRAL OUT” on the Phase C inverter and tighten to 12 inch-pounds.

Route the next longest white cable through the same cable ally to the AC connector marked “NEUTRAL OUT” on the Phase B inverter and tighten to 12 inch-pounds.

Route the shortest white cable to from the neutral bonding block to the AC connector marked “NEUTRAL OUT” on the Phase A inverter and tighten to 12 inch-pounds when the inverter is in place.

The neutral line from the external AC source is connected to the top of this neutral bonding block. The neutral is usually bonded to the ground bus bar within the AC distribution panel. If a distribution panel is not used, tie the neutral to an earth ground bar.

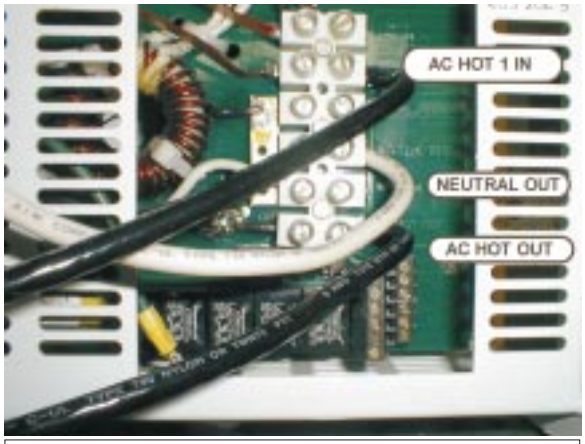
AC Bypass and Load Breaker

4.3.9 Route DC Cabling

Route all DC cables through the large hole in the back right corners of the Phase A and B enclosures for the correct inverters.

4.3.10 Route AC & DC Ground Cabling

Connect an 8 AWG grounding conductor from the AC Ground Bonding Bar (shown at right) to the ground bus in your AC distribution panel. This will provide the chassis ground for all components bonded to the enclosures, including the inverters. Connect a 2 AWG conductor between DC bonding block (DCBB) and an earth ground rod.



Sinewave Inverter AC Terminal Board

4.3.11 Route Phase B and Cabling

Route Phase B and C interconnect wires from the 3-phase load breaker to the Phase B and C bypass breakers and connect to each bypass breaker.

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4.3.12 Mount Phase A Inverter

Mount the Phase A inverter on the floor of the Phase A enclosure.

4.3.13 Connect Phase A AC Cabling

The AC bypass breaker for the Phase A inverter is mounted in the left side-panel of the Phase A module. Two black 6 AWG THHN AC cables are attached to the bottom of the bypass breaker. Route the cable attached to the bottom of the center breaker to the AC connector on Phase A inverter marked “AC HOT 1 IN. “ Torque to 12 inch-pounds.

Route the remaining loose cable attached to the bottom of this bypass breaker to the AC connector on Phase A inverter marked “AC HOT OUT.” Torque to 12 inch-pounds.

Route the remaining loose neutral cable to the Phase A inverter.

4.3.14 Connect DC Cabling

a) Do NOT place anything between the battery cable ring terminal and the inverter battery terminal. The ring terminal must lay flat against the inverter terminal in order to achieve maximum contact area.

b) Do NOT cover the terminal connection with anti-corrosive compound until AFTER the cabling is torqued down.

c) Do use the plastic red and black terminal covers that are shipped with each inverter. These help prevent accidental shorting of the battery terminals while servicing the inverters. Install covers after final torque check.

d) Tape the inverter positive and negative cables together every six inches for each inverter to reduce the cable’s inductance. See Trace Tech-notes #8 for more on battery cable inductance.

Step 1: On the right side of the Phase A (top) enclosure, locate the DC battery negative (-) cables, which are bolted to the DC negative bonding block (DCBB). The three cables differ in length only, and have a black heat shrink tube around the ring terminal end. The end opposite the ring terminal is connected to a DC shunt.

Step 2: The shortest battery negative cable remains in the Phase A enclosure. Connect it to the negative (black) terminal on the Phase A inverter.

Step 3: The mid-length cable must be routed through the large hole in the back right corner of the Phase A enclosure, directly below the shunt. This cable will end in the Phase B (middle) enclosure. Connect it to the negative (black) DC terminal on the Phase A inverter.

Step 4: The longest battery negative cable should be routed through the same hole in the Phase A enclosure, straight down through the Phase B enclosure and end in the bottom (Phase C) enclosure. Connect it to the negative (black) DC terminal on the Phase C inverter.

Step 5: In the Phase A enclosure, locate the battery positive (+) cables. These are connected to the DC250 DC circuit breakers mounted in the Phase A module and have RED heat shrink tubing near the ring terminal end. The other end of each is wired into the bottom of the DC disconnect (breaker).

Step 6: Route the longest of the three battery positive cables from the Phase A enclosure through the large holes located in the back right corner of the Phase A and Phase B enclosures and into the

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Phase C enclosure. Connect this cable to the DC positive (red) terminal on the Phase C inverter and tighten

Step 7: The mid-length battery positive should be routed in a similar fashion into the Phase B enclosure. Connect this terminal to the DC positive (red) terminal on the Phase B inverter and tighten.

Step 8: The shortest positive cable remains in the Phase A enclosure. Connect this cable to the DC positive (red) terminal on the Phase A inverter and tighten. When connecting the battery cables use the following guidelines:

SW Battery Terminals

4.3.15 Connect the 3 Phase Interface Cable

The three-phase interface cable connects between the serial data ports of the inverter. The cable connectors are keyed and so chances of mis-connection are greatly reduced. Working from top to bottom, connect the interface cable to all three inverters. The ends of the cable connect to the top and bottom inverters, and the middle connection goes to the Phase B , or middle inverter. Notice the cable ends are labeled A, B, and C. *'A'* goes to the top (Phase A) inverter, *'B'* to the middle (Phase B) inverter, and end *'C'* to the bottom (Phase C) inverter. Use a small flat blade screwdriver to secure the connectors to the inverter by tightening the two small screws on each connector.

4.3.16 Connect AC and DC Sources to the System

Before making connection of the AC and DC sources to the three phase systems perform the following checks:

- ✓ All DC wiring properly connected, torqued, and protected
- ✓ All AC wiring properly connected, torqued, and protected
- ✓ 3-phase interface cable in place and properly connected
- ✓ All wiring to and from bonding blocks, terminal blocks, and circuit breakers torqued and connected properly
- ✓ DC breakers (disconnects) in *OFF* position (down)
- ✓ Inverter by-pass breakers in *BY-PASS* position
- ✓ 3 phase output breaker in *OFF* position (down)

When all of the above items are verified as being correct proceed with the next section. If discrepancies are found, correct them before proceeding with the AC and DC source connection.

4.4 Battery Cabling

The model and power output of the inverter are the starting point for determining battery cable gauge. The following continuous DC current draws apply:

Within the NEC code, tables 310-16 and 310-17 define the minimum wire size required to carry a certain number of amps (ampacity). Table 310-16 derates the cable to account for heating effects due to conduit or raceway enclosure, while table 310-17 defines ampacities for cabling in free air.

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Attempting to save a few dollars by installing the minimum size cable is not recommended, disappointing system performance will be the most probable result.

DC Bonding Block

4.4.1 Inter-Battery Connection

In order to avoid excessively large cabling for battery inter-tie, use appropriately sized copper bus bars.

4.4.2 Connection of DC Source (Batteries) to the 3 phase system

Battery Negative (-) Connection

Using properly sized cable and appropriate terminals (5/16" hole), connect the negative conductors from the battery bank(s) to the system at the right side of the negative shunt. The shunt is located in the back right corner of the top (Phase A) enclosure. Use multiple negative conductors to assure adequate ampacity.

Battery Disconnects

The alternative is an excessively large gauge cable that will be both difficult to manipulate and difficult to connect to the system.

As a generalization (Refer to NEC and local codes for proper cable sizing), #4/0 AWG should be sufficient for all installations.

Battery Positive (+) Connection

Before connecting the battery positive cables, confirm that all three DC disconnects are in the *OFF* position. Route a #4/0 AWG cable from the battery bank(s) to each DC disconnect. Strip the cable 1" on the end that will connect to the breaker. The other end of the cable should be terminated appropriate to the battery bank installation used.

4.4.3 Install battery temp sensors

Install all the battery temp sensors on one battery in the middle of the battery bank.

4.5 Connection of AC Sources

3 Phase Sources with WYE (Star) Output Configurations

Consult the owner's manual for the AC source you will be using to determine if the source has a WYE or DELTA output configuration. If the source is a DELTA output, proceed to the area of this section titled "*3 Phase Sources with DELTA Output Configurations."* If the source has a WYE output configuration, perform steps 1 through 4 for interconnection:

Step 1: Wire the *'A'* leg from the source to the top middle position of the inverter/bypass breaker in Phase A module. The stickers above the breaker also show the proper position, *'From AC Utility or Generator Hot Out'*.

Step 2: Wire the *'B'* leg from the source to the top middle position of the Phase B inverter/bypass breaker in Phase B module.

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Step 3: Wire the *'C'* leg from the source to the top middle position of the Phase C inverter/bypass breaker in Phase B module.

Step 4: Wire the source neutral leg to the isolated neutral block in Phase A module.

3 Phase Sources with DELTA Output Configurations

This Trace Engineering three-phase system is designed only to work with WYE configured three-phase systems. Some three-phase generators offer both DELTA or WYE outputs. Consult the generator owner's manual for information about your specific generator's output configuration.

If the AC source that is intended to supply the inverter/charger system is DELTA type output only, a DELTA to WYE transformer will be necessary. Consult the AC source manufacturer for options on converting the output configuration of the source.

Connection to 3-Phase Distribution Box

Output from the three-phase system is from the top of the three-phase breaker in the Phase A module. This is where the connection to the distribution box should be made. Single-phase power will be available through the distribution box once wired. Be sure to adhere to all National and Local electrical codes when wiring the output to the distribution system.

4.6 Install Top Cover, Weather Seal, and Front Doors

Step 1: Install the white top cover by placing it over the top edge of the Phase A enclosure. The enclosure edges will fit inside the top cover flange.

Step 2: Secure the top cover to the Phase A enclosure with six #3191 carriage bolts. Beneath the head of the bolts place a #485 star washer, insert the carriage bolts through the hole in the lid and top edge of the enclosure, and secure from inside the enclosure with #2147external tooth star washers (against enclosure) followed by a #465 flat washers and #3329 wing nuts. Tighten finger tight.

Step3: Using the single sided, self adhesive weather seal provided, run two complete vertical strips from top to bottom down both sides of all three enclosures.

Step 4: Next, run weather seal horizontally from one side to the other across all three inverter shelves.

Step 5: Using a razor knife, cut a small 'X' over the screw heads protruding into the weather seal down the sides of the enclosure. This provides some relief to assure the weather seal will not obstruct the doors closing.

Door Installation

Three doors are provided each with two ½ turn fasteners on either side. The doors are pivoted and seal by fitting the lip at the top of each door under the structure above the door (either the shelf above or the top cover).

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It is easiest to install the doors by starting with the bottom door (Phase C enclosure). Fit the lip at the top of the door under the inverter shelf of the Phase B enclosure. Push in on the bottom front of the door once in place and secure the ½ turn fasteners with a flat blade screwdriver.

Repeat for the middle and top doors.

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5.0 Operation of the System

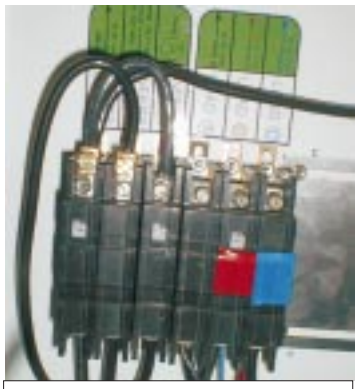
For detailed operating instructions for the SW series inverter/chargers,the 3-phase monitor, and the SWCA communications adaptor, refer to the respective owner's manuals included with the system.

5.1 Breakers and Disconnects

The Three-Phase Power Module system includes a 60-amp, 3-phase circuit breaker disconnect; an inverter input/output/bypass breaker gang for each inverter; a 250-amp DC circuit breaker disconnect for each inverter; and a DC breaker for each optional C-Series controller.

5.1.1 Three Phase Breaker

Located on the left side of the Phase A (top) enclosure is a three pole, 60 amp AC rated breaker. Placing this breaker in the 'OFF' position prevents three phase power from reaching the loads. This breaker is designed to protect the three phase output wiring.



3-Phase AC breaker shown to right of DC breakers.

5.1.2 Inverter/By-pass Breaker

A total of three inverter/by-pass breakers exist on the power module enclosures.

In the 'BY-PASS' position, AC source power is routed around the inverter. This allows continued operation of AC loads from an outside AC source (e.g. - a generator) while servicing any or all of the three inverter chargers.

When in the 'INVERTER' position, the outside AC power will 'pass through' the inverter on the way to the loads. The 'INVERTER' position is used during normal system operation.

5.1.3 DC Disconnects

One DC disconnect is provided in the positive battery cable to each inverter. When tripped or in the 'OFF' position DC power is not provided to the inverter and it does not operate.

5.2 Source Wiring Test.

Perform the following steps to verify proper wiring from the AC source. This is especially important for "phase sensitive" loads such as three-phase motors that drive devices that can be damaged from reverse.

1. Turn the inverters Off and disconnect DC power. This will verify that the load's wiring and operation is fully functional without the inverter being electrically connected.

2. Throw the three-phase breaker Off.

3. Place all three inverter by-pass breakers in the 'BY-PASS' position to allow power to go directly from the AC source to the load breaker.

4. Apply power from the source and verify proper voltages on the line side of the load breaker and check for proper operation of the "Motor-Saver" monitor. If an error of "rP" is displayed on the

Motor-Saver LED screen, this is an indication of a "Reversed Phase" condition and source wiring will need to be corrected. Refer to the Motor-Saver documentation for additional information.

5. If there are no errors displayed on the Motor-Saver and voltages are correct, proceed to test that the load is properly connected to the load breaker. Verify that there are no devices that can be damaged by incorrect motor rotation. Determine where you can isolate the motors in the load and do a momentary motor rotation test to verify correct motor rotation. Correct any wiring errors on the load side as required.

6. If there are no motor rotation problems, proceed to verify operation of the entire load.

7. If no problems are found with running the load, shut down the load and turn off the three-phase breaker on the PM.

5.2 Power up sequence for normal operation with inverter power.

1. Turn all AC sources Off.

2. Turn the three-phase breaker to the Off position to isolate the load.

3. Switch all three by-pass breakers to the normal operation position.

4. Turn each inverter's DC disconnect switch On one at a time to verify that each inverter does a proper startup.

5. Turn each inverter On.

6. Verify all phase-to-phase voltages and each phase-to-neutral voltage.

7. Confirm normal operation of all three inverters via the three-phase monitor. If everything is ok, proceed to step 8, otherwise, stop and determine the problem before proceeding.

8. Initiate the AC source and confirm that the AC HOT IN light is blinking and goes solid when it synchronizes. (This may take 10 to 30 seconds for the source to synchronize.) Disconnect the AC source after verifying proper transfer and operation.

9. Configure the inverters as necessary.

10. Switch the three-phase breaker to the ON position and verify the proper operation of the load on battery power.

11. Reconnect the AC source and verify proper operation and charging of the batteries.

5.3 Power Down Sequence

This procedure provides a safe shutdown for servicing.

Step 1: Switch the 60 amp 3 phase breaker to the 'OFF' postion.

Step 2: Switch all 3 inverter by-pass breakers to the 'BY-PASS' position

Step 3: Switch the DC disconnect breakers to the 'OFF' position.

Step 4: Shutdown or disconnect the AC source if necessary for safety (recommended)

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