



POWER PROTECTION

# Datawave<sup>®</sup> Magnetic Synthesizer

100 kVA to 200 kVA; 50 and 60 Hz

Installation, Operation,  
& Maintenance Manual



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## IMPORTANT SAFETY INSTRUCTIONS

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### NOTE

*Read the entire manual before installing or operating the system.*



### WARNING

**THE SHIPPING BANDS MAY BE UNDER TENSION. USE APPROPRIATE EYE, FACE, AND HAND PROTECTION TO SAFEGUARD AGAINST INJURY FROM BAND BACKLASH.**



### WARNING

**VERIFY THAT ALL INCOMING LINE VOLTAGE (POWER) AND LOW VOLTAGE (CONTROL) CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE INSTALLING CABLES OR MAKING CONNECTIONS, WHETHER IN THE JUNCTION BOX OR IN THE UNIT.**

**EQUIPMENT INSPECTION AND START-UP SHOULD BE PERFORMED ONLY BY TRAINED PERSONNEL. LETHAL VOLTAGES ARE PRESENT DURING START-UP PROCEDURES. ELECTRICAL SAFETY PRECAUTIONS MUST BE FOLLOWED THROUGHOUT INSPECTION AND START-UP.**

**ONLY QUALIFIED SERVICE PERSONNEL SHOULD PERFORM MAINTENANCE ON THE DATAWAVE SYSTEM. ALL VOLTAGE SOURCES TO THE UNIT MUST BE DISCONNECTED BEFORE INSPECTING OR CLEANING WITHIN THE CABINET.**

**LETHAL VOLTAGES EXIST WITHIN THE EQUIPMENT DURING OPERATION. OBSERVE ALL WARNINGS AND CAUTIONS IN THIS MANUAL. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY OR DEATH. OBTAIN QUALIFIED SERVICE FOR THIS EQUIPMENT AS INSTRUCTED.**

**THE MONITORING SYSTEM CONTAINS A LITHIUM BATTERY FOR MEMORY BACK-UP. DANGER OF EXPLOSION IF BATTERY IS INCORRECTLY REPLACED. REPLACE ONLY WITH SAME OR EQUIVALENT TYPE. DISPOSE OF USED BATTERIES ACCORDING TO MANUFACTURER'S INSTRUCTIONS.**

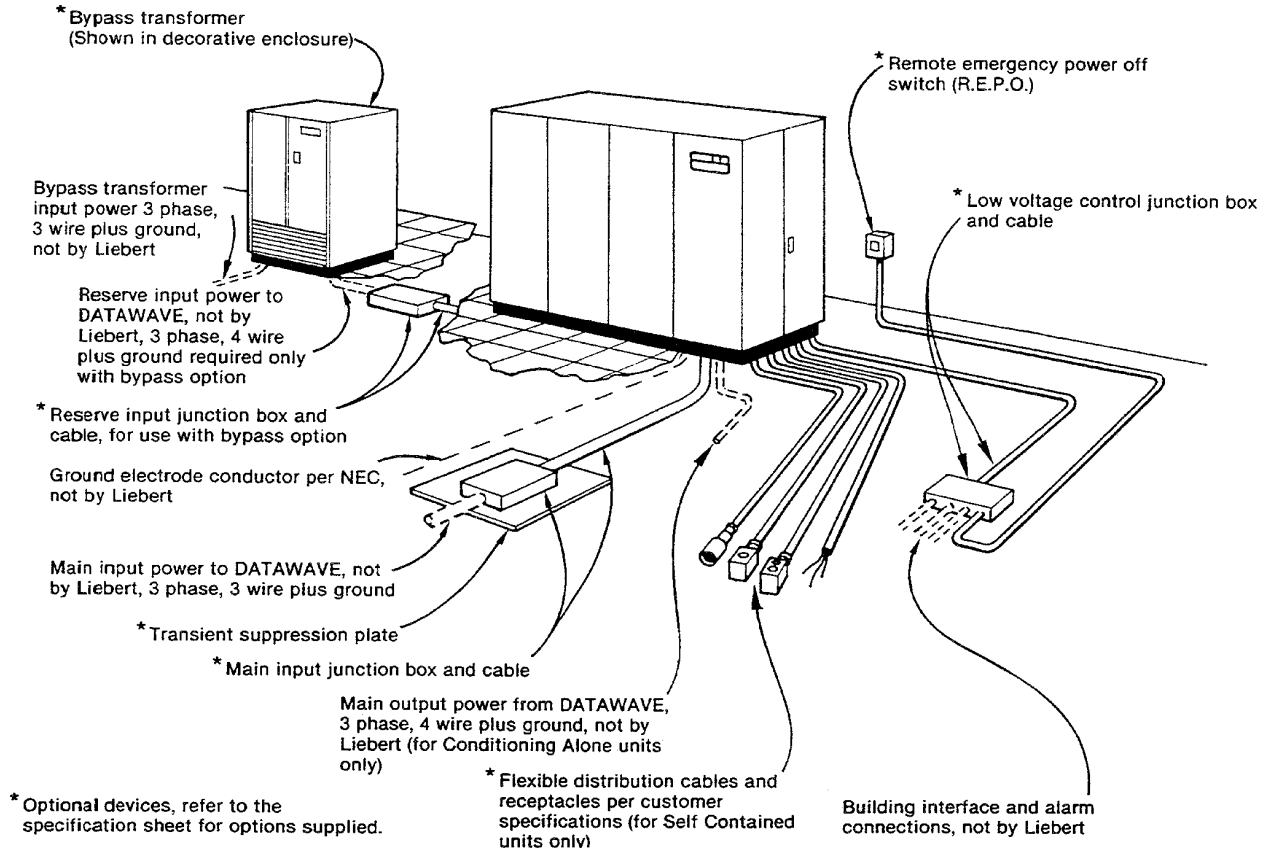


### NOTE

*The unit should not be loosened from the shipping pallet until after all handling by fork lift or pallet jack is completed.*

*All power and control wiring should be installed by licensed electricians and must comply with the NEC and applicable codes.*

**Figure i Typical Datawave Magnetic Synthesizer Equipment Arrangement**



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## 1.0 INSTALLATION INSTRUCTIONS

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### 1.1 Unpacking and Installation



#### NOTE

*Read the entire manual before installing and operating this system. Upon receipt of a Datawave Magnetic Synthesizer, the installer should perform the following steps to assure a quality installation.*

#### 1.1.1 Unpacking and Preliminary Inspection

A quality installation begins on the receiving dock.

1. **Inspect the shipping crate(s)** for damage or signs of mishandling before unpacking the unit(s). Check Shock-Watch indicator.
2. **Open the shipping crates carefully.** (Use care to avoid puncturing the container with sharp objects that would damage the contents).
3. **Remove the packing and vapor barriers and inspect the equipment** for any obvious shipping damages.



#### NOTE

*The unit should not be loosened from the shipping pallet until after all handling by fork lift or pallet jack is completed. Complete internal inspection should be accomplished only after equipment positioning and prior to electrical hookup.*

4. **If any damage as a result of shipping is observed,** immediately file a damage claim with the shipping agency and forward a copy to:

Liebert Corporation  
1050 Dearborn Drive  
P.O. Box 29186  
Columbus, Ohio 43224 USA

#### 1.1.2 Handling Considerations

The Datawave module (and cables, if furnished) is bolted to a wooden pallet to allow handling by fork-lift equipment.

**Easily moved** - The Datawave module and cable reels are furnished with casters to allow the unit to be rolled into place after it has been unbolted from the pallet.



#### CAUTION

**When lifting the Datawave unit by forklift, be certain that the forks extend under frame members of both sides of the unit of the unit, otherwise severe damaged to the unit may result and/or unit may tip over.**

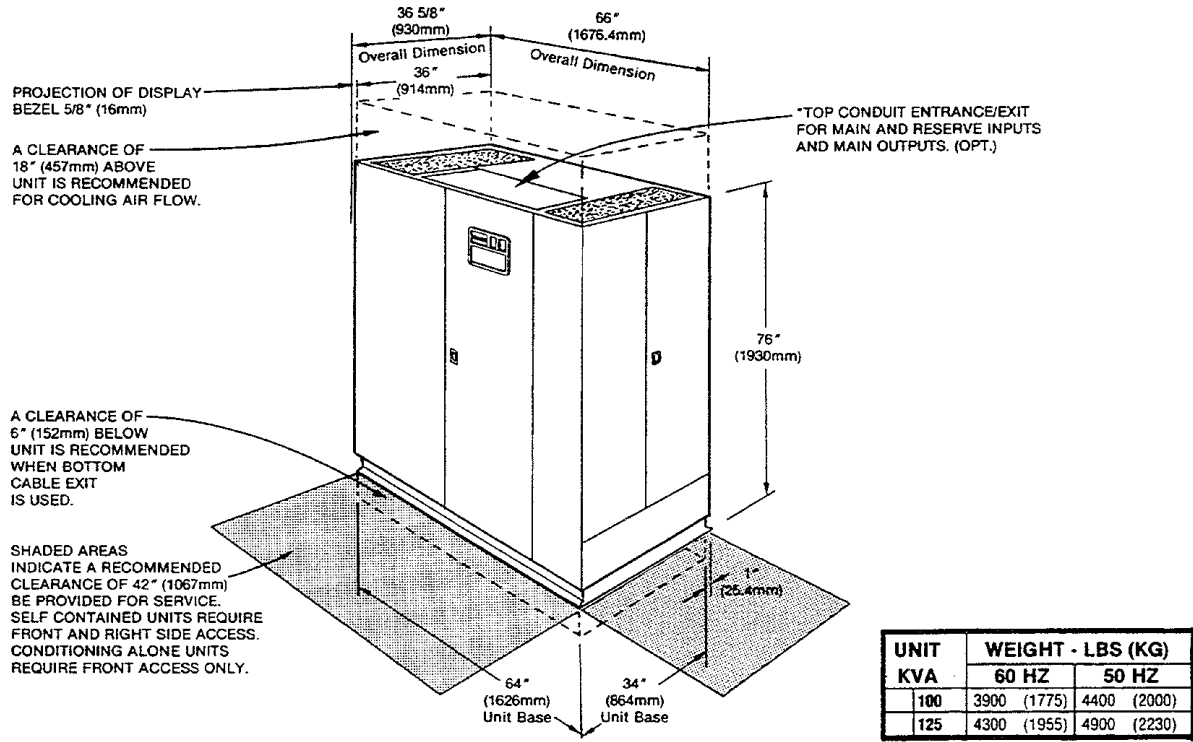
**Check size and weight** - Refer to the cabinet drawings furnished with the unit for size and weight information. Typical cabinet dimensions and weights are shown in **Figure 1** and **Figure 2**.

**Plan the route** - The route that the Datawave module will follow to its installation area should be planned to ensure that all passages are large enough to accommodate the unit, and that the floors are adequate to support the weight. (i.e., Are the doorways, elevators, ramps, etc. adequate? Are there any non-negotiable corners or offsets in the hallways?)

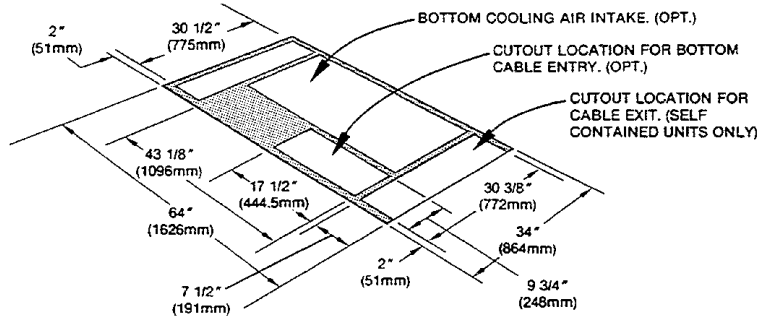
**Move with care** - In order to prevent panel damage, it is recommended that the exterior panels be removed before the unit is moved. When replacing panels, remember to reconnect all panel ground wires.

**Close quarters?** - Removal of the side panels will aid in maneuvering the unit through close quarters. Removal of the side panels and brackets reduces the unit dimensions to 34 inches (864 mm) wide.

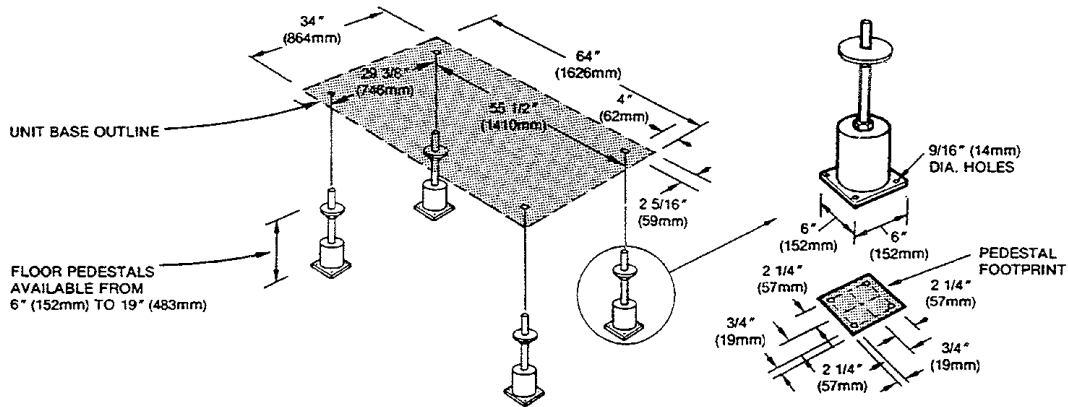
**Figure 1 Typical Cabinet and Floor Planning Dimensional Data, 100-125 kVA**



**CABINET DIMENSIONAL DATA**



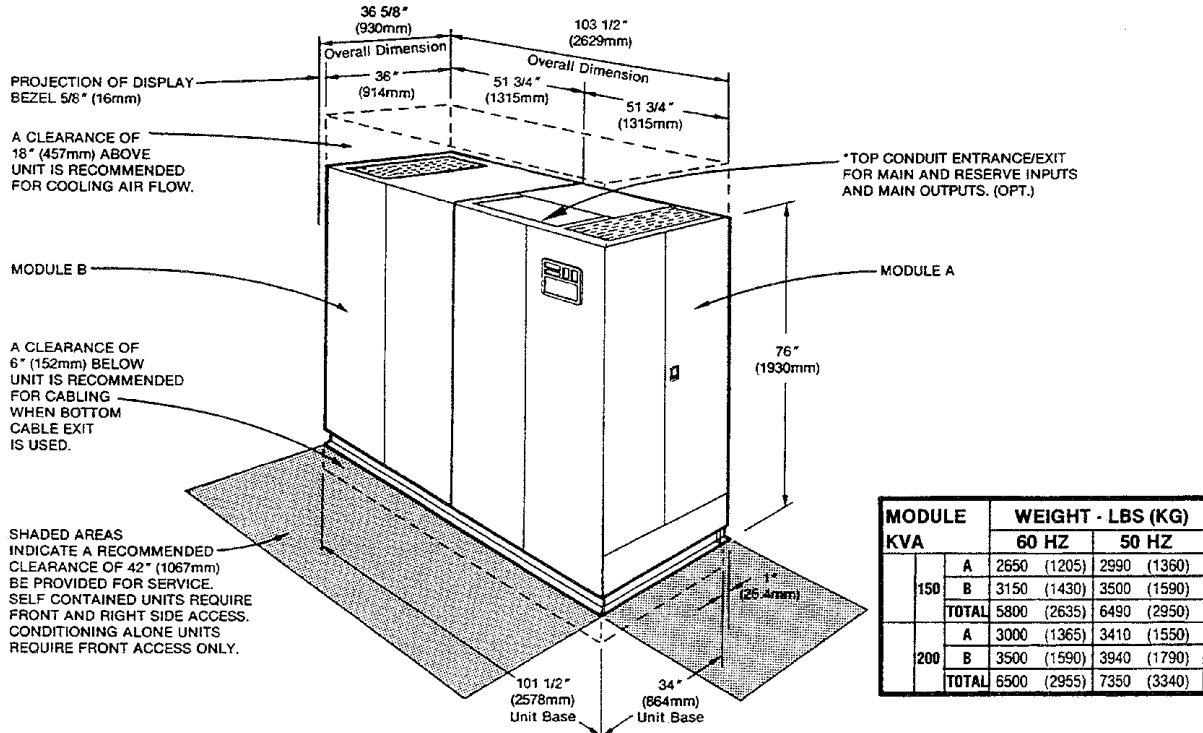
**FOOTPRINT AND FLOOR CUTOUT DIMENSIONS**



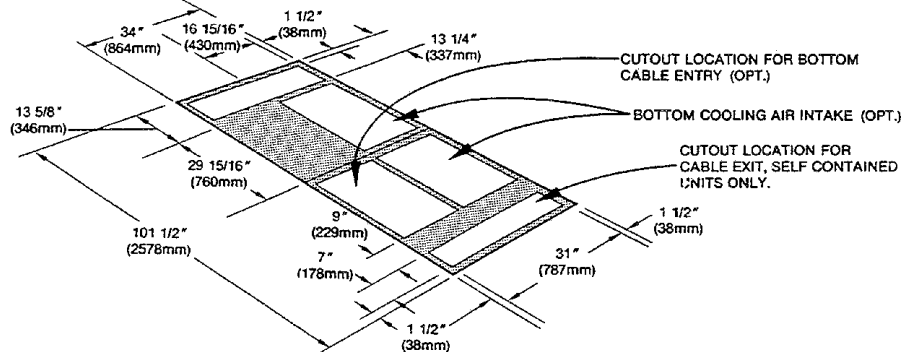
**OPTIONAL FLOOR PEDESTALS**



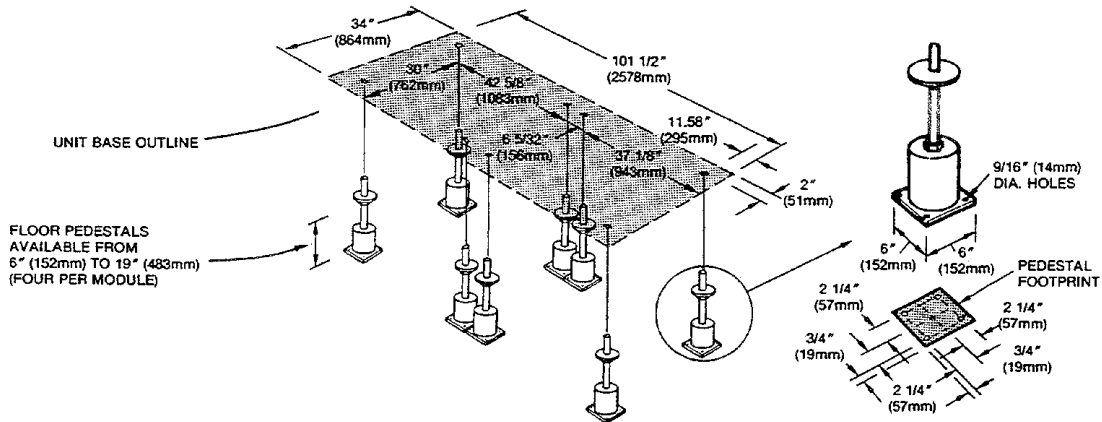
Figure 2 Typical Cabinet and Floor Planning Dimensional Data, 150-200 kVA



**CABINET DIMENSIONAL DATA**



**FOOTPRINT AND FLOOR CUTOUT DIMENSIONS**



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### 1.1.3 Unit Preparation

Set the palletized assembly in a level area, where there is enough room to lift the unit off the shipping pallet onto the floor.

Remove bolts holding the unit to the shipping pallet. After removing these bolts, the unit may be removed from the pallet.



#### CAUTION

**Before maneuvering the unit into its final position, read and follow all advisories in the following “Location Considerations” paragraphs.**

### 1.1.4 Location Considerations

**The Datawave Magnetic Synthesizer** should be located close to the load(s) which it is supplying.

**Equipment Location** should employ the shortest output distribution cable runs consistent with logical equipment arrangement and allowances for future additions.

**Operating Environment** - Ambient temperatures should be within 0°C to 40°C with relative humidity of 0% (non-condensing).

**Bottom Clearance** is required on SC Models for exist cables/conduit. This clearance is automatically provided by a raised floor (6 inches/150 mm minimum height).

**Figure 1** and **Figure 2** show the typical raised-floor cutout dimensions. When SC models are not located on a raised floor (or if the raised floor is not adequate to support the unit), optional floor pedestals may be used. (non-raised floor applications are not CSA approved.)

CA Models with top conduit entry do not require any bottom clearance.

**Recommended Minimum Service Clearances** are shown in **Figure 1** and **Figure 2**. For SC models, clearances at the front and right side of the unit are required for service access by the National Electrical Code (Article 110-16). For CA models, only clearance at the front of the unit is required for service access. Clearance above the unit is required for cooling air flow (exhaust).

**Audible Noise** - The average sound level output of the Datawave is 60 dBA at five feet (1.6 meters) which should be considered when determining unit location.

**Heat Output** - As all electrical devices, the Datawave Magnetic Synthesizer produces heat under normal operation. (See **Table 1**). This heat output should be included when calculating the environmental conditions of the room.

**Altitude** - The Datawave System is designed for operation in altitudes up to 5000 feet (1500 meters) above sea level. For high altitudes, contact the factory.

**Table 1 Heat Output, Datawave Magnetic Synthesizer**

| Heat Output BTU/Hr (kW) |           |        |          |        |          |        |
|-------------------------|-----------|--------|----------|--------|----------|--------|
| kVA/kW                  | Full Load |        | 3/4 Load |        | 1/2 Load |        |
| 100                     | 25,700    | (7.5)  | 23,780   | (6.97) | 21,090   | (6.18) |
| 125                     | 32,100    | (9.4)  | 29,720   | (8.71) | 26,360   | (7.72) |
| 150                     | 38,500    | (11.3) | 35,670   | (10.5) | 31,640   | (9.27) |
| 200                     | 51,400    | (15.0) | 47,560   | (13.9) | 42,180   | (12.4) |

### 1.1.5 Floor Pedestal Installation

Floor pedestals are optional equipment intended to provide clearance for bottom cable entry without relying on a raised floor to support the unit. The pedestals are adjustable over a limited range (approximately 3 1/2 inches) to allow leveling the unit and minor adjustments in the unit's installed height.



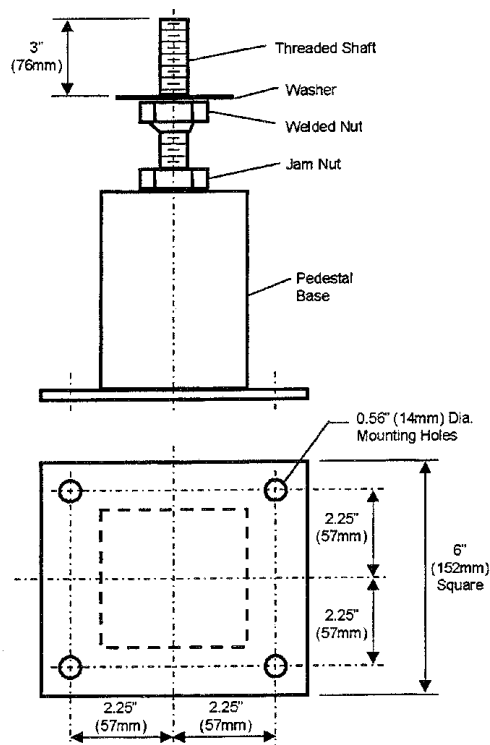
#### CAUTION

Floor pedestals may be reverse assembled for shipping. Before installation, the pedestals should be reassembled as shown in Figure 3. When the pedestal is properly assembled, the washer on top of the welded nut provides a bearing surface for the unit weight.

1. Insert the pedestal threaded shaft into the inside corner tubing of the cabinet base as shown in Figure 1 and Figure 2.
2. Adjust the pedestal height by turning the welded nut/shaft assembly into or out of the pedestal base as required.
3. Lock the height by tightening the jam nut against the pedestal base.

The pedestal may be mounted to the floor by means of the four holes in the base. Locations of floor pedestals relative to the Datawave base outline are shown in Figure 1 and Figure 2.

Figure 3 Floor Pedestal Details



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## 1.2 Power and Control Wiring

Power and control wiring should be installed by licensed electricians. All power and control wiring must comply with the NEC and applicable local codes.

### 1.2.1 Input Power Connections

If the Datawave Magnetic Synthesizer is furnished with junction boxes, input power connections are made as detailed in **1.2.2 - Junction Box Installation (If Used)**.

If junction boxes are not furnished, the input power feeder is connected to the input power lugs or blocks located inside the unit. (See **Figure 4** through **Figure 7**.)



#### WARNING

**VERIFY THAT ALL INCOMING LINE VOLTAGE (POWER) AND LOW VOLTAGE (CONTROL) CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE INSTALLING CABLES OR MAKING CONNECTIONS, WHETHER IN THE JUNCTION BOX OR IN THE UNIT.**

**To minimize disturbances** caused by other loads in the building, the 3-phase power input to the Datawave should be supplied directly from the service entrance. However, if this is not possible, the Datawave's ability to isolate the sensitive load from power disturbances allows the system to work even without a dedicated power feeder.

**The input feeder circuit** should be sized in accordance with the NEC and any local building codes to assure the feeder's ability to safely carry the system's full load current, including losses.

**Input feeder conductors** should be sized for no more than 2% voltage drop. If operation at under-voltage conditions for extended periods of time is desired, the input feeders must be oversized.

**Typical conductor size data** is shown in **Table 2**. All connections must comply with the NEC and all other applicable codes.

**The main input feeder** should consist of 3-phase conductors and one (safety) ground conductor (3W + G).

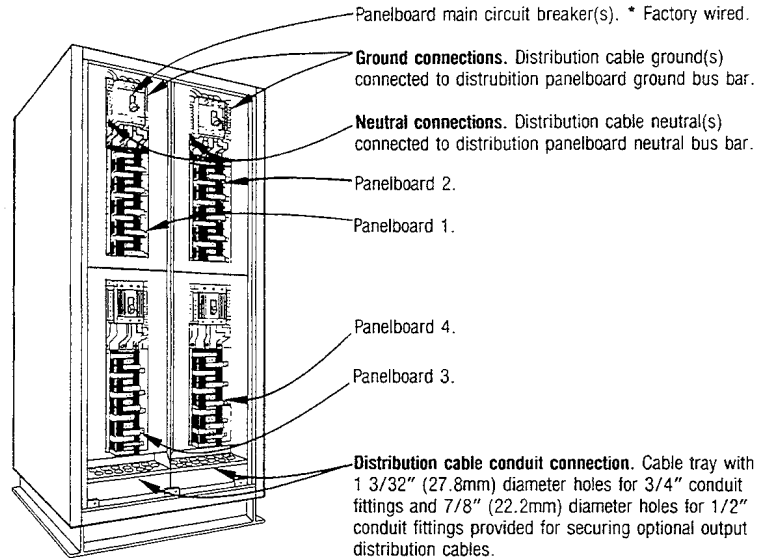
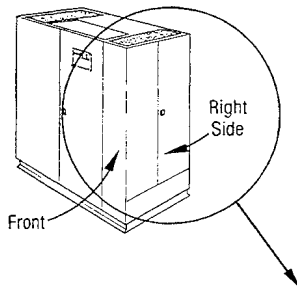
**For units with a bypass option**, the bypass input feeder must consist of 3-phase conductors, one neutral (if required by the load), and one (safety) ground conductor (4W + G).

**Bypass option** - Typical configuration diagrams for the bypass option are shown in **Figure 8**. An external bypass transformer may be required if Datawave input voltage is different from output voltage. Power terminals are provided inside the unit for connections to the bypass input.

**Bypass Transformer Connections** - Input connections to the bypass transformer should be 3-phase, 3-wire plus ground (3W + G), sized the same as the Datawave input wiring. Output connections from the transformer should be 3-phase, 4-wire plus ground (4W + G), sized for the full load output of the Datawave. If the bypass transformer is located farther than 10 feet (3 meters) from the Datawave, additional overcurrent protection for the output wiring from the transformer may be required to meet electrical codes.

**Any alternate energy source**, such as a diesel generator, powering the Datawave should be equipped with an isochronous governor to ensure proper regulation of the frequency. Typical computer loads specify a frequency range of  $\pm 0.5$  Hertz.

**Figure 4 Electrical Field Connections - Self-Contained (SC) Datawave 100-125 kVA**



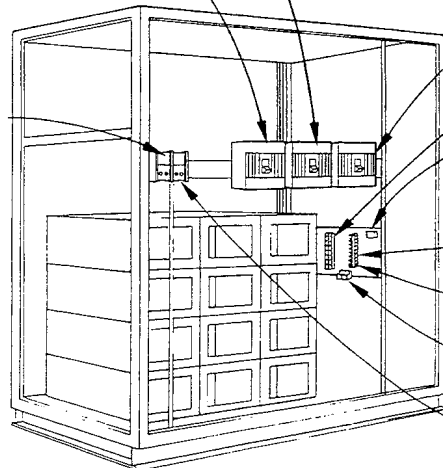
**RIGHT SIDE WITH PANELS REMOVED**

\*Customer connection not required. Shown for orientation and clarification only.

**Reserve input power connection.** Customer connects 3 phase power directly to line terminals of reserve input circuit breaker.

**Main input power connection.** Customer connects 3 phase, 3 wire power directly to line terminals of main input circuit breaker.

**Subfeed output neutral connections.** Terminal blocks supplied for customer connection of subfeed neutral.



**FRONT VIEW WITH PANELS REMOVED**

**Subfeed output connections.** Customer connects directly to load terminals of subfeed circuit breaker(s).

**Safety ground connection.** Terminal provided for customer connection of main input, subfeed and reserve input safety ground.

**Building interface relay connection.** Double pole, double toggle (DPDT) relay with terminals for customer connection to indicate unit status.

**Building interface and alarms connection.** Low voltage control terminal strip provided for connection of building interface and alarm circuits and two wire twisted pair centralized monitor system (available from Liebert or others).

**Sitemaster connection.** Terminals for connection of a 2 wire, twisted pair communications cable (available from Liebert or others) to optional Sitemaster.

**Ground electrode conductor connection.** Terminal for customer connection of continuous ground electrode conductor per NEC 250-26.

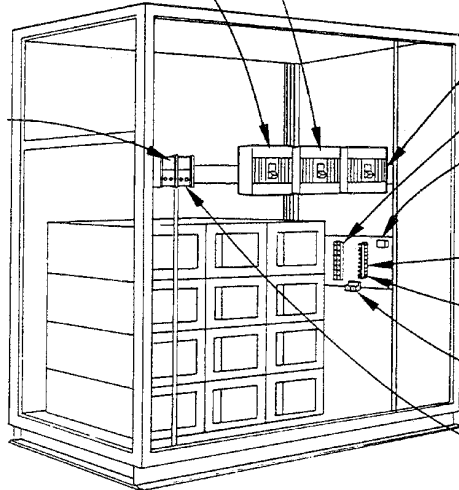
**Reserve input neutral.** Terminal block provided for customer connection of neutral conductor on units with bypass option.

**Figure 5 Electrical Field Connections - Conditioning Alone (CA) Datawave 100-125 kVA**

**Reserve input power connection.** Customer connects 3 phase power directly to line terminals of reserve input circuit breaker.

**Main input power connection.** Customer connects 3 phase, 3 wire power directly to line terminals of main input circuit breaker.

**Main output neutral connections.** Terminal block provided for customer connection.



**FRONT VIEW WITH PANELS REMOVED**

**Main output power connection.** Customer connects directly to load terminals of main circuit breaker.

**Safety ground connection.** Terminal provided for customer connection of main input main output and reserve input safety ground.

**Building interface relay connection.** Double pole, double toggle (DPDT) relay with terminals for customer connection to indicate unit status.

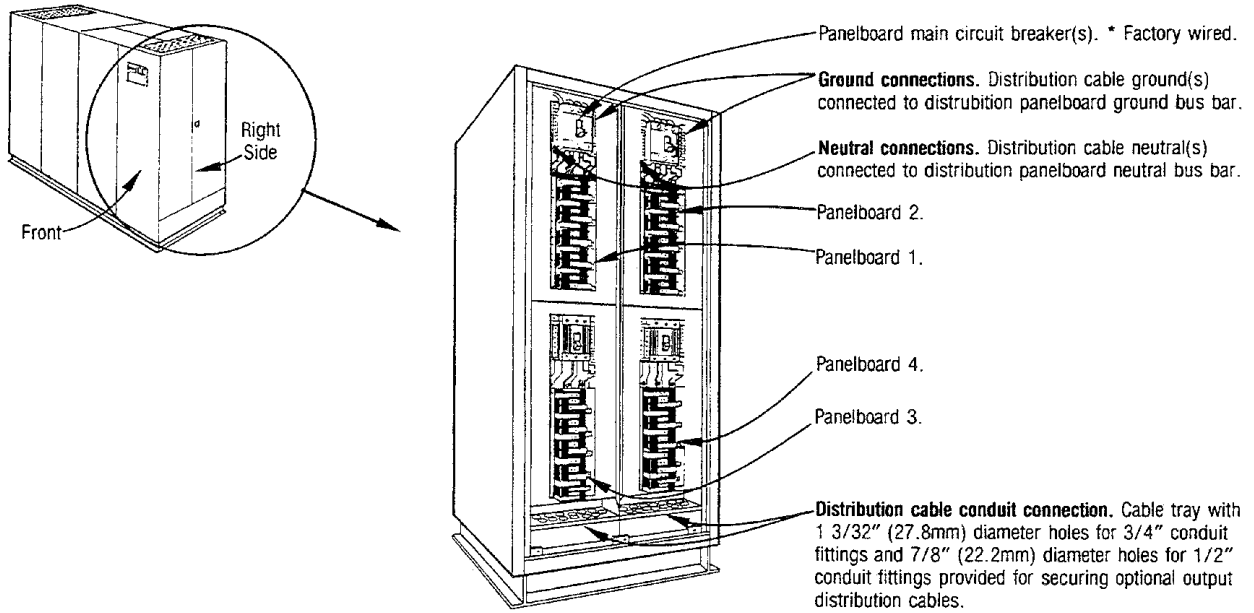
**Building interface and alarms connection.** Low voltage control terminal strip provided for connection of building interface and alarm circuits and two wire twisted pair centralized monitor system (available from Liebert or others).

**Sitemaster connection.** Terminals for connection of a 2 wire, pair communications cable (available from Liebert or others) to optional Sitemaster.

**Ground electrode conductor connection.** Terminal for customer connection of continuous ground electrode conductor per NEC 250-26.

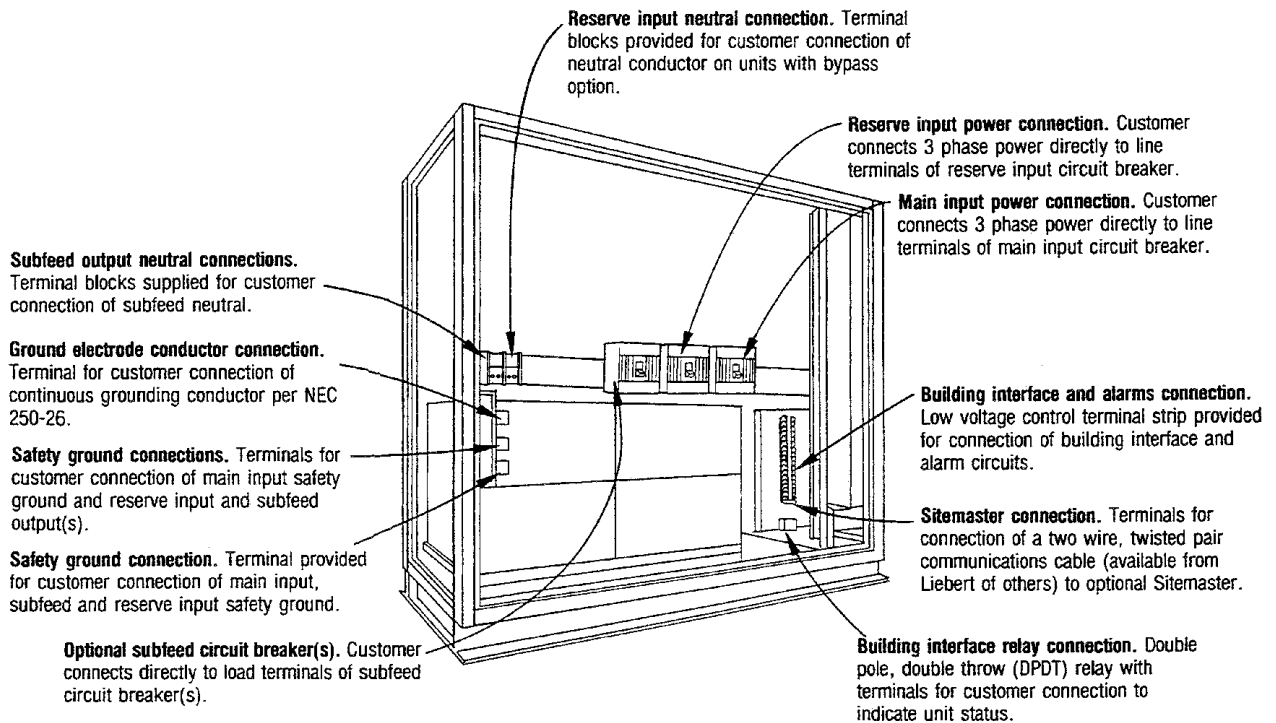
**Reserve input neutral.** Terminal block provided for customer connection of neutral conductor on units with bypass option.

**Figure 6 Electrical Field Connections - Self-Contained (SC) Datawave 150-200 kVA**



**RIGHT SIDE WITH PANELS REMOVED**

\*Customer connection not required. Shown for orientation and clarification only.



**Figure 7 Electrical Field Connections - Conditioning Alone (CA) Datawave 150-200 kVA**

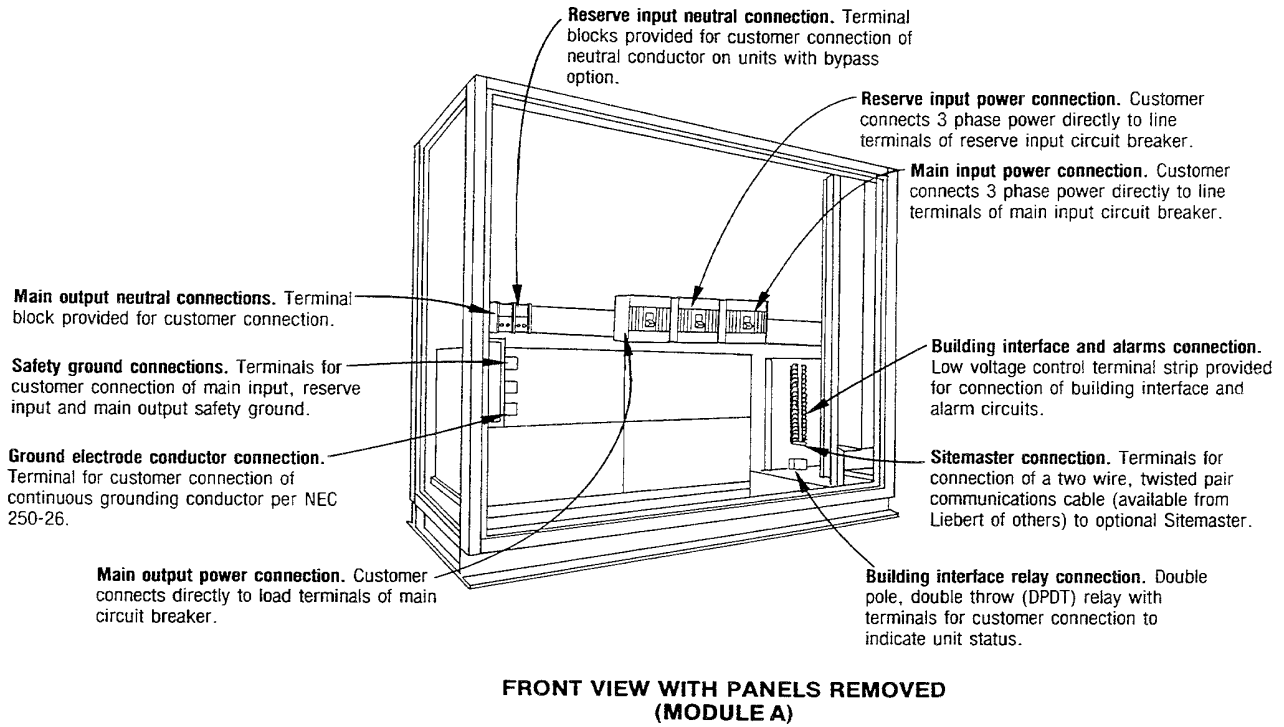
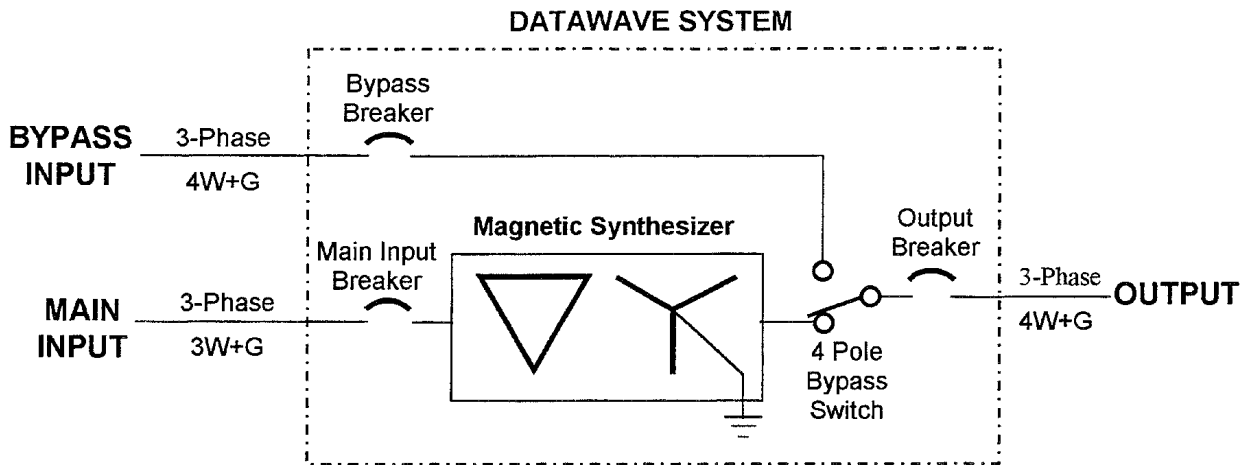


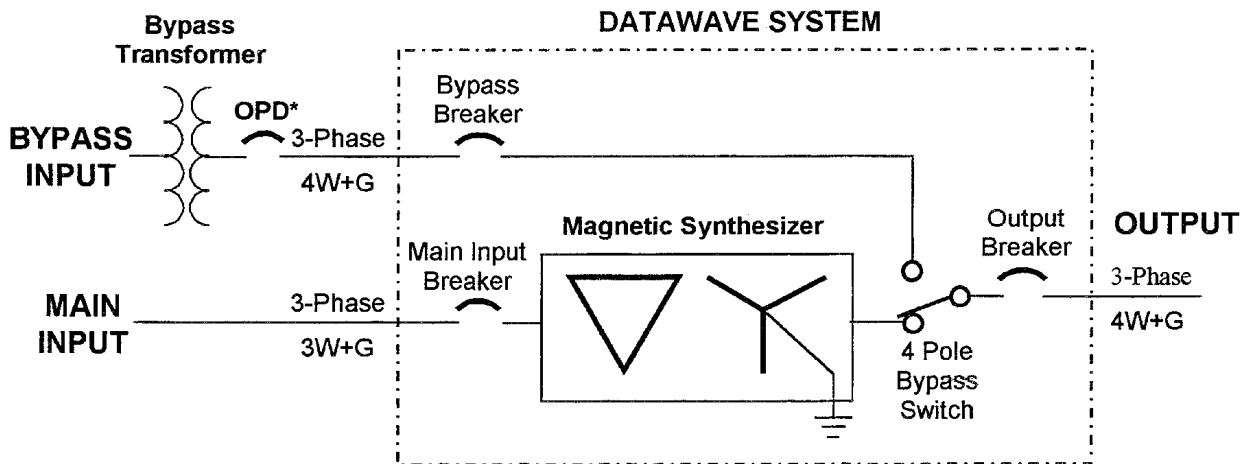


Figure 8 Datawave Bypass Configuration (100-200 kVA)



NOTE: For Input and Output Breaker sizes see Table 1-2.

**BYPASS CONFIGURATION WHEN NOMINAL INPUT VOLTAGE LEVEL MATCHES DATAWAVE OUTPUT VOLTAGE**



NOTE: For Input and Output Breaker sizes see Table 1-2.

\* Bypass transformer secondary overcurrent protection may be required by local codes unless transformer is located within 10 feet (3 meters) of the Datawave unit.

**BYPASS CONFIGURATION WHEN NOMINAL INPUT VOLTAGE LEVEL DOES NOT MATCH DATAWAVE OUTPUT VOLTAGE**

**Table 2 Suggested Minimum Wire Size Data**

| Voltage | kVA | Main Input <sup>1</sup> |     |   | Output |                  |   |
|---------|-----|-------------------------|-----|---|--------|------------------|---|
|         |     | FLA                     | OPD | Suggested feeder wire size <sup>2</sup> (AWG) | FLA    | OPD <sup>3</sup> | Suggested feeder wire size <sup>4</sup> (AWG) |
| 208V    | 100 | 311                     | 400 | 2-000*  | 277    | 350              | 500 kcmil                                     |
|         | 125 | 389                     | 500 | 2-250 kcmil*                                  | 347    | 450              | 2-0000*                                       |
|         | 150 | 466                     | 600 | 2-350 kcmil*                                  | 416    | 600              | 2-350 kcmil*                                  |
|         | 200 | 622                     | 800 | 3-300 kcmil*                                  | 555    | 700              | 2-500 kcmil*                                  |
| 240V    | 100 | 269                     | 350 | 500 kcmil                                     | —      | —                | —   |
|         | 125 | 337                     | 450 | 2-000*  |        |                  |   |
|         | 150 | 404                     | 500 | 2-250 kcmil*                                  |        |                  |   |
|         | 200 | 539                     | 700 | 2-500 kcmil*                                  |        |                  |   |
| 380V    | 100 | 170                     | 225 | 0000  | 152    | 200              | 000   |
|         | 125 | 213                     | 300 | 350 kcmil                                     | 190    | 250              | 250 kcmil                                     |
|         | 150 | 255                     | 350 | 500 kcmil                                     | 228    | 300              | 350 kcmil                                     |
|         | 200 | 340                     | 450 | 2-0000*                                       | 304    | 400              | 2-000*  |
| 400V    | 100 | 162                     | 200 | 000   | 144    | 200              | 000   |
|         | 125 | 202                     | 250 | 250 kcmil                                     | 180    | 225              | 0000  |
|         | 150 | 243                     | 300 | 350 kcmil                                     | 217    | 300              | 350 kcmil                                     |
|         | 200 | 323                     | 400 | 2-000*  | 289    | 400              | 2-000*  |
| 415V    | 100 | 156                     | 200 | 000   | 139    | 175              | 00  |
|         | 125 | 195                     | 250 | 250 kcmil                                     | 174    | 225              | 0000  |
|         | 150 | 234                     | 300 | 350 kcmil                                     | 209    | 300              | 350 kcmil                                     |
|         | 200 | 312                     | 400 | 2-000*  | 278    | 350              | 500 kcmil                                     |
| 480V    | 100 | 135                     | 175 | 00  | 120    | 150              | 0   |
|         | 125 | 168                     | 225 | 0000  | 150    | 200              | 000   |
|         | 150 | 202                     | 250 | 250 kcmil                                     | 180    | 225              | 0000  |
|         | 200 | 269                     | 350 | 500 kcmil                                     | 241    | 300              | 350 kcmil                                     |
| 600V    | 100 | 108                     | 150 | 0   | 96     | 125              | 1   |
|         | 125 | 135                     | 175 | 00  | 120    | 150              | 0   |
|         | 150 | 162                     | 225 | 000   | 144    | 200              | 000   |
|         | 200 | 216                     | 300 | 350 kcmil                                     | 192    | 250              | 250 kcmil                                     |

**FLA** = Full Load Amps of Datawave Magnetic Synthesizer

**OPD** = Overcurrent Protection Device inside Datawave Magnetic Synthesizer

Wire Sizes based on NEC 1996 Table 310-16, using 75°C copper conductor.

\*Parallel Feeders per NEC 300-20 and 310-4.

**NOTES:**

- Main input power feeder** should be dedicated feeder direct from service entrance if possible. Ground conductors recommended to be insulated conductors run with power conductors for increased system performance. Ground conductor minimum size per NEC Table 250-95. Input power feeder conduit may be used as the safety ground conductor. When conduit is used, adequate electrical continuity must be maintained at conduit connections to enclosures and throughout conduit run.
- Input feeder wire size** listed in **Table 2** is the minimum feeder size recommended. Larger wire size may be required because of voltage drop or supply overcurrent protection device.
- Output OPD's** listed in **Table 2** are the standard sizes for Model CA only. See the unit's specification sheet.
- Output feeder wire size** listed in **Table 2** is the minimum feeder size recommended. Larger wire size may be required because of voltage drop or excessive neutral current (see NEC Table 310-16 notes 8 and 10). For best performance, Synthesizer should be located as close to the load as practical.

## 1.2.2 Junction Box Installation (If Used)

Main input (power) and low voltage (control) junction boxes are available for the 15 through 75 kVA Datawave Magnetic Synthesizer to simplify customer connections.

**Shipping Arrangements** - The junction boxes, if used, can either be shipped with the system or can be advanced-shipped for installation during the roughing-in stage of new construction.

**Installation Location** - 10 foot (3 meters) long flexible cables are supplied by the factory for connecting the junction boxes to the unit. The junction boxes should be installed a maximum of 8 feet (2.4 meters) from the feeder entrance of the Datawave.

It is recommended that the junction boxes be centered under an easily removable floor tile.

Junction Box Connections must be installed in compliance with the NEC and all other applicable codes.



### WARNING

**VERIFY THAT INCOMING LINE VOLTAGE (POWER) AND LOW-VOLTAGE (CONTROL) CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE INSTALLING CABLES OR MAKING ANY CONNECTIONS IN THE JUNCTION BOX.**

Typical junction box connections are shown in **Figure 8** and described in **1.2.1 - Input Power Connections** and **1.2.6 - Output Power Connections**.

**Dimensions** - Dimensions are given on the drawings furnished with the unit. Typical dimensions of the junction boxes are as follows:

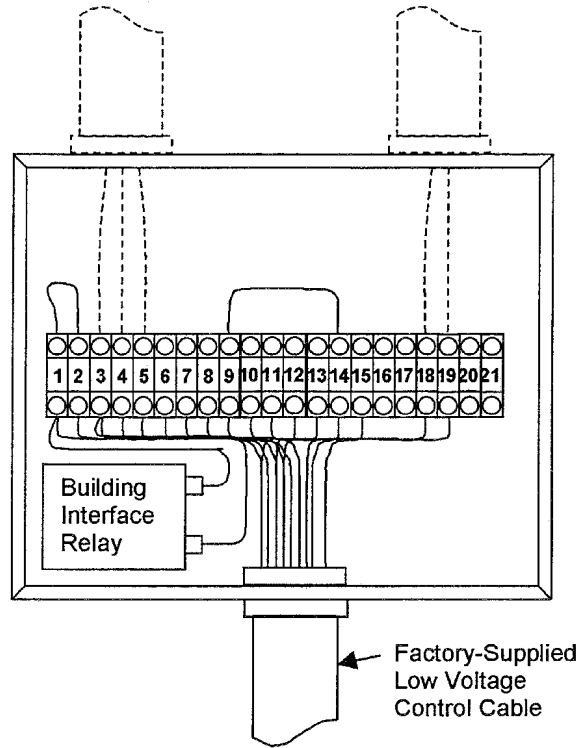
| Low Voltage (Control) Junction Box: |                     |          |
|-------------------------------------|---------------------|----------|
| Width                               | 8 in.               | (203 mm) |
| Length                              | 10 in.              | (245 mm) |
| Height                              | 4 in.               | (102 mm) |
| Main Input (Power) Junction Box:    |                     |          |
| Width                               | 16 in.              | (406 mm) |
| Length                              | 30 in.              | (762 mm) |
| Height                              | 6 in.               | (152 mm) |
| Wire Size                           | (2) #4 to 500 kcmil |          |

**Table 3 Main Input Circuit Breaker Lug Size and Interrupting Rating**

| OPD             | Lug Size <sup>1</sup><br>(Copper Conductor) | Interrupting Rating <sup>2</sup> |       |          |       |
|-----------------|---|----------------------------------|-------|----------|-------|
|                 |   | 208V                             | 480V  | 380-415V | 600V  |
| 125 to 250 AMPS | #6 AWG-350 kcmil                            | 65 kA                            | 25 kA | 25 kA    | 18 kA |
| 300 to 600 AMPS | (2) #2/0 AWG-400 kcmil                      | 65 kA                            | 35 kA | 25 kA    | 25 kA |
| 700 to 800 AMPS | (3) #3/0 AWG-500 kcmil                      | 65 kA                            | 50 kA | 50 kA    | 25 kA |

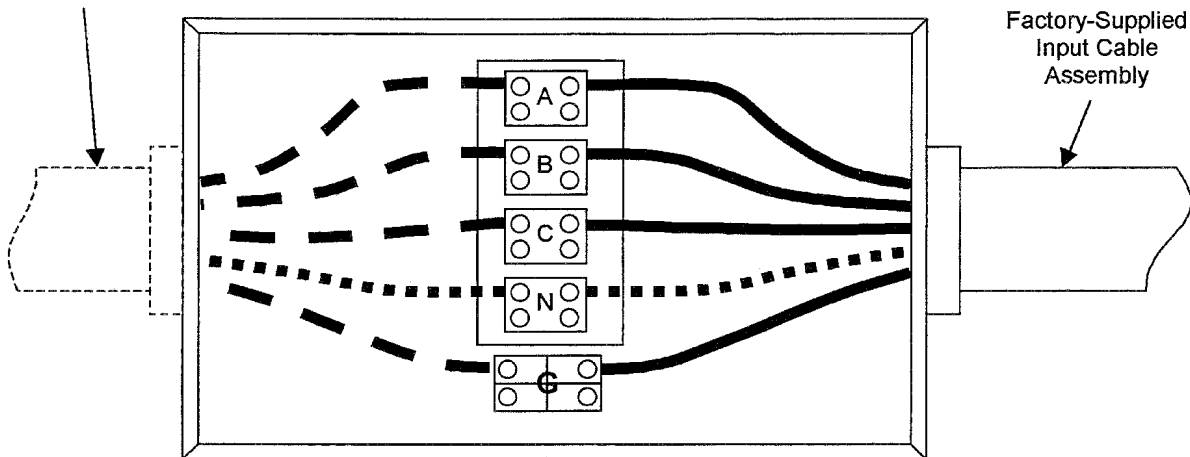
1. Applies to units without input junction box.  
2. Standard Rating. See Unit's Specification Sheet for other ratings.

**Figure 9 Typical Junction Box Connections**



**Low Voltage Control Junction Box**

**Customer Input Power Connection**  
3 Phase 3W+G for unit Main Input  
3 Phase 4W+G for unit Bypass Input



**Main Input and Bypass Input Junction Box**

---

### 1.2.3 System Grounding

The performance and safety of any power conditioning system depends upon proper grounding. **Figure 9** shows a typical grounding arrangement for the Datawave system.

**Equipment grounding** - Grounding is primarily for safety. Correct implementation of grounding also enhances equipment performance. All power feeders must include equipment grounding means as required by the NEC and local codes.

An insulated ground conductor is recommended to be run in each feeder conduit. Although ground conductors can be the minimum size per NEC Table 250-95, larger wire size may be used for increased system performance.

If the input power feeder conduit is used as a grounding conductor, adequate electrical continued must be maintained at all conduit connections.

**Using isolating bushings in a metal conduit run can be a safety hazard and is not recommended.**

**Signal reference grid** - If the Datawave is used to supply power to a computer room or area which is equipped with a signal reference grid or a grounded raised-floor stinger system, a grounding conductor should be connected from the Datawave system ground bus to the grid or floor system. This conductor should be #8 AWG or larger, and as short as practical. Less than 3 feet (1 meter) is recommended.

## 1.2.4 Grounding Electrode Conductor

**Required by code** - The Datawave Magnetic Synthesizer should be grounded according to the safety practices of NEC 250-26. A local grounding electrode conductor is recommended in addition to the equipment safety ground which is normally run with the input power conductors.

**Unit connection** - A terminal is furnished inside the unit for field-connection of the grounding electrode conductor. (See **Figure 4** through **Figure 7**).

**Electrode Connection** - As shown in **Figure 10**, the grounding electrode conductor is run from the Datawave to the *nearest effectively grounded* (in order of preference):

1. Building steel
2. Metal water pipe
3. Other made grounding electrode

**Sizing** of the grounding electrode conductor is based on the secondary circuit conductors. In accordance with NEC (Table 250-94), the minimum recommended grounding electrode conductor is shown in **Table 4**.

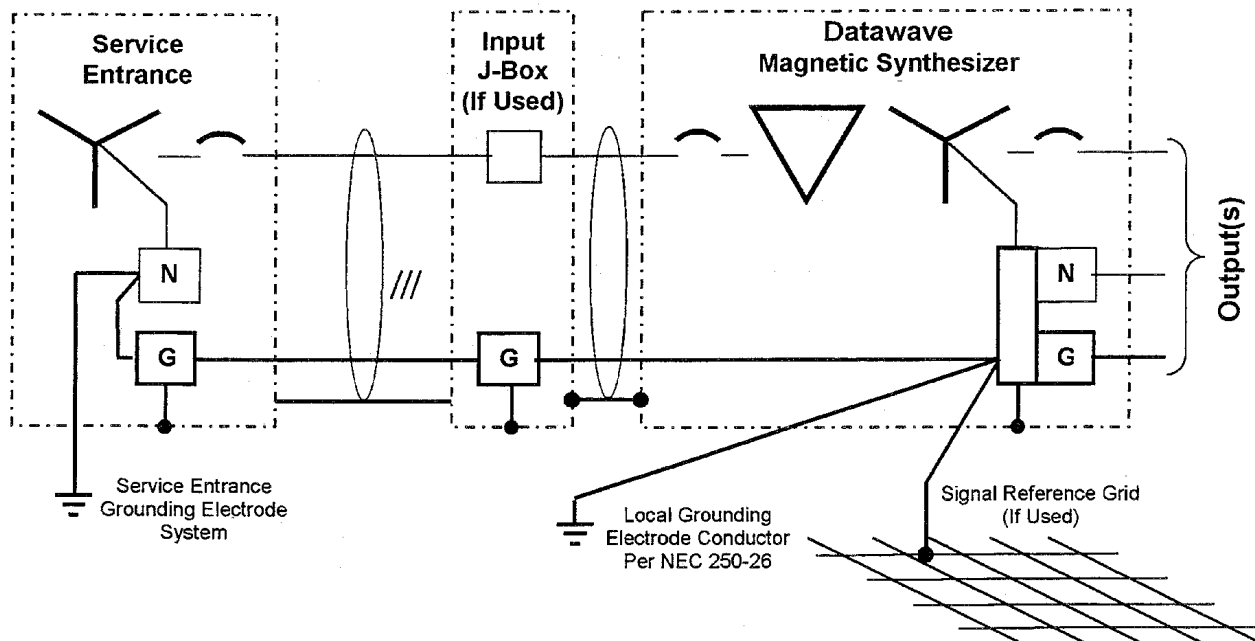
**Table 4** Grounding Electrode Size

| Minimum Grounding Electrode Conductor (AWG)<br>Based on 75°C Copper Conductors |                |      |      |      |      |
|--|----------------|------|------|------|------|
| kVA  | Output Voltage |      |      |      |      |
|  | 208V           | 380V | 415V | 480V | 575V |
| 100  | 0              | 4    | 4    | 6    | 6    |
| 125  | 0              | 2    | 2    | 4    | 4    |
| 150  | 00             | 2    | 2    | 2    | 4    |
| 200  | 00             | 0    | 0    | 2    | 2    |

Recommended methods for running the grounding electrode conductor (arranged in order of preference for system performance, as acceptable by local and other applicable codes):

1. Outside of conduit (where not susceptible to damage)
2. Inside non-metallic conduit
3. Inside non-ferrous conduit
4. Inside ferrous conduit *bonding to the ferrous conduit at both ends*, as acceptable by local and other applicable codes.

**Figure 10** Typical Datawave Grounding Arrangement



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## 1.2.5 150-200 kVA Units - Inter-Module Wiring Connections

Each 150 or 200 kVA Datawave system is supplied in two modules for shipping purposes, which must be located end-to-end, then treated (for wiring purposes) as a single unit.

**Identify Modules A and B** and determine their required orientation in the installed position. (Refer to **Figure 2**).

**Move Module B** to its final-installed position.

**Move Module A** into alignment with (but a few inches/centimeters away from) Module B.



### NOTE

*If the system is to be located next to a wall(s), all panels on the side(s) facing the wall(s) should be installed before moving the modules into the installed position.*

**Level and align both modules.** Level each module, both side-to-side and front-to-rear. Align the modules horizontally, vertically, and axially. (On uneven floors, the use of shims or optional floor pedestals/levelers will be necessary.)

**Bring the modules together.** Observe that the rubber gasket around the perimeter of Module B meets and seals with the mating perimeter of Module A.

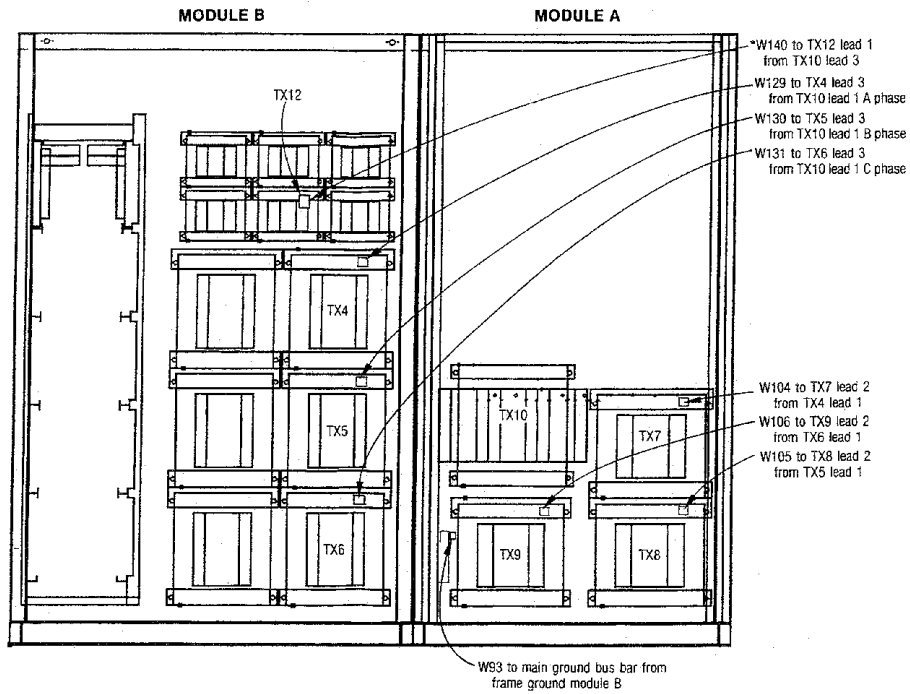
**Identify the interconnecting power conductors and control wires** located in Modules A and B. (Refer to **Figure 11** for wire numbers and connections.)

**Locate the three primary conductors (W104, W105 and W106) and ground (W93) in Module B.** Feed these conductors into Module A through the same (lower) opening. Match the primary conductors to the corresponding tagged terminals as shown in **Figure 11**. Connect the conductors. Support the transformer terminals when tightening. Refer to **Table 5** for terminal torque requirements.

**Locate the secondary conductors (W129, W130, W131, and W140 if required) in Module A.** Feed these conductors into Module B through the same (upper) opening. Match the secondary conductors to the corresponding tagged terminals as shown in **Figure 11**. Connect the conductors. Support the transformer terminals when tightening. Refer to **Table 5** for terminal torque requirements.

**Locate the fan power and temperature sensor connectors located in Module A and B.** Match the fan and temperature sensor connector in Module A to the corresponding connector in Module B. Plug the connector set together.

**Figure 11 Intermodule Wiring, 150-200 kVA**



\*Only used on units when output voltage is greater than 380 volts.

**FRONT VIEW WITH PANELS REMOVED**



---

## 1.2.6 Output Power Connections

When equipped with integral distribution, the Datawave provides the flexibility of custom output power distribution configuration.

**Output circuit breaker(s) and/or panelboards** with ground and neutral provisions are provided inside the Datawave unit for connecting load(s) as required. (See **Figure 5** and **Figure 6**.)

**Flexible output distribution cables** for use in data processing areas under a raised floor are optional and may be factory supplied. Cable lengths and layout should be well-planned:

**Cable access** - Cable routes should follow aisles between equipment. This will facilitate access to cables for installation, routine inspection, and future changes.

**Cable length** - Measure the distance to the load equipment following right-angle paths, rather than diagonally or directly. Always measure to the extreme far side of the equipment with respect to the Datawave unit to insure adequate cable length.

**Air circulation** - Prevent restriction of airflow under the raised floor by running the flexible conduits flat on the sub-floor, in parallel paths.

**Padlock-off provisions** - All output cables without receptacles which are hard-wired to the load equipment must be equipped with a padlock-off accessory for the output circuit breaker. The padlock-off accessory is to be used to lock-out and tag the circuit breaker when service is performed on the hard-wired load equipment in accordance with OSHA safety rules.

**The main output feeder** for Conditioning Alone units should be sized for no more than 2% voltage drop. Typical conductor-size data is shown in **Table 2**, however, larger wire size may be required because of voltage drop or excessive neutral harmonic currents. (See the NEC, Table 310-6, notes 8 and 10.) For best performance, the Datawave should be located as close to the load as practical.

**Initial system output loading** should be between 50% and 75% of rated capacity. This allows the addition of future loads without immediately investing in another power conditioner. The high partial-load efficiency of the Datawave Magnetic Synthesizer permits such sizing without imposing an energy-use penalty during initial operation.

For additional information on calculating the required system capacity, see Liebert Powerline PLT-09, *Power Calculations (System Sizing)*.

Keep the load balanced. Although the Datawave Magnetic synthesizer can tolerate up to a 100% load imbalance, balancing of loads is good design practice on any 3-phase system. Accordingly, each Datawave distribution panel is load-balanced at the factory, based on output branch circuit breaker sizes. All additions to the system should be arranged so as to preserve this balance.



### WARNING

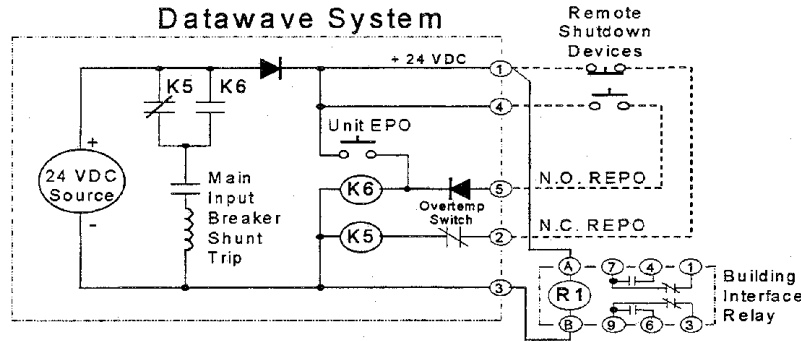
**VERIFY THAT INCOMING LINE VOLTAGE CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE INSTALLING OUTPUT BREAKERS AND CABLES.**

**Code Compliance** - All output cables and connections must comply with the NEC and all other applicable codes.

## 1.2.7 Control Wiring Connections

NEC Article 645 requires EPO switches at the principal room exits of Data Processing Rooms. All standard Liebert power conditioning systems have provision for external shutdown control from Remote Emergency Power Off (REPO) stations. **Figure 12** is a simplified diagram of the shutdown circuitry of the Datawave Magnetic Synthesizer.

**Figure 12 Simplified Shutdown Circuit**



**Low-voltage control circuit** - As shown in **Figure 12**, the control circuit operates on 24VDC. The shutdown device (represented by the REPO switch) activates a low-current 25VDC relay which in turn operates the shunt-trip mechanism. The shunt-trip solenoid opens the Main Input Breaker, which de-energizes the power center.

**Multiple-unit shutdown** - When more than one Datawave unit is installed by the user, a typical requirement is that actuation of a single device (REPO for example) must shut down all units. The low-voltage control circuits of all modules of any standard Liebert Datawave system are designed to meet this requirement.

**Detailed diagrams and descriptions** of the shutdown schemes for multiple-system installations are contained in the Liebert Power Line PLT-35, "Multiple Power Center Control Schemes."

**External control wiring connections** for Remote Shutdown, alarm, and/or monitoring are made to the low-voltage junction box (if used) or to the low-voltage control terminal strip located inside the Datawave Unit.

Control wiring connections vary with the type of monitoring system furnished with the unit. Three typical control wiring configurations are shown in **Figure 13** and **Figure 14**.

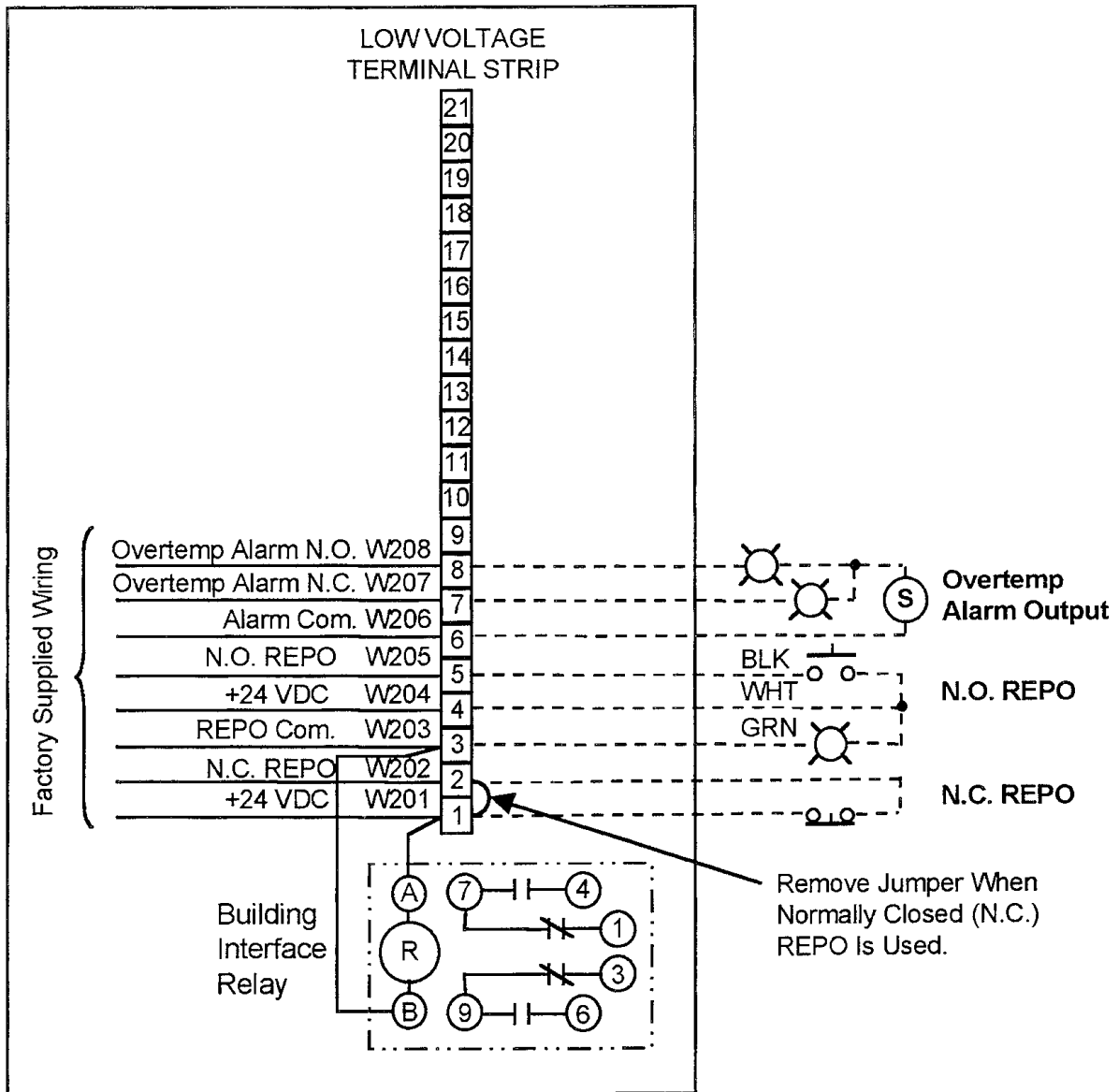
**Code Compliance** - Control wiring connections must comply with the NEC and all other applicable codes.



### WARNING

**VERIFY THAT ALL INCOMING LINE VOLTAGE (POWER) AND LOW VOLTAGE (CONTROL) CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE INSTALLING CABLES OR MAKING CONNECTIONS, WHETHER IN THE JUNCTION BOX OR IN THE UNIT.**

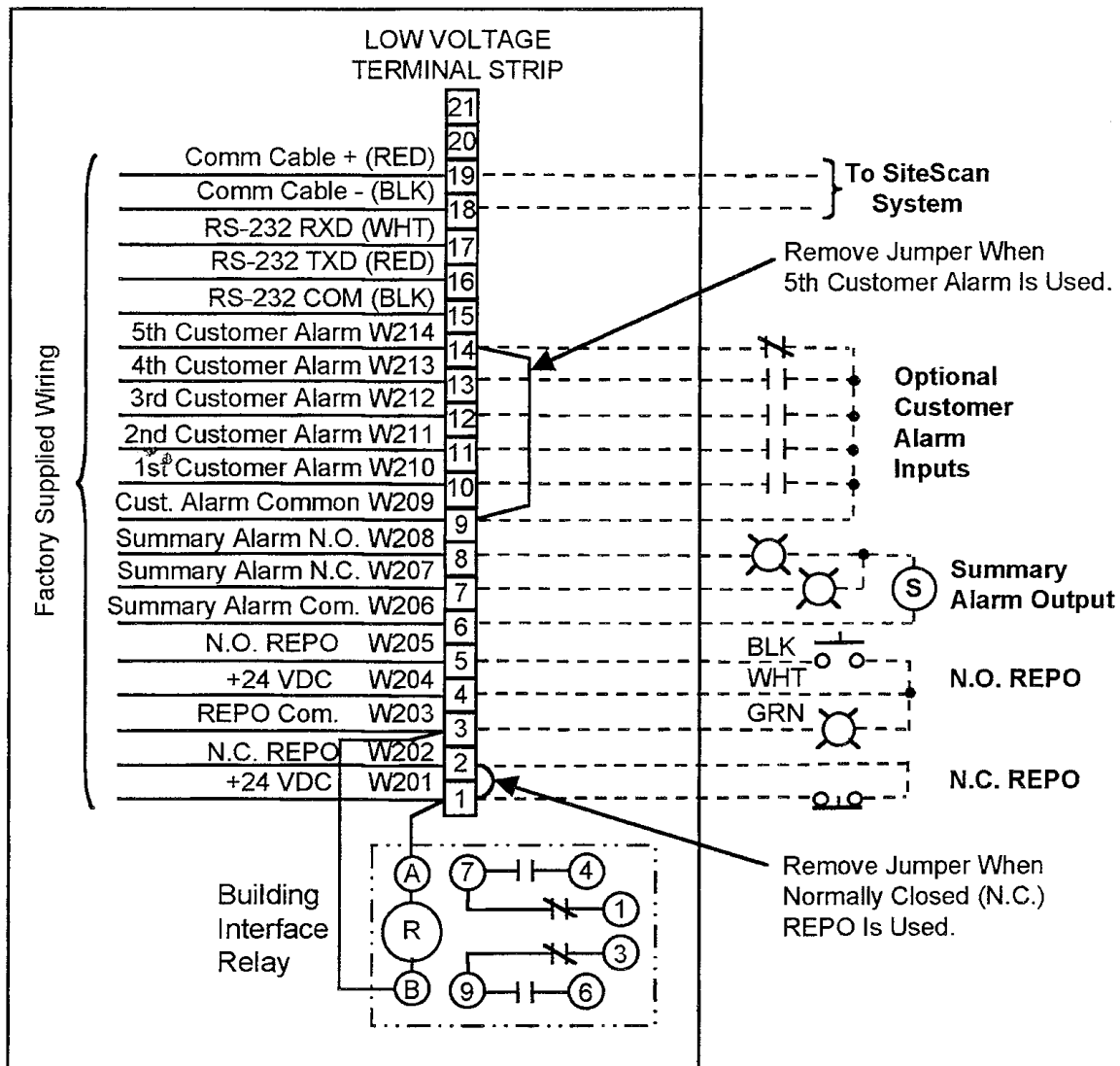
Figure 13 Typical Control Wiring for Units Without Monitoring



NOTES

1. Building Interface Relay can be used for remote shutdown or alarm. Relay is energized during normal operation. DPDT contacts rated ¼ HP at 120 VAC, 10A at 28 VDC or 240 VAC.
2. Other N.O. REPO devices may be wired in parallel to the N.O. REPO contacts. Other N.C. REPO devices may be wired in series to the N.C. REPO contacts. Multiple REPO lamps and other 24 VDC loads may be wired in parallel to the REPO lamps. Max. 24 VDC supply available is 1 Amp total. Both N.O. and N.C. REPO switches are powered from the same supply.
3. All Auxiliary Control Devices and Cabling to be Field Supplied except as noted.
4. Overtemp Alarm contacts change state when unit overtemperature is sensed.

Figure 14 Typical Control Wiring for Units With Monitoring



NOTES

1. Building Interface Relay can be used for remote shutdown or alarm. Relay is energized during normal operation. DPDT contacts rated ¼ HP at 120 VAC, 10A at 28 VDC or 240 VAC.
2. Other N.O. REPO devices may be wired in parallel to the N.O. REPO contacts. Other N.C. REPO devices may be wired in series to the N.C. REPO contacts. Multiple REPO lamps and other 24 VDC loads may be wired in parallel to the REPO lamps. Max. 24 VDC supply available is 1 Amp total. Both N.O. and N.C. REPO switches are powered from the same supply.
3. All Auxiliary Control Devices and Cabling to be Field Supplied except as noted.
4. Overtemp Alarm contacts change state when unit overtemperature is sensed.
5. RS-232 Port connected to low voltage terminal strip inside unit. Connect using suitable 300V communication cable.

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## 2.0 EQUIPMENT INSPECTION AND START-UP

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### 2.1 Internal Inspection

A detailed internal inspection should be performed after the unit is in place and before it is energized, to ensure trouble-free start-up. The same internal inspection should be carried out when performing preventive maintenance.



#### WARNING

**VERIFY THAT ALL INCOMING POWER AND CONTROL CIRCUITS ARE DE-ENERGIZED AND LOCKED OUT BEFORE PERFORMING THE INTERNAL INSPECTION.**

**Open the unit** - Gain access to the internal components of the Datawave unit by removing the exterior panels.

**Visually inspect** - Be sure wiring and components are not damaged. Check capacitors for oil leaks or bulging.

**Check power connections** - Check all power connections for tightness. Refer to **Table 5** for torque requirements of all electrical connections.

**Perform formal detailed inspection** - Follow the procedures described in **3.0 - Inspection and Start-Up Checklist** when performing detailed inspection.

### 2.2 Start-Up

**Checklists** - Follow the detailed the step-by-step checklist (**3.0 - Inspection and Start-Up Checklist**) when installing and starting-up the Datawave Magnetic Synthesizer.

**Initial system start-up** - a qualified electrician should be employed to perform the equipment inspection and start-up. Liebert system start-up may be arranged by calling your local Liebert sales representative or Liebert Global Services. In the USA, call 1-800-543-2378.

**Warranty effectivity** - A copy of the appropriate checklist (furnished with the equipment) must be completed, signed, dated and returned to the Factory. Warranty coverage of the equipment is not effective unless the Checklist is received by the Factory.



#### WARNING

**EQUIPMENT INSPECTION AND START-UP SHOULD BE PERFORMED ONLY BY TRAINED PERSONNEL.**

**HAZARDOUS VOLTAGES ARE PRESENT DURING START-UP PROCEDURES.**

**ELECTRICAL SAFETY PRECAUTIONS MUST BE FOLLOWED THROUGHOUT INSPECTION AND START-UP.**

**Table 5 Torque Specifications (Unless Otherwise Labeled)**

| <b>A. Nut and Bolt Combinations</b> |                         |            |   |            |
|-------------------------------------|-------------------------|------------|---|------------|
| <b>Bolt Shaft Size</b>              | <b>Grade 2 Standard</b> |            | <b>Electrical Connections with Belleville Washers</b> |            |
|                                     | <b>lb-in</b>            | <b>N-m</b> | <b>lb-in</b>  | <b>N-m</b> |
| 1/4                                 | 53                      | 6.0        | 46  | 5.2        |
| 5/16                                | 107                     | 12.1       | 60  | 6.8        |
| 3/8                                 | 192                     | 21.7       | 95  | 10.7       |
| 1/2                                 | 528                     | 60.0       | 256   | 28.9       |

| <b>B. Main Input and Main Output Circuit Breakers</b> |                  |                        |            |
|---|------------------|------------------------|------------|
| <b>Breaker Size</b>                                   | <b>Wire Size</b> | <b>Compression Lug</b> |            |
|   |                  | <b>lb-in</b>           | <b>N-m</b> |
| Up to 110 Amp   | #14 - #10        | 35                     | 4.0        |
|   | #8 - #3          | 100                    | 11.4       |
|   | #2 - #3/0        | 150                    | 17.1       |
| 125 to 250 Amp  | #3 - #1          | 200                    | 22.8       |
|   | #1/0 - 350 kcmil | 275                    | 31.3       |
| 300 to 800 Amp  | #2 - 600 kcmil   | 375                    | 42.7       |

| <b>C. Panelboard Main Circuit Breaker</b> |              |            |
|---|--------------|------------|
|   | <b>lb-in</b> | <b>N-m</b> |
| Busbar-to-Breaker                         | 90           | 10.2       |
| Compression Lug                           | 250          | 28.5       |

| <b>D. Branch Circuit Breakers</b> |              |            |
|-----------------------------------|--------------|------------|
|                                   | <b>lb-in</b> | <b>N-m</b> |
| Up to 30 Amp                      | 35           | 4.0        |
| 40 to 100 Amp                     | 45           | 5.1        |

| <b>E. Terminal Block Compression Lug</b> |              |            |
|--|--------------|------------|
| <b>AWG Wire Size or Range</b>            | <b>lb-in</b> | <b>N-m</b> |
| #14 - #10                                | 35           | 4.0        |
| #8                                       | 40           | 4.5        |
| #6 - #00                                 | 120          | 13.6       |
| #6 - 350 kcmil                           | 275          | 31.1       |
| #4 - 500 kcmil                           | 375          | 42.4       |

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## 3.0 INSPECTION AND START-UP CHECKLIST

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Unit Serial Number: \_\_\_\_\_

Unit Model Number: \_\_\_\_\_

Date: \_\_\_\_\_

### 3.1 Inspection



#### WARNING

**ALL EQUIPMENT INSPECTION PROCEDURES ARE TO BE PERFORMED WITH POWER TO THE UNIT TURNED OFF AND LOCKED OUT**

#### Exterior Inspection

- \_\_\_ 1. Conform that the exterior of unit is undamaged (including cables and receptacles, if furnished).
- \_\_\_ 2. Confirm that service and ventilation clearances are adequate (See Installation Manual Figure 1-3.)

#### Interior Inspection

- \_\_\_ 3. Remove accessible exterior panels.



#### NOTE

*When removing exterior panels, DISCONNECT PANEL GROUND WIRES BY SEPARATING THE EASY-DISCONNECT TERMINALS LOCATED ON THE FRAME. When replacing exterior panels, reconnect all panel ground wires.*

- \_\_\_ 4. Inspect all wire and conductor insulation for damage.
- \_\_\_ 5. Inspect all wiring connections to the capacitor banks. Re-secure the connections if necessary. Remove capacitor tray retaining screws which prevent trays from sliding during shipping.
- \_\_\_ 6. Check all transformer terminal connections for tightness. Retorque if necessary.
- \_\_\_ 7. Check all breaker connections for tightness. Retorque if necessary.
- \_\_\_ 8. Check all terminal mounting bolts for tightness. Retorque if necessary.
- \_\_\_ 9. Check transformer mounting bolts for tightness. Retorque if necessary.
- \_\_\_ 10. Remove any foreign objects from the components or the interior area of the unit. **Make sure air passages on transformers are clear and free of debris.**
- \_\_\_ 11. Check that the cooling fan blades move freely, and that the intake and exhaust air screens are clean and free of obstructions.
- \_\_\_ 12. Replace side panels, leaving access to circuit breakers for the following start-up procedure.



#### NOTE

*When replacing the side panels, be sure to reconnect the panel ground wires.*

---

## 3.2 Start-Up



### WARNING

**START-UP PROCEDURES SHOULD BE PERFORMED ONLY BY QUALIFIED PERSONNEL. HAZARDOUS VOLTAGES ARE PRESENT IN THE EQUIPMENT THROUGHOUT THE MAJORITY OF THE START-UP PROCEDURE. PROCEED WITH CAUTION.**

- \_\_\_ 13. Make certain that **all** circuit breakers are in the OFF position and that all power to the unit is locked out.
- \_\_\_ 14. Place BYPASS Switch (if provided) in the “NORMAL” position.
- \_\_\_ 15. Turn ON the building input power to the unit.
- \_\_\_ 16. Check the phase rotation at the main input breaker. Phase rotation should be A, B, C, left-to-right.
- \_\_\_ 17. Check and record the input voltages at the main input breaker. Measured voltages should correspond to the unit's nameplate input voltage:  
**Volts, phase A to phase B** = \_\_\_\_\_  
**Volts, phase B to phase C** = \_\_\_\_\_  
**Volts, phase C to phase A** = \_\_\_\_\_
- \_\_\_ 18. Turn ON the main input breaker; wait one minute. (If breaker trips OFF, check for wiring errors, including control wiring. Contact Liebert Global Service or the local factory representative for assistance.)
- \_\_\_ 19. Check the phase rotation at the line side terminals (top) of the output circuit breaker(s). The rotation should be A, B, C, left-to-right.
- \_\_\_ 20. Check and record the input voltages at the line-side terminals of the output circuit breaker. Measured voltages should correspond to the unit's nameplate input voltage.  
**Volts, phase A to phase B** = \_\_\_\_\_  
**Volts, phase B to phase C** = \_\_\_\_\_  
**Volts, phase C to phase A** = \_\_\_\_\_  
**Volts, phase A to neutral** = \_\_\_\_\_  
**Volts, phase B to neutral** = \_\_\_\_\_  
**Volts, phase C to neutral** = \_\_\_\_\_  
Measure and record the initial capacitor currents according to **5.3 - Datawave Magnetic Synthesizer Check**.  
If output voltages or capacitor currents are incorrect, check for wiring errors. Contact Liebert Global Services or the local factory representative for assistance.
- \_\_\_ 21. Verify that all internal cooling fans are operating.
- \_\_\_ 22. Depress the local EMERGENCY POWER OFF switch and verify system shutdown. Turn the unit back on.
- \_\_\_ 23. Repeat Step **22** for each remote EMERGENCY POWER OFF switch with which the system is equipped.  
Note that the remote EMERGENCY POWER OFF switch may shut down more equipment than just the Datawave unit.





**NOTE**

*Steps 24 through 32 apply to the optional Bypass Switch. If the system is not equipped with a bypass switch, proceed directly to Step 33.*

- \_\_\_ 24. Turn the bypass switch to “AUXILIARY” position.
- \_\_\_ 25. Turn ON the building power to the bypass input.
- \_\_\_ 26. Check the phase rotation at the line side of the Bypass Input Breaker. Phase rotation should be A, B, C, left-to-right.
- \_\_\_ 27. Check and record the input voltages at the line side (top) of the bypass input breaker:  
**Volts, phase A to phase B = \_\_\_\_\_**  
**Volts, phase B to phase C = \_\_\_\_\_**  
**Volts, phase C to phase A = \_\_\_\_\_**  
**(NOTE THAT THE NOMINAL VOLTAGE LEVEL OF THE BYPASS INPUT MUST BE THE SAME AS THE RATED NOMINAL OUTPUT LEVEL OF THE DATA-WAVE - THERE IS NO STEP-DOWN OF THE BYPASS VOLTAGE INSIDE THE UNIT.)**
- \_\_\_ 28. Turn ON the bypass input breaker. Check the phase rotation at the line side terminals of the output breaker(s). The rotation should be A, B, C, left-to-right.
- \_\_\_ 29. Check and record the voltages at the line-side terminals of the output circuit breaker:  
**Volts, phase A to phase B = \_\_\_\_\_**  
**Volts, phase B to phase C = \_\_\_\_\_**  
**Volts, phase C to phase A = \_\_\_\_\_**  
**Volts, phase A to neutral = \_\_\_\_\_**  
**Volts, phase B to neutral = \_\_\_\_\_**  
**Volts, phase C to neutral = \_\_\_\_\_**



**NOTE**

*These voltages should not differ significantly from those recorded in Step 20. If there is more than ±3% variation, turn OFF the building power to the unit, then verify proper tap settings of the bypass transformer (or the building distribution transformer if there is no bypass transformer). Then repeat Steps 24 through 29.*

- \_\_\_ 30. Depress the local EMERGENCY POWER OFF switch and verify system shutdown **via Reserve Input Breaker trip**. Turn the unit back on.
- \_\_\_ 31. Turn off all breakers and return Bypass switch to “NORMAL” position.

---

### 3.3 Monitoring System Check Out

- \_\_\_ 32. **BASIC INDICATORS, Main Input:**
  - \_\_\_ a. With the bypass switch in NORMAL position, turn the building power to the main input ON, then turn the main input breaker ON.
  - \_\_\_ b. Check that the local EMERGENCY POWER OFF button is illuminated and that the second indicator (TRANSFORMER OVERTEMP or ALARM PRESENT) is off.
  - \_\_\_ c. Return all breakers to OFF.
- \_\_\_ 33. **BASIC INDICATORS (With Bypass Option)**
  - \_\_\_ a. With the bypass switch in AUXILIARY position, turn the building input power ON, then turn the main input breaker ON.
  - \_\_\_ b. Check that the local EMERGENCY POWER OFF button is illuminated and that the TRANSFORMER OVERTEMP is off. **If “UNIT IN BY-PASS MODE” is alarmed, the ALARM PRESENT indicator should be ON.**
  - \_\_\_ c. Return all breakers to OFF and bypass switch to NORMAL position.
- \_\_\_ 34. **MANUAL RESTART CHECK. With Restart Selector Switch in the manual position:**
  - \_\_\_ a. Turn on building power to the Main input. Turn Main Input breaker ON.
  - \_\_\_ b. Turn off all building power to unit.
  - \_\_\_ c. Observe that Main Input breaker automatically trips open upon power loss.
  - \_\_\_ d. Restore main input building power and return Main Input breaker to ON.
- \_\_\_ 35. **POWER MONITOR PANEL.**

If unit is equipped with a Power Monitor Panel, turn the unit ON, and check to ensure that the voltage values indicated by the Monitor Panel correspond to the voltage values measured at the input and output circuit breaker (Steps 17 and 20).
- \_\_\_ 36. **CENTRALIZED MONITORING.**

If the unit is connected to a Centralized Monitoring System, turn the unit and Centralized Monitoring System ON. Verify proper communication to the monitoring system.
- \_\_\_ 37. **CONTROL VOLTAGE:**
  - \_\_\_ a. Obtain access to the low voltage terminals in the Low Voltage Junction Box (if used), or in the low voltage control section inside unit.
  - \_\_\_ b. Turn the unit ON. Measure and record the control voltage on terminals 1 (+) and 3 (COM).
  - \_\_\_ c. **Control voltage** = \_\_\_\_\_  
(Voltage should be between 20 and 28 VDC.)
- \_\_\_ 38. **CUSTOMER ALARMS. If customer alarms are provided:**
  - \_\_\_ a. Turn the unit ON and simulate alarm operation by jumpering the appropriate low voltage control terminals. (Refer to the control wiring installation drawing furnished with the unit.)
  - \_\_\_ b. Verify correct alarm annunciation by the Power Monitor Panel and by the Centralized Monitoring System (if used).

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### 3.4 Equipment Connection Check Out (For Units With Output Distribution Cables)



#### CAUTION

All loads should be disconnected or turned off before proceeding with the following steps.

For units with output distribution cables, be sure that there are **NO** output receptacles connected to load equipment plugs, and that the receptacles are not in contact with foreign objects.

Pay special attention to those output cables intended for direct-wiring connection; the exposed conductor ends of these cables must not be in contact with each other or with any foreign objects.

- \_\_\_ 39. With Bypass switch in the NORMAL position, turn on main input power to unit, then turn on the panelboard main output breaker(s).
- \_\_\_ 40. Individually turn on each branch circuit breaker and check the output voltage (also phase rotation, if a 3-phase circuit) at the receptacle or cable end.
- \_\_\_ 41. Turn OFF all branch circuit breakers and the panelboard main output circuit breaker(s).
- \_\_\_ 42. Connect the load equipment per equipment manufacturer's specification and recommendations.
- \_\_\_ 43. Turn the panelboard main output breaker(s).
- \_\_\_ 44. Turn on branch circuit breakers to the load equipment. **Observe the power-up sequence recommended by the equipment manufacturer.**
- \_\_\_ 45. Verify that all load equipment operates properly.
- \_\_\_ 46. Replace all unit panels.

After Inspection and Start-Up procedure is complete, the completed Start-Up & Inspection form furnished with the unit should be signed and returned to:

Liebert Corporation  
1050 Dearborn Drive  
P.O. Box 29186  
Columbus, Ohio 43229



#### NOTE

*Warranty is not in effect unless Inspection and Start-up form is received by the factory.*

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## 4.0 OPERATING INSTRUCTIONS

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### 4.1 Start-Up Procedures

**Before the unit is placed into service after initial installation**, after equipment relocation, or after equipment has been de-energized for an extended period of time, perform equipment inspection and start-up procedures as detailed in **2.0 - Equipment Inspection and Start-Up** and **3.0 - Inspection and Start-Up Checklist**.

**After initial system start-up**, the following guidelines can be used for standard equipment operation. These guidelines should be reviewed for any special equipment modifications, special site considerations, or company policies that may require changes to the standard equipment operation.

#### 4.1.1 Emergency Shutdown

**To perform an immediate system shutdown** during emergency conditions, lift the protective clear cover and push the “Emergency Power Off” (EPO) switch located on the unit front door.



#### NOTE

*Depending on the particular control circuit wiring, operation of the unit EPO switch may cause other equipment to also shutdown.*

If site is equipped with a Remote Emergency Power Off (REPO) switch (such as is required by NEC Article 645 at the principal exit doors), to perform an immediate room shutdown, activate one of the REPO switches.

#### 4.1.2 Normal System Shutdown

**To perform a normal system shutdown**, perform an orderly load equipment (computer system) shutdown according to the load equipment manufacturer’s recommended shutdown sequence. The load equipment can be turned **OFF** at each piece of load equipment or at the power center’s output distribution (circuit breaker) panels located behind the unit’s front door. Turn **OFF** all unit output breakers, then turn **OFF** the unit’s main input circuit breaker. To remove all power from the unit, turn **OFF** the building power to the unit’s input breaker or junction box.

#### 4.1.3 Normal System Turn ON

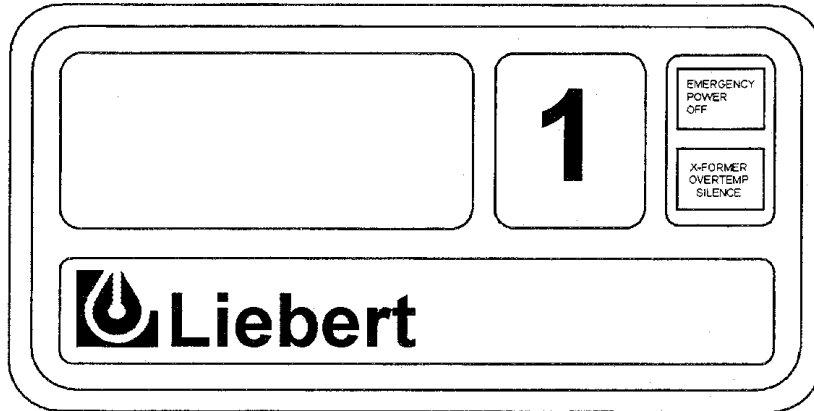
**Make certain all unit circuit breakers are in the OFF position.** All unit main circuit breakers are located behind the front doors. Output Distribution Breakers on Self-Contained units are located behind the right side doors. Turn **ON** building power to the unit. Turn **ON** the unit’s main input circuit breaker. If the circuit breaker has been tripped **OFF** (instead of being turned **OFF**), the circuit breaker handle must be moved to the **OFF** position before being turned **ON**. If the unit has a voltage monitoring panel, verify proper output voltages before turning **ON** output circuit breakers. Turn **ON** the main output or panelboard main breakers. Individually turn **ON** each output circuit breaker following the load equipment manufacturer’s start-up sequence.

#### 4.1.4 Manual Restart

If unit’s manual restart feature has been selected, the unit’s main input circuit breaker will be tripped upon a power outage, preventing repetitive application of unstable voltage and allowing for an orderly system restart. If the main input circuit breaker is tripped upon a power outage, after power is restored, follow the **Normal System Turn ON** outlined above.

## 4.2 Basic Monitor Panel (Units Without Monitoring)

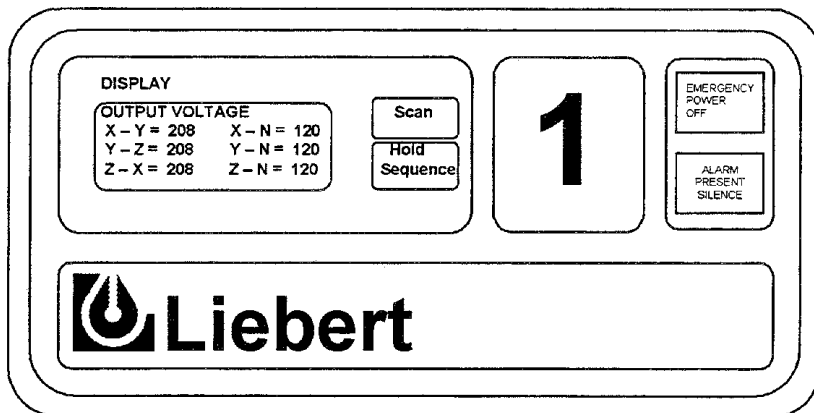
**XFORMER OVER TEMP/SILENCE** - Upon occurrence of a transformer overtemperature condition, the “Xformer Over Temp/Silence” switch will become illuminated and the audible alarm will be activated. Pushing the “Xformer Over Temp/Silence” switch will silence the audible alarm. The cause of the overtemperature condition should be investigated and corrected. Possible causes include unit overload, inadequate ventilation, high or low input voltage, or monitoring malfunction. Failure to correct the overtemperature condition may result in an automatic system shut-down due to the second stage of overtemperature sensing. After correction of the alarm condition, the alarm will automatically set.



## 4.3 Power Monitor Panel

**Monitored Parameters** - A 4 x 20 character LCD display is provided to indicate the input voltages (line-to-line), output voltages (line-to-line) and line-to-neutral), output currents (each phase, neutral, and ground), output voltage THD, output current THD, crest factor, K-factor, output kVA, kW, kW-Hours, power factor, percent load, and output frequency.

Pressing the “Scan” switch will activate the “Autoscan” mode where all monitored parameters are sequentially displayed automatically. Momentarily pressing the “Hold/Sequence” switch interrupts the “Autoscan” mode. Pressing the “Hold/Sequence” sequentially displayed parameters.



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**Alarms** - Upon occurrence of any of the following alarms, the alarm message appears on the LCD display, the “Alarm Present/Silence” switch is illuminated, and the audible alarm is activated. Pressing the “Alarm Present/Silence” switch silences the audible alarm. After the alarm condition is corrected, the alarm can be reset by pressing the “Alarm Present/Silence” switch when prompted by the LCD display or by way of any Central Monitoring System.

- **Output Overvoltage** - Indicates one or more of the output phase voltages has exceeded the preset limit (normally +6% of nominal). The high output voltage should be verified and corrective action taken. In the absence of other procedures, a normal (orderly) system shutdown should be performed to prevent load equipment damage.
- **Output Undervoltage** - Indicates one or more of the output phase voltages has exceeded the preset limit (normally -13% of nominal). The low output voltage should be verified and corrective action taken. In the absence of other procedures, a normal (orderly) system shutdown should be performed to prevent load equipment damage.
- **Output Voltage THD** - Indicates that the voltage distortion on one or more of the output phases has exceeded the preset limit (normally 10% THD). The cause of the high output voltage distortion should be investigated and corrective action (if any) taken.
- **Transformer Overtemp** - Indicates a unit transformer overtemperature condition. The cause of the overtemperature condition should be investigated and corrected. Possible causes include unit overload, excessive non-linear loading, inadequate ventilation, high or low input voltage, or monitoring malfunction. Failure to correct the overtemperature condition may result in an automatic system shutdown due to the second stage of overtemperature sensing.
- **Output Overcurrent** - Indicates one or more of the output phase currents has exceeded the preset limit (normally 95% of the unit’s full load amp rating). The overcurrent condition should be verified and corrective action taken. In the absence of other procedures, some of the output loads should be turned off to reduce unit loading. If unbalanced phase currents exist, some of the loads should be shifted from the higher loaded phase(s) to the lower loaded phase(s).
- **Neutral Overcurrent** - Indicates that the neutral current has exceeded the preset limit (normally 95% of the unit’s full load amp rating). The overcurrent condition should be verified and investigated to see if corrective action is required. In some cases, high neutral current indicates phase current unbalance which should be corrected. Where high neutral currents are the result of harmonic load currents, all affected components (including output wiring) should be verified to be suitable for the current.
- **Frequency Deviation** - Indicates that the output frequency has exceeded preset limits (normally  $\pm 0.5$  Hz). The frequency deviation should be verified and the cause investigated and corrected.
- **Phase Sequence Error** - Indicates that the output phase sequence is not A, B, C. The phase sequence should be verified and corrective action taken. 3-phase loads sensitive to phase sequence should not be operated without proper phase sequence.
- **Phase Loss** - Indicates that one or more of the phase voltages is low or missing. The low voltage condition should be verified and corrective action taken. In the absence of other procedures, a normal (orderly) shutdown should be performed to prevent equipment damage.
- **Ground Overcurrent** - Indicates the system ground current has exceeded the preset limit (normally 5 amps). The overcurrent condition should be verified and corrective action taken. Possible causes are wiring errors, ground faults, or excessive leakage current.
- **Customer Alarms (5)** - Indicates customer-designated alarms. The cause and corrective action depend on the nature of the alarm. See **1.2.7 - Control Wiring Connections** for contact closure connection information.

**To Set Unit Clock** - To set the clock from the unit front panel, simultaneously press the Scan and Hold membrane switches while the time and date screen is displayed on the LCD. A cursor should appear on the selected time and date field. Use the Scan switch to increment the highlighted field and the Hold switch to decrement the highlighted field. Use the Silence push button to select the next time and date field. The time can be displayed in AM/PM or 24 hour format. Simultaneously press the Scan and Hold switches to exit the clock set screen.

**RS-232 ASCII Communications Port** - Units with power monitoring are equipped with an isolated RS-232 ASCII Communications Port, which allows access to unit monitored parameters and alarm information. The RS-232 port connections are located on the low voltage control terminal strip inside the unit. See typical control wiring **Figure 13**.

The ASCII interface default parameters are as follows:

- Interface:** RS-232 Using EIA Voltage Levels
- Baud Rate:** 9600
- Parity:** None
- Data Bits:** 8
- Stop Bits:** 1
- Terminator:** <CR>
- Hand Shaking:** Not Supported
- Structure:** Half-Duplex
- Echo:** OFF
- Change to Receive After Transmit:** 1.28 msec
- Min. Delay to Transmit After Receive:** 120  $\mu$ sec
- Max. Response time Turn Around:** 300 msec
- Max. Response Completion Time:** 500 msec
- Min. Delay Between Commands:** 500 msec
- Max. Intercharacter Delay:** 12.5 msec

The ASCII port uses a Query-Response Format.

The list of available customer commands are shown in **Table 6**. Only one command is serviced at a time. Valid commands are terminated with a carriage return [0Dh]. Commands are accepted in upper or lower case. Responses are in upper case, terminated with a line feed [0Ah] and carriage return [0Dh].

**Table 6 RS-232 ASCII Port Customer Commands**

| Command                        | Description   | Typical Response  |
|--------------------------------|---|---|
| Time?<CR><br>Date?<CR>         | Unit Time<br>Unit Date  | 03:40:37A <LF><CR><br>05-15-97 <LF><CR>   |
| UID?<CR><br>KVA?<CR><br>V?<CR> | Unit ID<br>Nominal kVA<br>Nominal L-L Voltage   | Unit_No._PDU_21B_ _ _ _ <LF><CR><br>0150<LF><CR><br>0208<LF><CR>  |
| SS1?<CR>                       | System Information<br>(20 character fields<br>with comma<br>separators)   | UNIT_MODEL_NUMBER_ _ _ ,SERIAL_NUMBER_ _ _ _ _ _ ,<br>SITE_ID_NUMBER_ _ _ _ _ ,TAG_NUMBER_ _ _ _ _ _ _ _ <LF><CR>   |
| SA?<CR>                        | Number of Active<br>Alarms, 20 character<br>alarms with time<br>stamp.  | 02,OUTPUT_OVERVOLTAGE_ _ ,05-15-97,01:25:30A,<br>OUTPUT_OVERCURRENT_ _ ,05-15-97,01:27:46A<LF><CR>  |
| UPMD?<CR>                      | Monitored<br>Parameters, 32<br>Comma Separated<br>Data Fields.<br>See <b>Table 7</b> for<br>descriptions of field<br>positions. | 0484,0485,0483,0210,0212,0211,0121,0122,0121,0068,<br>0085,0120,0131,0018,0030,0092,0033,0600,0038,0041,<br>0043,0549,0632,0599,00001528,0018,0019,0020,0045,<br>0047,0049,0044<LF><CR> |

**Table 7 Monitored Parameters Data Definitions**

| <b>Field Number</b> | <b>Data Item</b>       | <b>Units</b>      |
|---------------------|------------------------|-------------------|
| 1                   | Input Voltage A-B      | Volts             |
| 2                   | Input Voltage B-C      | Volts             |
| 3                   | Input Voltage C-A      | Volts             |
| 4                   | Output Voltage X-Y     | Volts             |
| 5                   | Output Voltage Y-Z     | Volts             |
| 6                   | Output Voltage Z-A     | Volts             |
| 7                   | Output Voltage X-N     | Volts             |
| 8                   | Output Voltage Y-N     | Volts             |
| 9                   | Output Voltage Z-N     | Volts             |
| 10                  | Output Current X       | Amps              |
| 11                  | Output Current Y       | Amps              |
| 12                  | Output Current Z       | Amps              |
| 13                  | Neutral Current        | Amps              |
| 14                  | Ground Current         | 0.1 Amps          |
| 15                  | Output Power           | kW                |
| 16                  | Power Factor           | 0.01 Power Factor |
| 17                  | Output Power           | kVA               |
| 18                  | Output Frequency       | 0.1 Hz            |
| 19                  | Output Vx THD          | 0.1%              |
| 20                  | Output Vy THD          | 0.1%              |
| 21                  | Output Vz THD          | 0.1%              |
| 22                  | Output Ix THD          | 0.1%              |
| 23                  | Output Iy THD          | 0.1%              |
| 24                  | Output Iz THD          | 0.1%              |
| 25                  | Output kW-Hrs          | kW-Hrs            |
| 26                  | Output Ix Crest Factor | 0.1               |
| 27                  | Output Iy Crest Factor | 0.1               |
| 28                  | Output Iz Crest Factor | 0.1               |
| 29                  | Output Ix K-Factor     | 0.1               |
| 30                  | Output Iy K-Factor     | 0.1               |
| 31                  | Output Iz K-Factor     | 0.1               |
| 32                  | Output Loading         | % of Full Load    |



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## 5.0 MAINTENANCE

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### 5.1 Corrective Maintenance (Repair)

Even the most reliable equipment may fail. Liebert Global Services (LGS) is at your service to assure fast repair and minimize downtime of your installation.



#### WARNING

**ONLY QUALIFIED SERVICE PERSONNEL SHOULD PERFORM MAINTENANCE ON THE DATAWAVE SYSTEM**

**Standard electrical troubleshooting procedures** should be used to isolate problems in the Datawave power conditioner. If there are questions, don't hesitate to contact Liebert Global Services.

**Repair or replacement of standard items**, such as circuit breakers and indicator lights can be either handled by qualified electricians or referred to Liebert Global Services.

**Repairs related to the Datawave Monitoring System or power conditioning elements** should be referred to authorized qualified service personnel with training on the servicing of the unit. For assistance contact Liebert Global Services.

**To contact Liebert Global Services for information or repair service in the USA, call 1-800-543-2378.**

### 5.2 Preventive Maintenance (Inspection & Cleaning)

Air circulation through the Datawave cabinet may cause dust to accumulate on internal components. Cleaning should be done as necessary during electrical inspections.

Annual general system inspections, cleaning, and operation checks are recommended to ensure system performance and long service life.



#### WARNING

**ONLY QUALIFIED SERVICE PERSONNEL SHOULD PERFORM MAINTENANCE ON THE DATAWAVE SYSTEM. ALL VOLTAGE SOURCES TO THE DATAWAVE SYSTEM MUST BE DISCONNECTED BEFORE INSPECTING OR CLEANING WITHIN THE CABINET.**

#### Inspection Schedule

- It is difficult to establish a schedule for periodic cleanings since conditions vary from site to site. Inspections after the first 24 hours, 30 days, and 6 months of operation should help determine a pattern for the inspection schedule.
- Ventilation openings and grilles should be inspected and cleaned as required, every six months to a year.
- Electrical connections and component mountings should be inspected after the first 24 hours, 30 days, and 6 months of operation. Inspections should be conducted annually thereafter. Electrical connections using Belleville washers and locknuts do not require retorquing after initial system start-up. Tightness of all other electrical connections should be checked during annual electrical inspections.
- A complete inspection and operational checkout should be performed annually. This is best done by performing the inspection and start-up procedure as detailed in **3.0 - Inspection and Start-Up Checklist** and **5.3 - Datawave Magnetic Synthesizer Check**.
- Liebert Global Services offers a complete range of preventive maintenance services. These include thorough equipment performance checks and calibration of electronics. Contact Liebert Global Services. In the USA call **1-800-543-2378**.



#### NOTE

*Extended product warranties are dependent on proper, regular, preventive maintenance. Contact Liebert Global Services for details.*

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### 5.3 Datawave Magnetic Synthesizer Check



#### WARNING

**ONLY AUTHORIZED QUALIFIED SERVICE PERSONNEL TRAINED ON THE OPERATION OF THE DATAWAVE SYSTEM SHOULD PERFORM MAINTENANCE TO THE DATAWAVE POWER CONDITIONING ELEMENTS.**

The following is a brief procedure to determine if the Datawave Magnetic synthesizer Power Conditioning elements are operating properly. This procedure does not supersede the requirements for a thorough visual and physical inspection to determine hot components, loose connections, etc. Recommended practice is to record the measure voltage and currents at start-up and at each preventive maintenance visit for comparison purpose and trend analysis.

- When the Datawave is operating properly, the output voltages (line-to-line and line-to-neutral) and the internal capacitor currents should be balanced. The capacitors are divided into four (4) three-phase banks, C1 through C4. C1 (secondary winding) and C4 (primary winding) are the main ferroresonant capacitor banks whose currents oscillate in conjunction with the six saturating pulse transformers. C2 and C3 are capacitors associated with the second and third harmonic traps. Under normal operation, the output pulses of the six saturating transformers are combined to form a step-wave approximation of a sine wave. The second and third harmonic traps are used for dynamic conditions (such as start-up) to ensure proper transformer saturation sequence for a sine wave output.
- In order to properly test the operation of the synthesizer, ensure that the input voltage to the unit is near nominal (within 5%) and relatively balanced (within 3% of the average). To avoid any possible effects of unbalanced loading or harmonic load currents, the unit should be tested at no load. Also, the unit should be tested at normal operating temperatures.
- With a true RMS voltmeter, measure the output voltages line-to-line and line-to-neutral. The output voltage should be balanced within 1% of the average. The average should be within 3% of the nameplate output voltage.
- With a true RMS clamp-on current meter, measure the current of each phase of each capacitor bank.
- C2 currents can be measured on wires W141, W142, and W143 at the harmonic traps TX11, TX12, and TX13.
- C3 currents can be measured on wires W150, W151, and W152 at the harmonic traps TX14, TX15, and TX16.
- C4 can be measured by clamping on all capacitor wires connected to terminal 1 of transformer TX4 (W160, 164), TX5 (W161, 162), and TX6 (W163, 165). C4 can also be measured at the capacitor tray connectors. NOTE: If parallel wires are used, measure the current in all parallel wires simultaneously to avoid summing errors.
- The C1 capacitor current is sometimes difficult to measure directly due to wire routing. For ease of measurement, the C1 plus the C2 and C3 currents can be measured. Measure the C1+C2+C3 currents by clamping on all capacitor wires connected to terminal 3 of transformers TX4, TX5, and TX6. C1 currents can also be measured on wires W166, 170, W167, 168, and W169, 171 at the capacitor tray connectors.
- The measured capacitor currents should be balanced within 1.5% or 1 amp (whichever is greater). The percent unbalance equals the highest phase minus the lowest phase divided by the average of the 3-phases times 100%. The average of the measured currents should be within 5% or 1 amp (whichever is greater) of the nominal value measured at start-up. If output voltage or capacitor currents are out of tolerance, check for failed capacitors, faulty wiring, or other failed components. Contact Liebert Global Services for assistance.







## **Datawave<sup>®</sup> Magnetic Synthesizer**

**100 kVA to 200 kVA; 50 and 60 Hz**

### **Technical Support**

|                               |   |
|-------------------------------|---|
| U.S.A.                        | 1-800-222-5877  |
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| Germany                       | +49 89 99 19 220  |
| Italy                         | +39 2 98250 1   |
| Netherlands                   | +00 31 475 503333   |
| E-mail                        | upstech@liebert.com   |
| Web site                      | <a href="http://www.liebert.com">http://www.liebert.com</a> |
| Worldwide FAX<br>tech support | 614-841-5471  |

### **The Company Behind The Products**

With more than 500,000 installations around the globe, Liebert is the world leader in computer protection systems. Since its founding in 1965, Liebert has developed a complete range of support and protection systems for sensitive electronics:

- Environmental systems: close-control air conditioning from 1.5 to 60 tons.
- Power conditioning and UPS with power ranges from 250 VA to more than 1000 kVA.
- Integrated systems that provide both environmental and power protection in a single, flexible package.
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