



# A31

## DC TO AC

## SINE WAVE INVERTER

ECN/DATE

CPN40966

	16816 - 09/05	15884 - 4/03	14575 - 2/01
18601 - 03/10	16651 - 01/05	15349-05 - 6/02	13608 - 1/00

106 BRADROCK DRIVE  
DES PLAINES, IL. 60018  
(847) 299-1188  
FAX: (847) 299-3061

ISSUE DATE: 12266 - 8/98

INSTRUCTION DRAWING NUMBER:

P25-**LA31STD-1**

## IMPORTANT SAFETY INSTRUCTIONS

1. **SAVE THESE INSTRUCTIONS.** This manual contains important safety and operating instructions. Before using this equipment, read all instructions and cautionary markings on (1) unit, (2) battery, and (3) product using the battery.
2. **CAUTION:** To reduce risk of injury and/or damage to the batteries, use only the type of batteries specified on the charger nameplate.
3. Do not expose equipment to rain or snow.
4. Do not operate equipment if it has received a sharp blow, been dropped, or otherwise damaged in any way; take it to a qualified serviceman.
5. Do not disassemble this unit; take it to a qualified serviceman when service or repair is required. Incorrect re-assembly may result in a risk of electric shock or fire.
6. To reduce risk of electric shock, disconnect this unit from the AC supply, batteries and loads before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.
7. **WARNING – RISK OF EXPLOSIVE GASES**
  - a. Working in the vicinity of a battery is dangerous. Some batteries generate explosive gases during normal battery operation. For this reason, it is of utmost importance that each time before using this unit, you read this manual and follow the instructions
  - b. To reduce risk of battery explosion, follow these instructions and those published by the battery manufacturer and manufacturer of any equipment you intend to use in the vicinity of the battery. Review cautionary marking on all products.
8. **PERSONAL PRECAUTIONS:**
  - a. Someone should be within range of your voice or close enough to come to your aid when you work near a battery.
  - b. Have plenty of fresh water and soap nearby in case the battery electrolyte contacts skin, clothing, or eyes.
  - c. Wear complete eye protection and clothing protection. Avoid touching eyes while working near a battery.
  - d. If the battery electrolyte contacts skin or clothing, wash immediately with soap and water. If the electrolyte enters the eye, immediately flood the eye with running cold water for at least ten (10) minutes and get medical attention immediately.
  - e. Never smoke or allow a spark or flame in vicinity of a battery.
  - f. Be extra cautious, DO NOT drop metal onto a battery. It might spark or short-circuit the battery or cause an explosion.
  - g. Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a battery. A battery can produce a short-circuit current high enough to weld these items causing severe burns.
  - h. NEVER charge a frozen battery.
  - i. Do not use battery charger for charging dry-cell batteries that are commonly used with home appliances. These batteries may burst and cause injury to person or damage to property.
9. **PREPARING TO CHARGE**
  - a. If it is necessary to remove the battery connections, always remove grounded terminal from the battery first. Make sure all loads are disconnected and unit is off, so as not to cause an arc.
  - b. Be sure the area around the battery is well ventilated while the battery is being charged.
  - c. When cleaning battery terminals, be careful to keep corrosion from coming in contact with eyes.
  - d. Study all the battery manufacturer's specific precautions such as removing or not removing cell caps while charging, recommended rates of charge, and maintenance procedures.
  - e. Follow the battery manufacturer's recharging instructions.
10. **UNIT LOCATION**
  - a. Never place this unit directly above the standard flooded battery. Gases from the battery will corrode and damage equipment. A sealed maintenance free or valve regulated lead acid (VRLA) may be placed below this equipment.
  - b. Never allow the battery electrolyte to drip on this unit when reading the specific gravity or filling the battery.
  - c. Do not operate this unit in a closed-in area or restrict ventilation in any way.
  - d. Do not set any battery on top of this unit.

### 11. D.C. CONNECTION PRECAUTIONS

Connect and disconnect DC output cables only after setting all of this unit's switches to off position and removing AC input supply. Do not pull on output cables when disconnecting charger from battery.

### 12. GROUNDING INSTRUCTIONS

This battery charger should be connected to a grounded, metal, permanent wiring system; or an equipment grounding conductor should be run with circuit conductors and connected to equipment-grounding terminal or lead on battery charger. Connections to battery should comply with all local codes and ordinances.

## RECEIVING INSTRUCTIONS AND GENERAL EQUIPMENT INFORMATION

**CAUTION: To ensure safe installation and operation, the information given in the instruction manual should be read and understood before installing or using the equipment.**

### RECEIVING INSTRUCTIONS

Unpacking and Inspection: Examine the shipping crate upon arrival. If there is obvious damage, describe on the receiving documents. Within a few days after delivery, the equipment should be uncrated and carefully inspected for hidden damages. When removing packaging material, be careful not to discard any equipment, parts, or manuals. If any damage is detected you should:

1. File a claim with the carrier within five (5) days.
2. Send a copy of the claim to La Marche Mfg. Co.
3. Call La Marche Mfg. For a RETURN MATERIAL AUTHORIZATION NUMBER.

*Failure to properly file a claim for shipping damages, or provide a copy of the claim to La Marche Mfg., may void warranty service for any physical damages reported for repair.*

### HANDLING

***WARNING: Equipment can be very heavy, and top-heavy. Use adequate manpower or equipment for handling. Until the equipment is securely mounted, care must be used to prevent the equipment from being accidentally tipped over.***

### NOMENCLATURE PLATES

Each piece of La Marche Mfg. Equipment shipped is identified by part number on the nomenclature plate.

### ADJUSTMENTS

All equipment is shipped from the factory fully checked and adjusted. Do not make any adjustments unless the equipment has been powered-up and the settings have been determined to be incorrect.

### SPARE PARTS

To minimize downtime during installation or normal service, it is advisable to purchase spare fuses, circuit boards and other recommended components. Please refer to the list of recommended spare parts and their La Marche Mfg. Part numbers included with the instruction manual. It is recommended that spare fuses be ordered for all systems.

To order spare parts, please contact La Marche Mfg. (847)-299-1188 during business hours and ask for the Parts Department.

## **1.0 GENERAL**

The La Marche Model A31 is a transistorized DC to AC inverter designed to power an AC load.

The Model A31 will provide a sine wave output with approximately 5% total harmonic distortion into AC loads with power factors up to .8 over a wide DC input range.

The ferroresonant output transformer provides input to output isolation, output regulation, current limiting and filtering. The DC input from the battery source is switched by transistors in all solid state electronic circuitry to produce a sine wave output.

The DC input sources are sensed for low and high voltage conditions, the unit is turned off automatically if the DC input is not within the proper range.

## **2.0 OUTPUT RATINGS**

### ***2.1 OUTPUT VOLTAGE***

The Model A31 generates sinusoidal output voltage (120 volts nominal 208, 220 and 240 volts optional) into AC loads of up to a .8 lagging power factor with approximately 5% total harmonic distortion (THD). The output is rated for continuous use over the rated temperature and DC input ranges.

### ***2.2 OUTPUT CURRENT***

Measured at rated output. See chart on specification sheet.

### ***2.3 REGULATION***

Steady state output voltage remains within +4% of any input voltage within 1.75 volts/cell to 2.4 volts/cell (lead battery) for any AC load current from no load to rated output.

### ***2.4 CURRENT LIMIT***

Fixed at approximately 150 % of rated output. The ferroresonant transformer is designed to current limit under AC overload conditions.

*NOTE: Units with a transfer switch (inv. prime) will transfer the load to the alternate source when an overload condition exists.*

### ***2.5 OUTPUT FREQUENCY***

The output frequency is quartz crystal controlled to +/- .05% of the rated value. In units with line synchronization the phase displacement between the inverter output and the bypass line input are no greater than 5 electrical degrees when synchronization is established. The capture range for input synchronization signal is +/- 3 cycles of the nominal output frequency.

### ***2.6 EFFICIENCY***

Greater than 70% measured at rated output load and nominal input voltage.

### ***2.7 POWER FACTOR***

The Model A31 is capable of powering loads with power factors of .8 leading or lagging.

### ***2.8 CREST FACTOR***

Unit will remain within rated output voltage and current specifications with load current crest factors of up to 2.8.

### **2.9 MEAN TIME BETWEEN FAILURE**

The mean time between failure (MTBF) as tested per Bell Communications Standard TR-TSY-000332 is 183,000 hrs at 50 C.

## **3.0 INPUT RATINGS**

### **3.1 INPUT VOLTAGE**

The nominal DC input voltages are 24, 48 and 120 volts. The Model A31 will operate within specifications over a range of 1.75 volts/cell to 2.65 volts/cell (lead battery).

### **3.2 INPUT CURRENT**

See chart on specification sheet for input current ratings at nominal DC input voltages.

### **3.3 INPUT FILTERING (24 & 48 Vdc only)**

The input noise does not exceed 32 dbrn "C" message weighed on batteries rated at 50 ampere-hours or greater.

## **4.0 TYPICAL ELECTRICAL SPECIFICATIONS**

SEE A31 SPECIFICATION SHEET

## **5.0 FEATURES**

### **5.1 INPUT PROTECTION**

Fused DC input. A circuit breaker may be provided as an option.

### **5.2 PRE-CHARGE CIRCUIT**

See Section 8.5 - Installation and Operating Instructions.

### **5.3 OUTPUT PROTECTION**

- (a) Circuit Breaker.
- (b) Fused bypass AC line. (alternate source)
- (c) Fixed current limit at approximately 150% of rated load, at nominal DC input voltage.

### **5.4 LOW DC VOLTAGE SHUTDOWN**

A circuit provided for load protection which causes the unit to shut down should its input voltage drop below a preset value. Adjustments are provided for low voltage shutdown at 1.75 volts/cell (lead) and 1.1 volts/cell (nickel cadmium) from the factory unless other settings are specified.

### **5.5 HIGH DC VOLTAGE SHUTDOWN**

A circuit provided for load protection which causes the unit to turn off above a preset value. Adjustments are provided for high voltage shutdown at 2.65 volts/cell (lead) and 1.65 volts/cell (nickel cadmium) from the factory unless other settings are required.

### **5.6 ENCLOSURE**

Rack mounted NEMA #1 enclosure primed and painted with a bonderized ANSI #61 gray enamel.

## **6.0 OPTIONAL ACCESSORIES**

SEE A31 SPECIFICATION SHEET

## **7.0 ENVIRONMENTAL RATINGS**

### ***7.1 OPERATING AMBIENT TEMPERATURE RANGE***

0-50 degrees C (32-122 degrees F)

### ***7.2 STORAGE TEMPERATURE RANGE***

-40 degrees C to +60 degrees C (-40 degrees F to +140 degrees F)

### ***7.3 HUMIDITY***

This unit is capable of operating in an ambient relative humidity range of 0-95% (non-condensing).

### ***7.4 SHOCK***

The unit in its shipping container, withstands shock developed when one edge of the container is dropped six (6) inches while the opposite edge is resting on the ground, or if it is dropped two (2) inches on any surface no physical damage or degradation of the electrical performance will occur.

### ***7.5 VIBRATION***

The unit in its shipping container withstands vibration encountered in shipping without physical damage or degradation of the electrical performance.

### ***7.6 ALTITUDE***

This unit is capable of operation at altitudes to 3300 feet at an ambient temperature of +50 degrees C (122 degrees F) and 10,000 feet at ambient of +40 degrees C.

### ***7.7 HEAT DISSIPATION (BTU)***

***REFER TO A31 SPECIFICATION SHEET***

### ***7.8 VENTILATION REQUIREMENTS***

The unit should be mounted so that ventilating openings are not blocked and air entering the cabinet does not exceed +50 degrees C (122 degrees F). There should be at least 6" of free space around the enclosure. When two or more units, in 9E cases, are stacked, a heat baffle must be used between units.

### ***7.9 AUDIBLE NOISE***

Audible noise is not greater than 65 DBA measured at 5 feet from any surface on the unit enclosure.

## **8.0 INSTALLATION AND OPERATION INFORMATION**

### ***8.1 MINIMUM WIRE SIZES***

The AC output and the DC input minimum wire size requirements are different in each state. All National and Local wiring codes should be followed. At distances exceeding 10 feet, the DC wire size should be chosen to keep the voltage difference between the units DC input terminals and the battery at less than 1/2 volt when the unit is fully loaded. For loop lengths greater than 20 feet, larger wire should be used to control these voltage drops. The total loop length is twice the distance from the wiring point to the unit.

### ***8.2 WIRE SIZES***

These wire sizes are based on those recommended in the National Electric Code Table 310-16 for copper wire at 90 degrees C conductor temperature operating in an ambient of 30 degrees C. (For higher operating temperatures refer to the derating factors in the National Electric Code Table 310-16.)

### **8.3 FIELD GROUND TERMINAL**

This terminal should be connected to an earth ground. The size of the conductor is based on National Electric Code Table 250-95 for copper wire at 75 degrees C

### **8.4 FIELD GROUND & LINE NEUTRAL**

A jumper is supplied which connects the bypass line and the inverter output neutral together. This can be connected to field ground if local codes apply.

### **8.5 DC INPUT**

Make sure that the battery system that is being used is the same number and type of cell as the nameplate information on the inverter.

**\*\*\*OBSERVE PROPER POLARITY!\*\*\***

### **8.6 CAPACITOR PRE-CHARGE CIRCUIT (S2A-172)**

#### **(A) Capacitor pre-charge instructions when the inverter has a DC breaker called DCB and a pre-charge push button:**

Place the inverter on/off switch to the "off" position. Place the DCB to the "off" position.

The battery wires should be connected in proper polarity to the inverter input terminals. The positive battery wire should be connected to the terminal marked positive (+) and the negative battery wire should be connected to the terminal marked negative (-).

Push and hold the pre-charge button (PCB).

After the battery is connected wait approximately one (1) minute and the green LED marked "READY" should illuminate. At this time release the PCB, place the DCB to the "on" position and turn the inverter on with the DC switch (SW-1).

If the green LED "READY" does not light, check the type and number of cells of the battery to verify that it is correct.

If the red LED marked "REVERSE POLARITY" illuminates, the battery has not been installed as indicated. Disconnect the battery wires immediately or damage to the inverter may occur.

**CAUTION:** Before replacing the DC fuse or resetting the DC breaker the pre-charge instructions must be followed before restarting unit or damage to the unit may occur.

#### **(B) Capacitor pre-charge instruction when the inverter has a DC input fuse called F1 and a capacitor pre-charge connector:**

The black pre-charge connector should be inserted in the white connector, which is located inside the unit on the terminal bracket. The white connector is a dead connection. The inverter's ON/OFF switch should be in the OFF position.

The battery wires should be connected in proper polarity in the inverter input terminals. The positive battery wire should be connected to the terminal marked positive (+) and the negative battery wire should be connected to the terminal marked negative (-).

The green LED marked "READY" should illuminate after the battery is connected approximately one (1) minute. At this time, install the black pre-charge connector into the black connector. The black connector is located next to the white connector inside the unit on the terminal bracket. Turn on the inverter.

If the green LED "READY" does not light, check the type and number of cells of the battery to verify that it is correct.

If the LED marked "REVERSE POLARITY" illuminates, the battery has not been installed as indicated. Disconnect the battery wires immediately or damage to the inverter may occur.

### **8.7 AC LOAD AND AC BYPASS LINE**

A terminal strip, (TS-A), is provided for the AC load and AC bypass line, when used. Connect the AC load wires phase (hot) to the phase terminal. Connect the neutral to (N) terminal.

### **8.8 ADJUSTMENTS**

The unit is factory set. No field adjustments are necessary. If an internal setting must be changed, call the factory for more information.

### **8.9 START - UP**

***The start-up procedure will guide you on how to safely power up an A31 Inverter with or without a static switch and to confirm the utility power wiring to the inverter.***

#### ***(INVERTER PRIME)***

If the inverter has a 1 millisecond static switch, **Option codes 22P or 22S**, it will have a S2A-239A circuit board.

After the pre-charge instructions are complete, turn on the AC output breaker of the inverter.

The LED's on the front door should do a blink sequence and the "LOAD ON" prime LED and the "INVERTER AVAILABLE" LED should light. Turn on the bypass source. (Utility).

The "PHASE-LOCK" LED, "UTILITY AVAILABLE" LED, "INVERTER AVAILABLE" LED AND "LOAD ON PREFERRED SOURCE" LED should be lit. The re-transfer switch should be in the auto position. Confirm the output voltage at the load terminals.

#### ***(INVERTER STANDBY)***

If the inverter has a 1 millisecond static switch, **Option codes 22P or 22S**, it will have a S2A-239A circuit board.

After the pre-charge instructions are complete, turn on the AC output breaker of the inverter.

The LED's on the front door should do a blink sequence and the "LOAD ON ALTERNATE" LED and the "INVERTER AVAILABLE" LED should light.

Turn on the bypass source (Utility). The "UTILITY" LED, the "LOAD ON PREFERRED SOURCE" and the "PHASE LOCK" LED should light. The re-transfer switch should be in the auto position.

To confirm settings the customer cal mode may be entered by holding the select switch (SW1 on the 239A board, SW1 on the 240 board) in the up position for 5 continuous seconds. Upon entry the display will show "CAL". The calibration mode works such that the software will execute each calibration task in a predefined sequence advancing to the next calibration setting only when the operator toggles the transfer mode switch. **Refer to the 22P/22S Static Switch (P25-DSSS-1) specification sheet included in manual.**

If the inverter has a 20 millisecond static switch, **Option codes 164 or 165**, it will have printed circuit board S2A-139A. Turn on the alternate source (bypass). The "BYPASS AVAILABLE" LED and "LOAD ON BYPASS" LED should be lit. The "INVERTER AVAILABLE" LED should be "OFF". Turn on the AC output breaker of the inverter. Confirm the output voltage at the load terminals.

If the inverter does not have any static switch, after confirming that there is no voltage on the load terminals, then turn on the AC output breaker of the inverter. Confirm the output voltage of the inverter at the load terminals.

Once the inverter start-up has been completed it does not matter if you turn the inverter or utility (bypass) on first because the wiring has been tested.

## **9.0 CIRCUIT BOARD DESCRIPTIONS**

### ***9.1 REVERSE POLARITY P.C. BOARDS (S2A-172)***

This p.c. boards consists of two LED's. RED LED for reverse polarity. GREEN for ready. When using the capacitor pre-charge bar, it allows the customer to see if the batteries (DC input) is being hooked up correctly.

### ***9.2 A31 OSCILLATOR/LINE SYNC. (S2A-167)***

This printed circuit board includes the DC input voltage sensing circuitry and oscillator circuits.

When the DC input voltage is above 2 volts per cell it allows the circuitry to operate, sending the correct signals to the drive/snubber printed circuit board. (S2A-165) Should the DC input voltage fall below 1.75 volts per cell, the sending circuit will turn off the inverter and inhibit any output. This prevents the battery from being overly discharged when the inverter is being operated solely from the battery.

The line synchronization circuit provides output frequency control of the inverter. When a bypass line is available it compares the frequency and phase relationship of the bypass line and inverter output.

This circuit consists of a phase locked loop and voltage controlled oscillator. If the inverter output is not in phase with the bypass line the oscillator frequency is "pulled" lightly to correct the inverter's output until a condition of near zero phase difference is established between the two sources. This circuit provides the necessary frequency and phase stability to operate a static output transfer switch.

The phase locked loop circuitry will accept bypass line frequencies of about 3 cycles higher or lower than the inverter rated output frequency. If the bypass line frequency, for instance, was at 50 Hz, the unit output frequency would go down to about 57 Hz but no further. If the bypass line frequency was at 70 Hz, the unit output frequency would go up to about 63 Hz but no further. Within the range of 57-63 Hz, the inverter output frequency will track the bypass line.

Without a bypass line connected, or during a bypass line failure, an internal quartz crystal clock generates the time base for the oscillator and controls the output frequency to about +/- .05% of the rate

The settings for low and high DC voltage shutdown are on this printed circuit board. Consult factory if settings are going to be adjusted.

There are also three LED's on this board: "PHASE LOCK", "LOW" and "HIGH" DC VOLTAGE ALARM LED's.

### ***9.3 A31 DRIVE/SNUBBER PRINTED CIRCUIT BOARD (S2A-165) (Used with BI-Polar Transistor Modules)***

This printed circuit board receives signals from the oscillator/line sync. printed circuit board, (S2A-167). These signals are then conditioned & stepped down in the S2A-165 assembly. The assembly also contains the power transistor snubber circuits. The S2A-165 then sends voltage signals to the transistor modules firing them.

### ***9.4 A31 IGBT DRIVER BOARD (S2A-297 or S2A-306) (Used with IGBT Transistors)***

A31 IGBT Drive Board receives the signals from the oscillator/line sync. printed board (S2A-167). These signals are amplified and converted to signals, which are able to drive IGBT modules.

The S2A-297-0101 and S2A-306-0101 boards contain housekeeping power supplies which supply the power to S2A-297-0201, S2A-306-0201 and S2A-167 boards.

The amplitude of the IGBT gate driving signal is 20V P-P (-5V to +15V PEAK)

The IGBT Printed Circuit Boards are mounted on the top of the two IGBT modules.

## **10.0. TROUBLESHOOTING**

### ***10.1 GENERAL INFORMATION***

This troubleshooting guide is intended for use only by trained service personnel or experience electricians.

**CAUTION: HAZARDOUS AC AND DC VOLTAGES ARE PRESENT IN THE UNIT!**

### ***10.2 PRELIMINARY CHECKS***

Before proceeding with any testing or trouble shooting, give the unit a general inspection.

- Check for the following:
- Check for shipping damage, loose connections, broken wires, etc.
- Check the DC input cables to make sure they are proper polarity and secure. The DC voltage input must be above 2 volts per cell (lead acid) and 1.3 volts per cell (nickel cadmium).
- Check the bypass line connections to make sure they are proper & secure. The total load must not exceed the nameplate rating.

### ***10.3 QUICK CHECK TROUBLE ANALYSIS***

#### ***SYMPTOM / POSSIBLE CAUSE***

#### **INPUT FUSE OR OPTIONAL DC BREAKER TRIPS.**

- A. Capacitor pre-charge circuitry improperly being used.
- B. Shorted C1, C2 or C4 Capacitor.
- C. Defective A31 oscillator/line sync. printed circuit board (S2A-167)
- D. Defective A31 drive/snubber printed circuit board S2A-165 for BI-Polar Transistor Module Only or S2A-297 or S2A-306 card for IGBT Module.
- E. Defective transistor module or IGBT Module
- F. Shorted wiring.

#### **OUTPUT AC BREAKER TRIPPED**

- A. Overload condition.
- B. Shorted equipment or component on the AC output.
- C. Defective breaker.
- D. Shorted SCR's in static switch.

#### **LOCKOUT (no AC output)**

- A. Defective AC breaker.
- B. Defective input fuse or optional DC breaker tripped.
- C. No or low DC voltage input.
- D. Broken wire.
- E. Shorted or open C1 capacitor.
- F. Low or high DC voltage shutdown set improperly.
- G. Open F2 Fuse
- H. Open fuses on S2A-165 or S2A-167 printed circuit boards or an open fuse on the S2A-297 or S2A-306 circuit board.
- I. Shorted C4 fuse.

## F2 FUSE CLEARS

Defective A31 Oscillator/line sync. printed circuit board. (S2A-167)

## F3 FUSE CLEARS

- A. AC bypass line, overload condition.
- B. Shorted SCR's on static switch.

## "READY" LED FOR THE PRE-CHARGE CIRCUITRY NOT LIGHTING

- A. Defective C2 capacitor.
- B. Bad LED.
- C. Bad connection to the S2A-172 Printed circuit board.
- D. No or low DC voltage input.
- E. ON/OFF switch in "ON" position.
- F. Shorted transistor modules.
- G. Shorted (C4) cap.
- H. Open pre-charge resistor.

## UNITS' AC LOAD CONTROLLED BY WRONG POWER SOURCE.

- A. Defective SCR module.
- B. Defective electric transfer switch.
- C. Defective static switch.
- D. Dip switches set incorrectly on S2A-160 printed circuit board
- E. Overload on prime source.

### **10.4 VOLTAGE TEST POINTS**

Equipment Required:

**DUAL TRACE OSCILLOSCOPE**

**Standard VOM**

## **A31 Oscillator/Line sync. printed circuit board (S2A-167)**

- A. DIPswitch 1,2,3, 4 must be in the open position.

### **B.1 Transistor Module Only**

TS-1 from pin numbers 3 and 4, the two square waveforms must be zero to approximately 80 volt positive peaks (dual trace oscilloscope) on 48Vdc input units. On 24Vdc input units the two square waveforms must be zero to approximately 40 volt positive peaks. On 120Vdc input units the two square waveforms must be zero to approximately 120 volt positive peaks.

### **B.2 IGBT Module Only**

TS-1 from pin numbers 3 and 4, the two square waveforms must be zero to approximately 80 volt positive peaks (dual trace oscilloscope) on 48Vdc input units. On 24Vdc input units the two square waveforms must be zero to approximately 12 volt positive peaks. On 120Vdc input units the two square waveforms must be zero to approximately 120 volt positive peaks.

- C. TS-1 Pin Number 6 to the negative input terminal, you should read a 12 Volt square wavesignal.
- D. TS-1, Pin Number 1 to Pin Number 2, you should read your DC input voltage. Pin Number 1 to Pin Number 5 you should read your DC input voltage. Pin Number 1 is positive, Pin Number 2 and Pin Number 5 is negative.
- E. TS-2 Pin Number 1 AC line bypass phase, Pin Number 2 AC line bypass Neutral. Pin Number 5 to Pin Number 6, AC output voltage of the A31 Inverter (120Vac).
- F. LED 1, Phase lock LED, If two sources are insync. LED will light.

- G. LED 2, low voltage shutdown when lit.
- H. LED 3, high voltage shutdown when lit.

*NOTE: An open fuse on this board indicates a defective board.*

**A31 drive/snubber printed circuit board (S2A-165), (S2A-306) & (S2A-297)**

- A. Need special test equipment, recommend sending printed circuit board to the factory.
- B. An open fuse on the S2A-165 board indicates defective transistor modules. An open fuse on the S2A-297 or S2A-306 cards indicate a defective IGBT driver card.

**Transistor modules.**

R1 or R2 open, defective transistor modules.

The procedure for checking the transistor modules is as follows:

**(DISCONNECT THE TRANSISTOR TO BE CHECKED)**

- Base to emitter, low resistance in both directions, but not zero ohms.
- Base to collector, low resistance in one direction, high resistance in the other direction.
- Emitter to collector, low resistance in one direction, high resistance in the other direction.
- Transistor Number 1 collector to Transistor Number 2 collector twice the DC input voltage. (With the inverter running)

**To check units with the IGBT Modules.**

- With an ohmmeter, measure the resistance between Terminal 1 (collector) and Terminal 2 (emitter) negative lead on Terminal 1 should read, low resistance. Reverse the meter leads and it should read a high resistance.
- With negative lead on one, measure to Terminal 3, it should read high resistance.
- With negative lead on Terminal 1, measure to Terminal 5, it should read a low resistance.
- When the S2A-297 or S2A-306 card is removed, jump the gate and emitter of the IGBT with copper wire to protect from ESD damage.

**C1, Resonating Capacitors 560 Vac - 660 Vac (approximately)**

With an analog ohmmeter, R x 10,000 scale, you should see the meter deflect to low resistance, then gradually rise to high resistance.

**Electronic Transfer Switch (S2A-139A)**

- A. Pin Number 2 positive DC input, Pin Number 1 negative DC input.
- B. Pin Numbers 4,5,6,7 and 8 an oscilloscope is required to see the switching of the SCR's.

**Status Light Panel (S2A-147)**

- A. Pin Number 1 positive DC input voltage, Pin Number 2 and 3 negative DC input voltage.
- B. Pin Number 6 neutral, Pin Number 7 AC bypass phase.
- C. Pin Number 8 inverter output neutral, Pin Number 9 inverter output phase.

**No AC voltage output.**

- A. Check the F1 and F2 fuse, if open refer to previous possible causes.
- B. Check DC input, look at the rectifier.

- C. Check the status on the three LED's located on the S2A-167 p.c. board. Low or high DC input voltage, look at the rectifier.
- D. Check the F1 and F2 fuse on the S2A-167 printed circuit board, if open defective p.c. board. Also look at R1 and R2 transistor modules and the two fuses located on the S2A-165 p.c. board.
- E. Check the two fuses on the S2A-165 printed circuit board. If open, check transistor modules.
- F. R1 or R2 open, defective transistor modules. Also, look at the two fuses on the S2A-165 p.c. board.
- G. Open F4 fuse - shorted C4 capacitor. Also, look at the R1 and R2 and transistor modules and the two fuses on the S2A-165 p.c. board.
- H. If all above checks out fine measure AC voltage at the C1 capacitors - 500Vac - 660Vac with the inverter turned on. If zero volts are measured, remove the main two leads going to the C1 capacitors and measure the AC voltage on the two leads. If you have roughly 300 Vac, then you have a shorted C1 capacitor. Replace.
- I. If still no AC voltage, start by disconnecting the DC input. (Refer to 8.6 capacitor pre-charge) Put your DC voltmeter on the C2 capacitors, if the capacitors do not start to charge (DC input voltage) and your ready LED does not come on, check the pre-charge resistor, on/off switch in the "off" position and C2 capacitors, if all this checks out, look at the transistor modules R1 and R2 and the two fuses on the S2A-165 p.c. board, the transistor modules are defective.
- J. Whenever a transistor module is found defective, other components need to be checked prior to restarting the inverter. (If the other items are not checked, the transistor modules will become defective upon starting the inverter.)

- F1 and F2 fuse on the S2A-167 printed circuit board.
- The two fuses on the S2A-165 printed circuit board.
- F4 fuse open, C4 needs to be checked.
- Units with a 2 millisecond or 20 millisecond static switch the SCR devices.

### **SCR Module**

The procedure for checking the SCR module is as follows:

- A. Disconnect the wiring going to the module.
- B. Using an ohmmeter, the three main terminals (A1K2, K1, A2) you should read high resistance in both directions on your meter.
- C. Gate (G1) should read a high resistance between the top (A1K2), bottom (A2) terminals and a low resistance (10 ohm - 40 ohm) to the middle (K1) terminal.
- D. Gate (G2) should read a high resistance between the middle (K1) and (A2) terminal and a low resistance between terminal (A1K2).

***(A schematic of the module is located on the side.)***

# General Maintenance Procedure

## Yearly

1. Blow out rectifier/inverter with a low-pressure air hose.
2. Make sure all connections are tight.
3. Perform a visual check on all internal components.
4. Check front panel meters and alarms for accuracy.

## 4th Year

**REPEAT** ABOVE WITH THE ADDITION OF:

1. Check relay contacts for pitting or corrosion.
2. Check capacitors for leakage.

## 7th Year

**REPEAT** ALL, WITH THE ADDITION OF:

1. Filter, resonating capacitors and control relays should be replaced.

## 10th Year

**REPEAT** ALL WITH THE ADDITION OF: (except replacing capacitors, they should be replaced every 7 years)

1. Check magnetics, components and wiring for signs of excessive heat.

## MANUFACTURER'S WARRANTY

All La Marche Manufacturing Co. equipment has been thoroughly tested and found to be in proper operating condition upon shipment from the factory and is warranted to be free from any defect in workmanship and material that may develop within one year from date of purchase. In addition to the standard one (1) year warranty, La Marche warrants its magnetics on a parts replacement basis only for four (4) more years under normal use.

Any part or parts of the equipment (except fuses, DC connectors and other wear-related items) that prove defective within a one (1) year period shall be replaced without charge providing such defect, in our opinion, is due to faulty material or workmanship and not caused by tampering, abuse, misapplication or improper installation. Magnetics are warranted for five (5) years after date of purchase. During the last four (4) years of this five (5) year warranty period, the warranty covers parts replacement only, and no labor or other services are provided by La Marche, nor is La Marche obligated to reimburse the owner or any other person for work performed.

Should a piece of equipment require major component replacement or repair during the first year of the warranty period, these can be handled in one of two ways:

1. The equipment can be returned to the La Marche factory to have the inspections, parts replacements and testing performed by factory personnel. Should it be necessary to return a piece of equipment or parts to the factory, the customer or sales representative must obtain authorization from the factory. If upon inspection at the factory, the defect was due to faulty material or workmanship, all repairs will be made at no cost to the customer during the first year. Transportation charges or duties shall be borne by purchaser.
2. If the purchaser elects not to return the equipment to the factory and wishes a factory service representative to make adjustments and/or repairs at the equipment location, La Marche's field service labor rates will apply. A purchase order to cover the labor and transportation cost is required prior to the deployment of the service representative.

In accepting delivery of the equipment, the purchaser assumes full responsibility for proper installation, installation adjustments and service arrangements. Should minor adjustments be required, the local La Marche sales representative should be contacted to provide this service only.

All sales are final. Only standard LaMarche units will be considered for return. A 25% restocking fee is charged when return is factory authorized. Special units are not returnable.

In no event shall La Marche Manufacturing Co. have any liability for consequential damages, or loss, damage or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with other equipment or materials, or from any other cause. In addition, any alterations of equipment made by anyone other than La Marche Manufacturing Co. renders this warranty null and void.

La Marche Manufacturing Co. reserves the right to make revisions in current production of equipment, and assumes no obligation to incorporate these revisions in earlier models.

The failure of La Marche Manufacturing Co. to object to provisions contained in customers' purchase orders or other communications shall not be deemed a waiver of the terms or conditions hereof, nor acceptance of such provisions.

The above warranty is exclusive, supersedes and is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness. No person, agent or dealer is authorized to give any warranties on behalf of the Manufacturer, nor to assume for the Manufacturer any other liability in connection with any of its products unless made in writing and signed by an official of the manufacturer.