# DSP Graphic Voltage Controller (GVC)

## Retrofit Installation and Startup Guide

**Dwg. A131853**

**Revisions**

| Rev. | Date | Author | Description |
|---|---|---|---|
| 0 | 9/9/10 | F.Skovran | Initial |
| A | 11/12/10 | F.Skovran | Corrected General Wiring Diagram |
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| | | | |

## WARNING! High Voltage!

**T/R power supplies contain dangerous and potentially lethal voltages.**

- Do not attempt to install the GVC module into a T/R controller while it is operating.
- Turn off power to the T/R set and ground its high-voltage bushing before doing any physical or electrical installation of GVC circuit boards.
- Take precautions against shock or electrocution.
- Ground any electrical storage devices such as capacitors before touching electrical connections.
- Do not stand in water or on damp surfaces while working on a T/R set.
- NWL will not be liable for death, injury, or damages resulting from the unsafe installation or operation of this device.

# How to Use This Manual

You are about to install the most advanced voltage controller available for electrostatic power supplies: the NWL Graphic Voltage Controller (GVC).

For all its sophistication, the GVC is easy to use. That's because it utilizes a multi-line graphical screen that displays ESP operating parameters and guides you through any reconfigurations.

It's also simple to install, especially if you're replacing an existing NWL automatic voltage controller.

If you are replacing an NWL automatic voltage controller, such as the MicroPack III™, or a earlier version of the GVC, read ***Section 1: Before You Start*** first. Then turn to ***Section III: Installation and Configuration***. You probably do not need to read ***Section II: System Requirements and Compatibility***, since your new GVC module will use the same wiring and the same trigger board as the existing NWL controller.

If you are replacing a controller from another supplier***, read all three sections and carefully follow all instructions***. This will help assure a smooth installation and fast startup.

If you are familiar with simple mechanical and electrical installation procedures, you should have little trouble adding the GVC to your ESP power supply. This manual will guide you every step of the way.

You should understand how to use the GVC's graphical display and keypad module in order to complete system configuration and checkout. The procedure is pretty much self-evident, but if you find some instructions in this manual confusing, consult the "Basics of Display/Keypad Use" introductory section of the Graphic Voltage Controllers User's Guide. You may also want to read the short *'What the Symbols Mean'* topic in the "How to Use This Manual" section of the **User's Guide**. It explains the typographical conventions we use in that guide and this one to represent on-screen items. Both **User's Guide** introductory sections appear just before Chapter One.

If you have any questions, contact NWL technical support at 1-800-PICK-NWL. We welcome user suggestions on improving any of our manuals or products.

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# BEFORE YOU START

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# Chapter 1: Basic Procedures

***Safety, Noise/Spike Prevention, Tools, Cabling, Upgrading***

## Follow Safety Precautions

***WARNING!*** Transformer/rectifier power supplies for electrostatic precipitators (T/R sets) contain dangerous and potentially lethal voltages. For your safety, observe the following precautions:

- De-energize (turn off power to) the T/R set and ground its high voltage bushing before attempting the physical or electrical installation of any GVC circuit boards.
- Take precautions against shock and electrocution.
- Ground any electrical storage devices, such as capacitors, before attempting to work on your T/R set or controller.

Do not stand in water or on damp surfaces while working on the T/R set or controller.

NWL, its parent corporation and affiliates will not be liable for death, injury or damages resulting from the unsafe installation or use of this device.

## Guard Against Noise and Spikes

Noise and spikes in your electrical supply can cause malfunctions in electronic control systems. You need "clean" power for proper operation and to prevent damage. We strongly recommend you take the following steps to insure noise- and spike-free power. You will find more specific instructions later in this manual.

***Check the electrical ground***

If you're using the GVC as a direct replacement for an older analog voltage controller, the existing ground may not be adequate for reliable operation. We recommend that you use *at least* a #6AWG ground with the control module, *tied directly to the earth ground from the T/R set control cabinet.*

***Avoid long wiring runs to the SCRs***

Install trigger board module G70050 as close to the SCRs as possible to keep wiring runs short. This will reduce the chance of picking up noise.

***Install surge protection on feedback circuits***

Some sites may have problems with noise spikes generated in the wiring by precipitator sparking. To prevent this, install MOV-based surge arrestors on the secondary feedback circuits. The arrestors should be rated between 25VDC and 120VDC. We recommend that you install them where the feedback wiring terminates in the T/R set control cabinet.

Severe surging, or spiking, calls for stronger measures. Isolation amplifiers or EMI filters will solve most problems. However, they are rarely necessary.

***Follow good wiring practice***

Keep the 480VAC power supply lines physically separated from the signal and control lines, so the controller doesn't pick up noise from the high-voltage cables.

***Keep spikes off the power lines***

Variable frequency drives connected to the 480VAC power lines can induce transient spikes into those lines and the 120VAC circuits they feed. Large transients that reach the GVC can cause loss of line synchronization or false firing of the SCRs. The remedy: add filtering on either the 480VAC or 120VAC lines to remove the spikes. Contact NWL for additional assistance.

## Tools Required

Standard mechanical and electrician's tools are fine for most installations. These include

- wire cutters/strippers
- screwdrivers, pliers, nut drivers
- electric drill
- hole cutter for T/R set control cabinet (optional)
- volt/ohm meter
- clamp-on current meter

For system checkout we strongly recommend that you use an *external true RMS meter* to calibrate the digital metering on the GVC. This will give you more accurate readings on an SCR-controlled system.

## Feedback Cabling

NWL strongly recommends the use of shielded cable on all feedback wiring to the GVC. Shielding prevents induced noise from other equipment or adjacent AC lines from reaching the unit.

## Upgrading Procedures

Major modifications to your T/R set are usually not required. All that's necessary is care in making the electrical connections. Even non-NWL T/R sets rarely present a challenge. Where modification is required, the procedures are simple and straightforward.

***Upgrading an NWL controller***

If you are replacing an NWL voltage controller, such as the Micropack III, or an earlier version of the GVC, you probably do not need to read ***Section II: System Requirements and Compatibility***. The correct electrical connections are in place and the feedbacks are already properly scaled. You simply hook them up. You may go directly to ***Section III: Installation and Configuration*** for instructions.

***Upgrading another manufacturer's controller***

*You must follow the procedures in Section* ***II: System Requirements and Compatibility*** *to assure correct installation.* Failure to do so may cause improper operation of the GVC or damage to the unit. Incorrect

installation will void your warranty. NWL will not be responsible for any problems resulting from incorrect installation.

However, you will find the instructions in ***Section II*** relatively easy to follow. They tell you how to make sure your system is properly configured before actual installation. For the most part you simply identify the feedbacks, scale them properly, and make sure that the power supply is adequate for operation. If you need to make any modifications for correct GVC operation, they are usually minor.

Once you have completed this preparation you can proceed to the actual installation and configuration process.

Note that your GVC requires 120VAC for operation. **See** ***Section II, Chapter 3: System Requirements****,* for details on supplying this power if it is not already present.

**Section II**

# SYSTEM REQUIREMENTS AND COMPATIBILITY

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# Chapter 2: Does Your System Need Modification?

*Extra Hardware May Be Required*

The NWL GVC Retrofit Kit is shipped with all the hardware required for over 90% of T/R controllers. This takes the form of three separate components:

1. Graphical display and keypad module for front-panel installation
2 T/R control module, for installation inside the control cabinet. This includes the following circuit boards:

    - I/O board, for connecting feedbacks, alarms, etc.
    - CPU board, containing the microprocessor and control circuitry
    - Power supply
    - Tumbling hammer control daughter board (optional)

3. SCR trigger module, for installation at the SCR

If you are upgrading from an NWL Micropack II, Micropack III, or earlier version GVC, you will not need the SCR trigger module, since one is already in place.

We also supply all cables for interconnecting the three major components.

However, there are a few ESP power supplies that require additional hardware to make them compatible with the GVC. If your system falls under any of the categories below, obtain and install the proper parts before installing the GVC. You'll find more complete information in ***Chapter 3: System Requirements***. If you have any questions about these requirements after reading the present chapter and ***Chapter 3,*** contact NWL technical support.

## Saturable Core Reactor Systems

These systems are not compatible with the GVC without modifications to the actual power supply. If the system does not already include SCRs, for example, you will have to add them.

NWL can help you modify saturable core systems for compatibility with the GVC. Contact our technical support staff. In most cases we will need to see the circuit schematic for your saturable core system before we can determine what hardware you will need.

## Connecting Systems with Solid State Relays to Alarm Inputs

Alarm inputs must be based on 120VAC dry-contact logic (relays). If your system uses solid state relays for alarm inputs, you must add load-down resistors of 5KΩ or lower, rated 5W or higher.

See ***Chapter 3: System Requirements*** for more information.

## Alarm Outputs

The GVC has a mechanical relay with dry contacts for a common alarm output. The output contacts are rated for 250VAC/30VDC and are fused for 2.5 amps for system protection. If your alarm annunciation circuit requires different voltages, an auxiliary relay for switching the contactor will need to be installed.

## Feedback Requirements

Certain feedback circuits have specific hardware requirements, as listed below.

***Primary voltage feedback***

This must be supplied by a potential transformer of 10VA or more. *Chapter 3: System Requirements* lists acceptable transformer types. If this transformer-supplied feedback is not available in your system, contact NWL technical support for suggested modifications.

***Primary current feedback***

Primary current feedback should utilize a current transformer (CT) with sufficient capacity to provide 1VA to the GVC in addition to any other circuitry it presently supplies. To meet this requirement you may need to replace the existing CT with a larger one, or add a second CT.

***Milliamp DC feedback***

All precipitator load current must go through a milliamp feedback resistor to provide O-10VDC at rated T/R current. Check to make sure this resistor is in place and properly connected.

## Contactor On/Off Output

The GVC has a mechanical relay with dry contacts for contactor switching. The output contacts are rated for 250VAC/30VDC and are fused for 2.5 amps for system protection. If the contactor uses a 480VAC coil, an auxiliary relay for switching the contactor will need to be installed.

# Chapter 3: System Requirements

*Power, Inputs, Outputs, Feedbacks*

If you are upgrading to the NWL GVC from another manufacturer's voltage controller, you must check your system for two reasons:

1. To identify the various signal and power lines for later hookup;

2. To make sure your ESP power supply meets all requirements for proper GVC operation.

In this chapter we will walk through specifications for each GVC input, output, feedback connection, and power supply connection. We will also suggest ways in which you can correct areas that don't conform to GVC requirements.

*Be sure to label all connections clearly as you check them out. This will make final hookup much easier.*

## Power Input

The GVC requires 120VAC, 50/60Hz. This should be as free of noise and spikes as possible. Proper grounding of the controller, as described in *Chapter 1: Basic Procedures* above, is essential. If your system has variable frequency drives connected to the 480VAC power lines, it is advisable to install filtering on either those lines or the 120VAC circuits they feed to safeguard against potential transient spikes.

## Alarm Inputs

Standard alarm inputs must be based on 120VAC logic with dry contacts (relays). Auxiliary alarms are dry contact 15VDC inputs. The GVC can be configured to work with normally closed or normally open contacts. Normally closed is the default.

Check to see if your system uses solid state relays for alarm inputs. The alarm inputs may not provide enough load for Solid State relay-based alarm inputs to function properly.

If the system uses solid state relays, you may need to add load-down resistors to the circuit(s). Proper load resistors will have a value of 5KΩ or lower and a rating of 5W or higher.

## Remote Enable, Remote On Inputs

The Remote Enable and Remote On inputs are commonly used in conjunction with remote pushbuttons, a Main Fuel Trip, or other sensors to energize or de-energize the T/R set. Both inputs require 120VAC, supplied by dry contacts (relays).

120 VAC must be maintained on the Remote Enable input in order to keep the T/R energized. The loss of the 120 VAC at this input will de-energize the T/R and prohibit it from being energized. Once the Remote Enable input is satisfied, momentary application of 120VAC at the Remote On will energize the T/R set.

Check to see if your system uses solid state relays for Remote Enable and Remote On inputs. The input circuits may not provide enough load for Solid State relay-based systems to function properly.

If your system uses solid state relays, you must add load-down resistors to these circuit(s). Proper load resistors will have a value of 5KΩ or lower and a rating of 5W or higher.

## Alarm Output

The GVC has a mechanical relay with dry contacts for a common alarm annunication. The output contacts are rated for 250VAC/30VDC and are fused for 2.5 amps for system protection. If your alarm annunciation circuit requires different voltages, an auxiliary relay for switching the contactor will need to be installed.

## Contactor On/Off Output

The Contactor On-Off Output energizes the coil of the magnetic contactor. It has a mechanical relay with dry contacts for contactor switching. The output contacts are rated for 250VAC/30VDC and are fused for 2.5 amps for system protection.

Check to make sure your controller is not using a 480VAC contactor coil. If it does use a 480VAC coil, install an auxiliary 120VAC relay to switch contactor power. Drive the relay from the Contactor On/Off Output.

## Feedback Circuits

Feedback from the T/R set allows the GVC to control power in response to sparking and other precipitator behaviors. Each feedback circuit has different electrical requirements. *It is vital to system performance and safety that you properly identify each feedback signal line and make sure its values are properly scaled to the requirements of the GVC.*

You should identify the following feedback signal lines for connection to the GVC.

***Primary Voltage Feedback***

Primary voltage feedback is normally used for metering purposes only. (If there are no secondary voltage feedbacks it is used for voltage limit, undervoltage trip, and overvoltage trip). The primary voltage feedback input will accept 0-150VAC. The required voltage must be supplied by a transformer rated at 10VA or higher.

If your system does not include such a transformer, you must install one. The transformer should be a potential type transformer. We recommend a 4:1 transformer with a 0-150VAC secondary, since 4:1 is the default value for the GVC. Other ratios are usable, but will require reconfiguration of the default parameters.

*Do not install a control transformer in a metering circuit. This will yield misleading readings.*

Depending on your line voltage you may have to select a different transformer ratio. The proper values are shown in the chart below.

| ***Nominal AC Line Voltage*** | ***Potential Transformer Ratio*** |
|---|---|
| 575V | 4:1 |
| 480V (default) | 4:1 (default) |
| 380V | 4:1 |
| 240V | 2:1 |
| 120V | 1:1 |

If a 10VA transformers not available, call NWL technical support to tell us what VA value you have. We may be able to suggest a workable modification.

***Primary Current Feedback***

Primary current feedback provides the GVC to limit the maximum current supplied to the T/R set. It accepts values of 0-5 amps AC. This input signal is provided by a current transformer (CT) in line with the T/R primary.

The CT must have sufficient capacity to supply all components on the loop, including meters, overload relays, current sensors, long wiring runs, etc, and still deliver IVA to the GVC. The following chart shows suggested CT values for a given T/R rating. If you are unsure of your T/R rating, the primary current panel meters on the T/R set enclosure provide a rough guide.

| ***Panel Meter (Full Scale)*** | ***Possible T/R Amps AC Rating*** | ***Suggested CT*** | ***Number of Loops on CT*** |
|---|---|---|---|
| 25 | 0-21 | 50:5 | 2 |
| 50 | 22-41 | 50:5 | 1 |
| 75 | 42-62 | 150:5 | 2 |
| 100 | 63-83 | 100:5 | 1 |
| 150 | 84-125 | 150:5 | 1 |
| 200 | 126-166 | 200:5 | 1 |
| 250 | 167-208 | 500:5 | 2 |
| 300 | 209-250 | 300:5 | 1 |
| 400 | 251-333 | 400:5 | 1 |
| 500 | 334-416 | 500:5 | 1 |

***Milliamp DC (mADC) Feedback***

Your system must include a milliamp feedback resistor to provide input to the GVC control circuit.

This resistor may already be in place in your system. To make sure it is properly sized, check to see if it meets these conditions:

- all precipitator load current must pass through the resistor
- it must be connected between ground and the low side of the rectifier bridge
- it must provide no more than 12 VDC input to the control circuit at the T/R set's rated output

Typical resistor values that meet these requirements for a given T/R rating are shown in the chart below.

| *Typical mADC Rating* | *Suggested Sense Resistance* | *Suggest Resistor Wattage* |
|---|---|---|
| 250 | 37.5 Ω | 50 watts |
| 500 | 20 Ω | 50 watts |
| 1000 | 10 Ω | 50 watts |
| 1500 | 7.5 Ω | 50 watts |
| 2000 | 6 Ω | 100 watts |

Contact NWL technical support for other T/R values.

***Kilovolt DC (Secondary Voltage) Feedback***

Review the configuration of the T/R set and determine whether it provides a KV metering circuit.

- If the T/R is a fall-wave unit (single bushing), you will connect the KVDC feedback circuit to the KV1 input
- If it is a double half-wave unit (dual bushings), you will connect to *both* KVI and KV2 inputs
- On a T/R set that does not provide a KV metering circuit, do not connect anything to this feedback circuit. The GVC will display a calculated KV reading.

KVDC feedback requires a maximum of 8.4 VDC at the T/R set's rated kVDC. As part of the process covered in *Chapter 5: Configuration* below, you will calibrate the GVC for this range by entering the value of the voltage divider resistor in your T/R set.

To make this calibration accurate and prepare the GVC for voltage sensing, determine the value of the voltage divider resistor in the T/R set.

- If that value is between 40 megohm and 120 megohm, connect a 10 K Ω resistor in series between the voltage divider and ground. Typically this should be a wirewound device with a 12W rating.
- If the value is outside that range, contact NWL for the proper resistor rating.

The 10 K Ω resistor is used for voltage sensing in the feedback circuit.

## SCR Output

The SCR output *is* connected to the NWL-supplied trigger board that supplies the necessary isolated gate pulses for the SCRs.

Be sure that the connections at the SCR are properly phased with the 120VAC connections feeding the controller power supply. If they are out of phase, the T/R set will not operate during final system check out. You will then have to reverse the phasing to correct the problem. (See "Chapter 4: Electrical Connections" for a fuller explanation.)

**Section III**

# INSTALLATION AND CONFIGURATION

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## Appendices

# Chapter 4: Physical Installation

*Mechanical Installation, Electrical Hookup*

This chapter covers the physical upgrading of your T/R control enclosure through the installation and wiring of the GVC. Assuming that all relevant wiring in the control cabinet has been identified and tagged, you should be able to complete these two steps in very little time.

## Mechanical Installation

Mechanical installation involves mounting the GVC's three component pieces in appropriate locations. The components include:

1. The control module, a single unit consisting of

    - power supply
    - I/O circuit board
    - microprocessor board
    - optional tumbling hammer daughter board;

2. The trigger board (if required; upgrades from a Micropack II, III, or earlier version of the GVC will continue to use the trigger boards already in place)

3. The graphical display and keypad module.

***Trigger Board Installation***

The trigger board should be mounted as close as possible to the SCRs to minimize noise pickup by the control wires. You can mount it to the SCR assembly.

For easy installation follow this procedure:

1. Refer to the supplied template in the appendices to this manual. Mark the places where you will drill four (4) holes on your chosen mounting location for the unit's plastic standoffs. Make sure that the trigger board will not touch any metal surfaces when mounted on these standoffs.

2. Drill the holes.

3. Secure the plastic standoffs in these holes.

4. Secure the trigger board to the standoffs.

Check again to be sure the trigger board is safely away from all metal surfaces.

***Control Module Installation***

The control module is already mounted on its own metal plate. Note the four pre-drilled mounting holes in the plate.

First, locate a good place for the module. During electrical installation you will need access to the control module to hook up power, signal, and control lines.

We recommend the back of the control cabinet door, the inside control cabinet wall, or the control cabinet's inside back panel. We also recommend vertical mounting, with the terminal connectors at the top, to conserve

space and reduce dust accumulation by circuit components. Care should be taken not to mount the control module too close (less than 4 inches) to any high voltage (400 VAC or greater) wires or components. These items may generate electric fields that adversely effect the operation of the control module.

1. For easy installation follow this procedure:

2. Refer to the supplied template in the appendices to this manual. Mark the places where you will drill four (4) holes for the unit's mounting hardware.

3. Drill the holes.

4. Mount the plate flush to the control cabinet surface using bolts or studs.

***Graphical Display and Keypad installation***

The display/keypad module is housed in an aluminum enclosure. The two RJ-45 telephone-style mod (modular) jacks on the rear of the enclosure provides electrical connections for the operation and the programming of the display. The RJ45 jack labeled RUN will be connected to the control module inside the T/R set control cabinet.

***A. If you're permanently mounting the display on the control cabinet***

The recommended mounting location for the display/keypad is on the T/R controller cabinet door.

1. You can use a standard *4-1/2* inch meter hole if one exists. There are four 6-32UNC threaded mounting holes on the enclosure backplate that will be for attaching the display to the door using the existing meter stud mounting holes..

    - If you do not have an open meter hole, mark positions for screw holes and an opening for the mod jacks using the supplied drawing

    - Then drill the holes in the cabinet door.

2. Position the display enclosure over the mounting holes in the door.

3. From the inside of the door use lock washers and screws to secure the display to the cabinet.

***B. If the display will be moved among the control cabinets***

A single display can serve up to 90 T/R controllers on one link. Incases where you'll be moving the display/keypad module among several T/R controllers, all you need is a convenient way to plug it into each one.

We recommend cutting holes in each control cabinet to mount two external mod jacks, one marked "GVC network" and the other "GVC local," for easy plug-in access. The wires from these jacks will connect to the microprocessor board inside the cabinet, as described below. In this way you won't have to open the cabinet door each time you need to plug in the display/keypad to monitor or make changes to the system.

## Electrical Connections

All electrical connections between the T/R set and the GVC are made to the control and trigger board modules. Most of these are made to the circuit boards on the control module. These are easy to identify.

As you look at the control module you will see two circuit boards mounted together, one above the other. The bottom one is the I/O circuit board. The top one is the DSP microprocessor circuit board. The power supply stands by itself.

The I/O board, where you'll do all of your wiring, has several connecting points. The ones with which you'll be most concerned are:

- The feedback, alarm/remote input, and alarm/contactor output terminal connector labeled J14, J15, & J16 respectively.

- The auxiliary alarm input terminal connector, labeled J17.

- The Mate-N-Lock connector, labeled J3, that provides output to the SCR trigger board.

Refer to the terminal layout drawing and the general retrofit drawing and follow these simple steps to complete your wiring.

***Power Supply***

1. Run 120VAC to Jl on the control module power supply board, using the supplied cable with the two-pin mate-n-lock connector. If you are upgrading an NWL Micropack III, or an earlier version of the GVC, use the same cable that was plugged into J1 of the previous power supply.

2. Make sure the 120VAC on Jl, pin 2 is in phase with the power line voltage on the anode of 1SCR. Refer to the General Retrofit drawing.

***I/O Board Connections***

1. Connect all power, control, and signal lines to their proper terminal connectors per the table below.

| Connector | Circuit |
|---|---|
| J14-1 | Primary Voltage Feedback |
| J14-2 | Primary Current Feedback |
| J14-3 | kVDC (Bushing #1) Feedback |
| J14-4 | kVDC (Bushing #2) Feedback |
| J14-5 | mADC Feedback |
| J14-6 | Feedback Common/Ground |
| | |
| J15-1 | AC Overcurrent Alarm Input |
| J15-2 | SCR Overtemperature Alarm Input |
| J15-3 | T/R Overtemperature Alarm Input |
| J15-4 | T/R Low Oil Level Alarm Input |
| J15-5 | Remote Enable Input |
| J15-6 | Remote On Input |
| J15-7 | Alarm Common/Return |
| | |
| J16-1 | Remote Alarm Relay Contact – N.C. |
| J16-2 | Remote Alarm Relay Contact – COM. |
| J16-3 | Remote Alarm Relay Contact – N.O. |
| J16-4 | Option Voltage Source Terminal (Internally tied to J16-5) |
| J16-5 | Voltage Source for Contactor Coil (120 VAC typ.) |
| J16-6 | Output to Energize Contactor Coil |

2. If you are not using an external overcurrent relay, jumper terminal J15-1 to 120VAC to prevent the GVC from issuing constant false alarms.

3. Wire connector J17 per the table below, This is for the optional user-defined auxiliary alarm dry-contact inputs, contacts rated 15VDC.

| Connector | Circuit |
|---|---|
| J17-1 | Aux. Alarm #1 |
| J17-2 | Aux. Alarm #2 |
| J17-3 | Aux. Alarm #3 |
| J17-4 | Aux. Alarm #4 |
| J17-5, 6, 7, 8 | Aux. Alarm Common/Return |

4. Note connector J7 is used for the optional tumbling hammer daughter board. If you are not using this option, the connector will not be used. If you have ordered the optional rotating hammer board, wire the board terminals per the table below.

| Connector (Located on Hammer Bd.) | Circuit |
|---|---|
| J2-1 | Voltage Source for Hammer #4 |
| J2-2 | Output for Hammer #4 |
| J2-3 | Voltage Source for Hammer #3 |
| J2-4 | Output for Hammer #3 |
| J2-5 | Voltage Source for Hammer #2 |
| J2-6 | Output for Hammer #2 |
| J2-7 | Voltage Source for Hammer #1 |
| J2-8 | Output for Hammer #1 |
| | |
| J1-1 | Hammer #4 Aux. Contact Feedback |
| J1-2 | Hammer #3 Aux. Contact Feedback |
| J1-3 | Hammer #2 Aux. Contact Feedback |
| J1-4 | Hammer #1 Aux. Contact Feedback |
| J1-5, 6, 7, 8 | Hammer Feedback Common/Return |

5. If the keypad/display module is to be permanently mounted on the T/R control cabinet, plug its cable into the desired Local jack, J1, or the Network jack, J2. If the controller is to be part of a RS485 network for communicating to an NWL PCAMS, DCSi, or a network display connect the communications wiring to the Network Port connector J9 per the below table.

| Connector | Circuit |
|---|---|
| J9-1 | HI (+) |
| J9-2 | LO (-) |
| J9-3 | COM |

6. If the keypad/display unit is to be remotely mounted, but not used as a network display, wire the rs485 communications cable to Local Port connector J8 per the table below.

| Connector | Circuit |
|---|---|
| J8-1 | HI (+) |
| J8-2 | LO (-) |
| J8-3 | COM |

***DSP Board Connections***

The only connection on the DSP board is to the optional field bus module, if required. This optional module must be ordered and shipped separately. It is to be installed by the user directly on the DSP board. Refer to the drawing in Appendix 2 for the location of the field bus converter jack.

1. Make sure that the mounting feet on the module are fully retracted by turning the two screws on the front plate counterclockwise.

2. Carefully line up the module with the mounting rails of the jack. Slowly any carefully start to slide the module into the jack. **As the module approaches the pins in the back of the jack, stop and visually verify that all of the pins in the jack are properly aligned and entering the sockets in the module. If the pins are not properly aligned damage will occur to the jack on the DSP board.** If the pins are all aligned, continue to slowly push the module into the jack until it is fully seated.

3. Turn the two screws on the front plate of the module clockwise to secure the module to the DSP board.

4. The users wiring will then connect directly to the connector on the field bus module. The type of connection will be dependant upon the specific field bus used.

***Trigger Board Wiring***

1. Plug one end of the supplied 4-wire cable into J3 on the I/O board, and the other end into Jl on the SCR trigger board.

2. Connect the trigger board to the SCRs.

3. If you are replacing an NWL controller, use the existing wire from the SCRs. Insert its quick-disconnect plug into J2 on the trigger board.

4. If you are replacing a non-NWL controller, use the supplied pig-tail/quick disconnect cable. Wire the pig-tail end to the SCRs as follows:

| *Connection Point* | *Pig-tail gate connection* | *Pig-tail cathode connection* |
|---|---|---|
| 1 SCR | J2/5 | J2/4 |
| 2 SCR | J2/2 | J2/1 |

*(I SCR is the one with its cathode on the output side of the SCR assembly.)*

5. Then insert the quick-disconnect end of this cable into J2 on the trigger board.

This completes physical installation of the GVC.

# Chapter 5: Configuration

*Calibrating The GVC*

You must configure the GVC before using it. Configuration sets up the operating parameters of the T/R set it is controlling, allowing it to

- fully protect the T/R set
- display accurate readings on T/R set operation.

***Configuration is necessary when retrofitting an existing T/R set with a new controller. Failure to configure the GVC could result in damage to the T/R set.***

This chapter concentrates on configuring the GVC for maximum protection of the T/R. The procedure is short, simple, and straightforward. Most T/R parameters can stay at their preset default values for now.

You will use the display/keypad to set parameters. Basic information on how to use this module is included in the instructions below. Consult the User's Guide if you need more help.

## Preparing for Configuration

Prior to energizing the unit, verify that the dip switches located on the DSP board are configured as below.

SW3 – Diagnostics Configuration Switch (For NWL Use Only) – All switch positions should be OFF.
SW4 – Communications Configuration Switch – Switch positions 1 to 3 OFF, Switch position 4 ON.
SW5 – Field Bus Converter Configuration Switch – All switch positions should be OFF.
SW6 – Boot Configuration Switch – All switch positions should be OFF.

To begin the configuration process, make sure the display/keypad module is plugged into the GVC local port on the T/R controller, then follow these procedures.

Power up the T/R controller by moving the power handle on the control cabinet to the "ON" position. *Do not push the <HV 0n/0ff> button on the display/keypad until configuration is complete!*

1. The display will activate. If you receive a *Loss of Memory* alarm when you first power up, this is not necessarily a cause for concern. To clear press <Enter>. The word Meter will be blinking in the main menu bar at the top.

2. Using the <Arrow> keys, scroll (move) the blinking cursor over until **SignOn** blinks. Press the <Enter> key to select this function.

3. The cursor will move to the *Enter Access Code* area where you will enter your level 3 password.

   a. Use the <+ lncr> and <-Decr> keys to display the first digit of your password. Press <Enter> to record it.

   b. Select the second digit Press <Enter> to record it and return to the main menu.

The main menu should now display more options. (If it doesn't, you may have entered your password incorrectly.)

## Configuring the System

- You will be entering parameters in four display screens:
- configuration (Config)
- calibration (Cal)
- Rating
- Setup

***The Config Screen***

Scroll to the new option **Config** and press <Enter> to reach the configuration screen. You will be entering values for the kilovolt feedback parameter.

Check the *KVI Feedback* and *KV2 Feedback* lines on the right-hand side of the screen. If your T/R set is a full-wave single-bushing unit, the default setting (shown below) is correct.

| *T/R Type* | *KV1 Feedback* | *KV2 Feedback* |
|---|---|---|
| Full-wave | Yes (default) | No (default) |
| Double half-wave | Yes | Yes |
| No Feedback | No | No |

If your T/R set is a double half-wave unit, or has no provision for KV feedback, you will have to change the settings to match those in the chart, as follows:

1. press <Enter> again. The cursor will move to *Max. Cur.*
2. use the <Arrow> keys to scroll to *KV1 Feedback* and *KV2 Feedback* in turn
3. press the <+ lncr> or <-Decr> key at each of these items to change the setting, then <Enter> to lock the value
4. scroll to *Menu* and press <Enter> to lock in the settings and return to Config on the main menu.

If your T/R unit does not have provisions for KV feedback, the GVC will calculate the secondary voltage based on the primary voltage reading.

***The Rating Screen***

The **Rating** screen allows you to enter the voltage ratings for your T/R set, so the GVC can prevent it from exceeding safe values.

1. Scroll to **Rating** on the main menu and select it with the <Enter> key.
2. Move among the categories with the <Arrow> keys. Eater the T/R set's rated values for all four items in the middle window, using <+ lncr> and <- Decr> keys to change the displayed numbers and pressing <Enter>

after each change to lock the value

- ***Pri Volt (VAC) Rating***
- ***Pri Amps (AAC) Rating***
- ***Sec Volt (kVDC) Rating***
- ***Sec Amps (mADC) Rating***

3. Scroll to the ***Cal Setup*** item and press <Enter>.

### *The Cal Setup Screen*

To complete the configuration process you must enter the values for certain components used in the feedback circuits. You can also select the spark and arc sensitivity. On the screen that appears, review the default values. If any of them do not match the values in your system, scroll to them and enter the proper figures as described below.

#### *VAC Turns Ratio*

This is the value of the transformer used in the Primary Voltage Feedback circuit. Most transformers use a 4:1 ratio. See the chart in ***Chapters: System Requirements*** under "Primary Voltage Feedback" above for typical values. If necessary, change this to the value used in your T/R set.

#### *AAC Turns Ratio*

This is the value of the current transformer used in the primary current feedback circuit. If necessary, derive it by dividing the CT by the number of loops. Or use the appropriate value under "Panel Meter (Full Scale)" on the chart in ***Chapter 3: System Requirements*** under "Primary Current Feedback" above for typical values.

#### *Volt Div. Hi Res/Lo Res*

In the ***Hi Res*** area enter the actual value of the voltage divider resistor used in your T/R set. It is usually in the range of 40-120 megohm.

In the ***Lo Res*** area enter the value of the voltage-sensing resistor (usually 10K). See ***Chapter 3: System Requirements*** under "Kilovolt DC (Secondary Voltage) Feedback" above for more information.

#### *Sec. Current Shunt*

The Secondary Current Shunt is the resistor used in the Milliamp DC feedback circuit This value is usually in the range of (I -50fi). See *Chapter 3: System Requirements* under "Milliamp DC (mADC) Feedback" above for more information.

#### *Sensitivity Levels*

There are three sensitivity levels to set, all listed in the right-hand section of this parameter entry window: *KVSpk Sen, mA. Spk Sen,* and Arc *Sense.*

Leave these settings at "Hi" for the time being. Adjustment to prevent false sensing, if necessary, will be made during final system calibration and checkout

Scroll to “Return to Cal” and press <Enter> to return to the "Rating" screen and then return to the main menu.

***The Setup Screen: Computer Address (optional)***

Use this parameter only if the GVC will be connected to a central computer that uses software such as NWL's PCAMS, DCSi, or a network display module.

1. From the main menu select Setup and press the <Enter> key. The cursor will move to *Address.*

2. Set the address of this T/R set with the <+ lncr> and <-Decr> keys. Press <Enter> to input the values.

3. Use *only* the <Arrow> keys to scroll to *Menu* and press <Enter> to return to the main menu.

# Configuring the Alarms

The GVC has three types of alarms: internal, standard, and auxiliary. Most of these must be configured to make sure the T/R and precipitator are fully protected, and to eliminate false alarms.

You will be entering all settings in the Setpoint screen and in the Alarm display and its *Auxiliary Alarms* subdisplays.

***Internal Alarms***

Internal alarms indicate potentially serious problems. When an internal alarm is activated, the GVC trips the contactor to remove high voltage from the T/R set and displays an alarm message. These alarms are:

- *UNDERVOLTAGE:* occurs when the T/R set operates at or below a set value for a designated period of time, indicating & short circuit or high spark rates in the precipitator.

    1. Set the *U.V.* ***Trip*** level to the value at which you want the controller to indicate an undervoltage condition (typical is *10 KVDC).*

    2. Go to *U.V.* ***Delay*** and enter the number of seconds the T/R will tolerate a U.V. condition before powering down (typically *30 S[ec]* or less).

- *SCR UNBALANCE:* trips if an unbalance in primary current feedback lasts longer than 15 seconds.

- The level at which this alarm activates is shown in the *SCR Unbalance* field. Typical value is *50%.*

- *OVERVOLTAGE:* activated instantly if the secondary voltage exceeds its rating by 115%.

- *LOSS OF MEMORY:* alerts you that the battery-backed RAM chip has failed to retain programmed parameters, which you must now reset. See above under "Preparing for Configuration" for instructions on correcting this problem.

- *LOSS OF LINE SYNC:* indicates that the microprocessor is not receiving a line sync/pulse from the system hardware.

The only configurable internal alarm is SCR Unbalance. To configure this alarm, go to the Setpoint screen and enter the appropriate value in the SCR Unbalance field. The range is 7% to 99%, but typical value is 50%.

***Standard Alarms***

The standard alarms are:

| | |
|---|---|
| OC (overcurrent) RELAY | SCR HI TEMP |
| T/R HI TEMP | LOW OIL |

Each has a dedicated input. Like internal alarms, standard alarms warn you of serious threats to precipitator operation, including potential damage to the T/R set.

All four standard alarms appear on the main Alarm display screen, and each can be configured to your needs. To configure them, scroll to the display with the <Arrow> keys and move into the parameter entry window with the <Enter> key. Use the <- lncr> and <- Decr> keys to select the correct parameters for your existing equipment, as follows.

- Logic can be set to
  - *N.O.*. (normally open) or
  - *N. C.* (normally closed).
- Type can be set to
  - *Display:* shows alarm but does not trip the contactor or a relay
  - *Disp[lay]/Relay:* takes the preventive measure of tripping a relay in addition to indicating results
  - *Disp/Rly/Contactor]:* adds the capability of de-energizing the power supply by opening the contactor under the specified condition as well as tripping a relay and displaying an alarm
  - *Disabled:* ignores any signal at this input (used, for example, in cases where the T/R set has no provisions for a particular alarm function).

On the *OC Relay* alarm only *Logic* can be set. The *Type* of this alarm is not open to alteration, and it will always trip the contactor.

***Auxiliary Alarms***

Each auxiliary alarm (up to four) you have wired to the controller must be defined and configured. Each appears on a separate screen. To reach this screen

1. Scroll to **Alarm** on the main menu and use the <Enter> key to access the parameter entry window
2. Scroll to ***Auxiliary Alarms*** and press <Enter>
3. The first alarm will display as *Aux Alarm 1*
4. Scroll to the alarm you wish to access with the left and right <Arrow> keys.

Ones you have reached the Auxiliary Alarm you wish to configure, use the <Arrow> keys to move around. Then set up each parameter as described above under "Standard Alarms."

The same configurable parameters as in the standard alarms are offered here, with the same choice of settings. An additional field, called *Count,* needs no configuration. Its purpose is to keep a running total of the number of alarm events that have occurred since the value was last cleared.

## Configuring the Communications Ports

***Network Port***

The Net Port parameter in the Setup display lets the customer choose which protocol will be used for the RS485 network port. If NWL is selected, the network port will utilize the NWL proprietary protocol. If Modbus is selected, the PowerPlus converts the network port from the NWL proprietary protocol to a Modbus RTU protocol. In this case the control will not be able to communicate with other NWL network devices such as any network displays, PCAMS, or DCSi. The Net Port parameter must be set to NWL for these devices to operate properly.

1. Scroll to **Setup** on the main menu and use the <Enter> key to access the parameter entry window
2. Scroll down to the **Net Port** parameter and select the desired protocol. Press the <*Enter*> key.

***Optional Field Bus Converter***

If the controller has an optional field bus converter installed on the DSP board, the specific field bus will be designated in the **Anybus** parameter on the Setup display. The type of module is automatically read and cannot be changed by the operator without changing the module. There are other specific protocol parameters that also have to be configured.

1. Scroll to **Setup** on the main menu and use the <Enter> key to access the parameter entry window
2. Scroll down to the **Anybus** parameter and press the <*Enter*> key.
3. A new screen will be displayed with the specific protocol parameters for the field bus being used. Enter the appropriate data for each parameter. Press <*Enter*> after each entry.
4. When complete scroll down to the **RESET FIELDBUS** and press <*Enter*>. The cursor will move to the **RETURN TO SETUP** field. Press <*Enter*> to return.

---

Configuration is now complete. *Do not touch the <HV 0n/0ff> key on the keypad yet. You must first check out the system for proper operation, as described in the next chapter.*

# Chapter 6: System Energization and Checkout

*Ensuring Proper Operation*

In this chapter we will test the GVC and its T/R set for proper operation, then put the system in service.

***There should be few, if any problems. In the unlikely event that you find a problem, correct it before proceeding to the next step. If you cannot correct it, contact NWL technical support.***

All operations will be carried out from the display/keypad module. Be sure to watch the analog meters on the T/R set control cabinet carefully where required.

*Follow these instructions precisely, in exactly the order given.*

Start by putting the system in manual mode:

1. from the main menu on the display, scroll to Mode and press the <Enter> key;

2. scroll to *Manual* and change it from *Off to On* by pressing the <+ lncr> or **<-** Decr> key; then press <Enter> to lock the value

Do not leave this screen yet.

## Checking Power Control

We will now test for proper energization.

1. Scroll to *Cond. Angle.*

2. Press the <HV 0n/0ff> key-the T/R set will energize and the ***HV OFF*** indication at the bottom of the display will change to ***HV ON***.

3. While observing the control cabinet meters and comparing them to the digital readouts *hold down the* <+ lncr> *key.*

    - Important: make sure the meters stay below the T/R set maximum ratings until the system is properly checked out and calibrated.

4. The *Cond. Angle* value should rise with the meters and the display readouts.

5. If the meters do not rise, check to make sure the phasing of the trigger board/SCR connection matches that of the 120VAC power to the power supply.

    - If it does not, de-energize the T/R set with the <HV 0n/0ff> key.

        ***Danger: Do not attempt to reverse the phasing -with the controller powered up.***

Then reverse the 120VAC feeds to the control module power supply, and repeat the preceding steps.

6. If the T/R set exhibits short circuit behavior (the amp and milliamp meters rise, but AC volts and DC KV do not move) or open circuit behavior (AC volts and DC KV move but amp and milliamp meters do not), you have a problem with either the T/R set or the precipitator.

- Power down by de-energizing with the <HV 0n/0ff> key
- Correct the problem and restart energization and checkout from the beginning.

As you ramp up the power with the <+lncr> key, one of the following should happen:

- a *Spark* or *Arc* indication will appear in the *HV ON* display field.
- the GVC will reach the T/R set's current or voltage limit
- the GVC will reach full conduction limit.

## *Final* Calibration

When the display indicates precipitator sparking is taking place, use the <- Decr> key to back the power down until the sparking stops. You can now fine-tune the GVC's digital readings to take into account resistor tolerances, wiring runs, and other factors in your T/R set. This will yield much more accurate readings and T/R set control.

We strongly recommend the use of external true RMS meters as references to achieve accuracy.

You can also calibrate the digital readings to match your existing T/R control cabinet analog meters, but this will not be as accurate. It could compromise the GVC's protection of "the T/R set.

***Digital Readout and Control Calibration***

Return to the main menu and select Cal with the <Enter> key.

Watch the digital readouts in the electrical readings window just below the main menu. Compare them to the reference meters as you adjust settings on this screen.

1. Start with ***VAC Gain*** and adjust it with the <+ Incr > and <- Deer > keys until *PRIM. VOLTS* in the electrical readings window matches the VAC reference meter.
2. Adjust ***AAC Gain*** until *PRIM. AMPS* matches the AC Amps reference.
3. Adjust ***kVDC Gain*** and ***KV2 Gain*** to match the *SEC. VOLTS* reading to the Kilovolt DC reference.
4. Adjust the ***mADC Gain*** value to match the *SEC. AMPS* reading to its Milliamp DC reference.

The GVC is now calibrated for the most precise display and safest control of your T/R set's power output.

***Spark Sensing Calibration***

The final step in fine-tuning the GVC is the prevention of false sparking and arcing.

If the GVC indicates sparks or arcs when there are none, the sensitivity is set too high. To correct this problem

1. Select *Cal Setup* from the Rating screen
2. In the parameter entry window of the *Cal Setup* screen change settings as follows (the first two cover sparks, while the third covers arcs):

- scroll to *KVSpk Sen* and choose a higher or lower setting as needed from among *Dis(able), Low,* and *Hi*
- at *mA SpK Sen* choose among *Dis, Low, Med. Md2,* and *Hi*
- *at Arc Sense* choose between *Low* and *Hi*

## Starting Automatic Control

The GVC is now fully calibrated. To start automatic operation

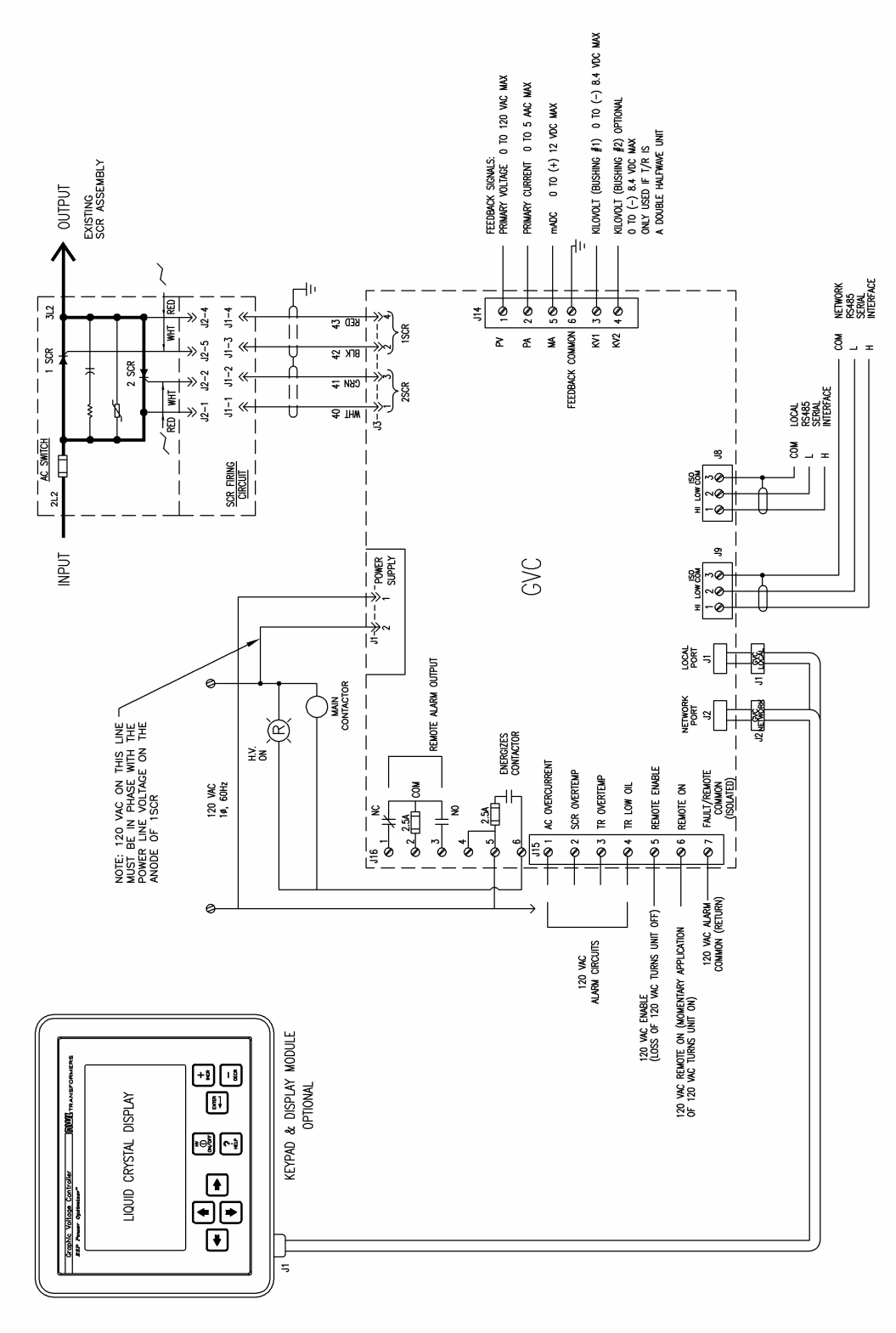
1. return to the main menu
2. select **Mode**
3. scroll to the ***Manual*** line and switch it ***Off*** with the <+ lncr> or <- Decr> keys
4. press <Enter> to lock in the setting
5. return to the main menu and scroll to **Meter**.

The display will now show the GVC automatically controlling your T/R set, protecting it from potentially dangerous condition, controlling sparking, and saving energy.

# Appendix 1

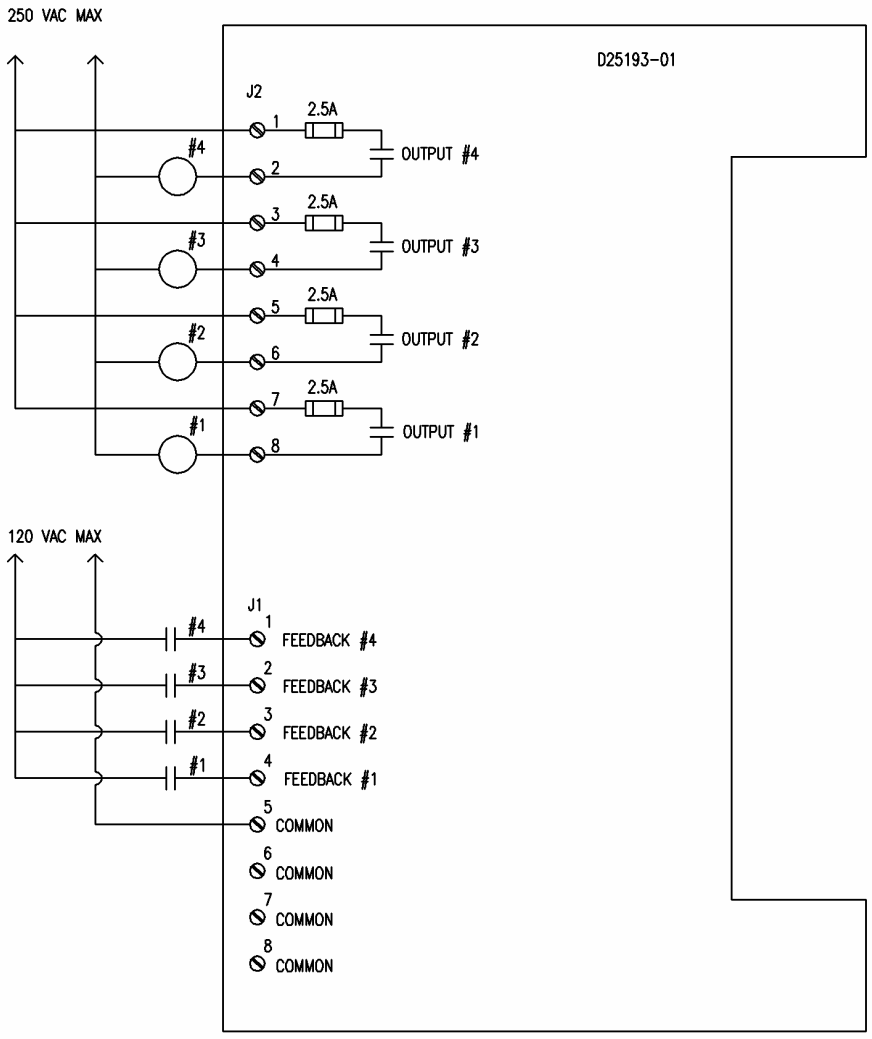
## *General Wiring*

**Dwg. B131727**



# Appendix 1A

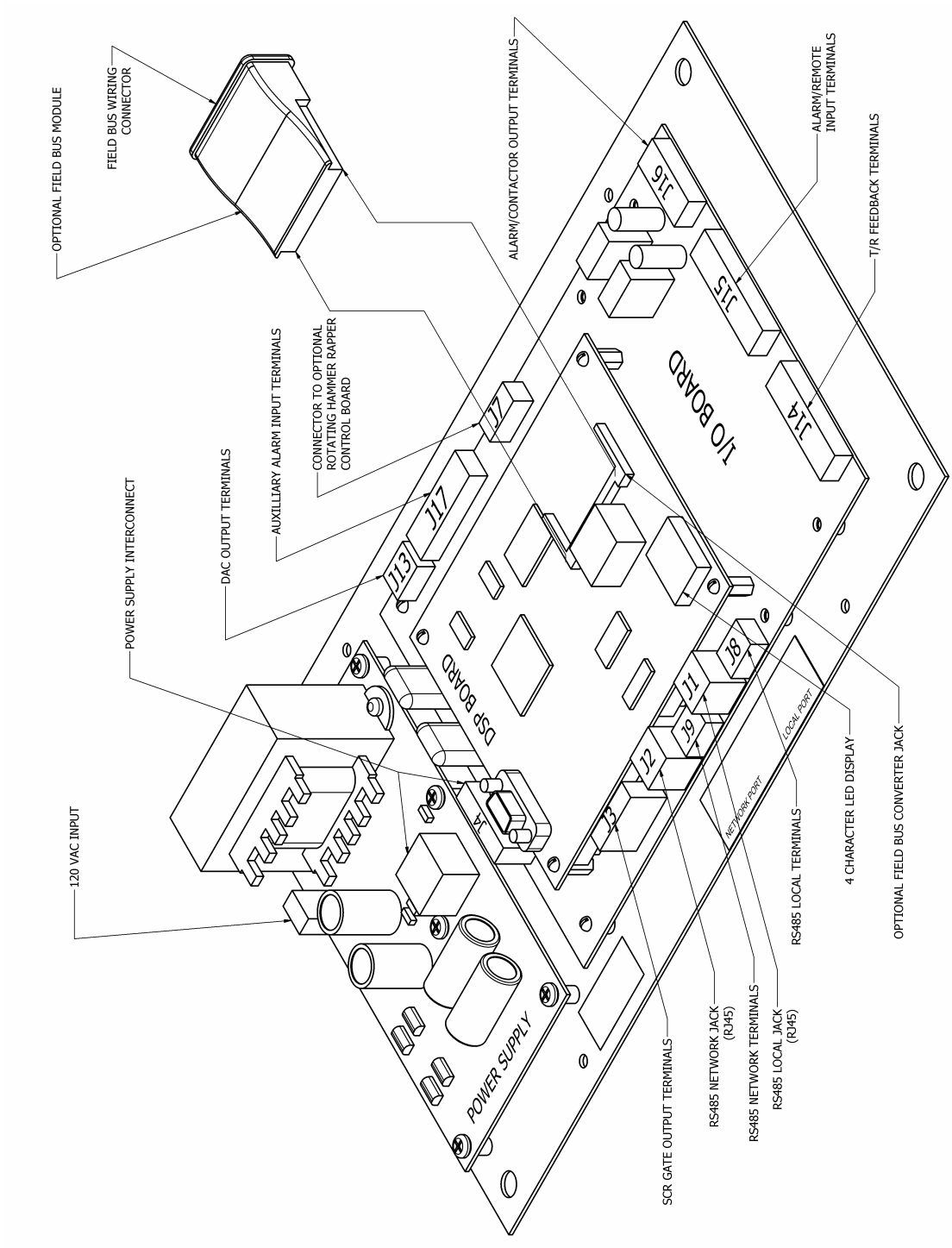
***Optional Rapper Control Board Wiring***



# Appendix 2

## *Control Module Layout*

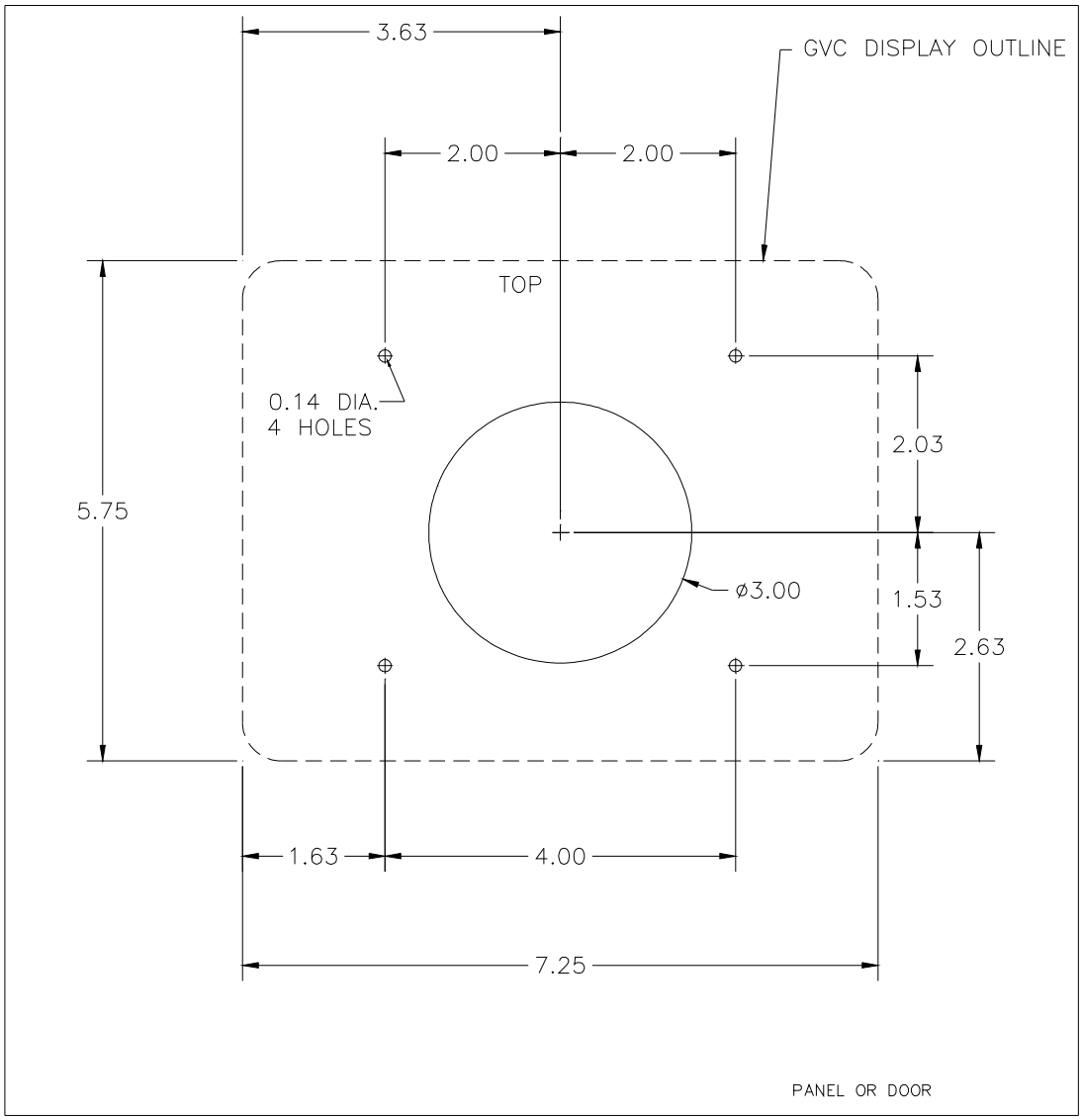
(Not Drawn To Scale)



# Appendix 3

## *Keypad/Display Mounting*

(Not Drawn To Scale)

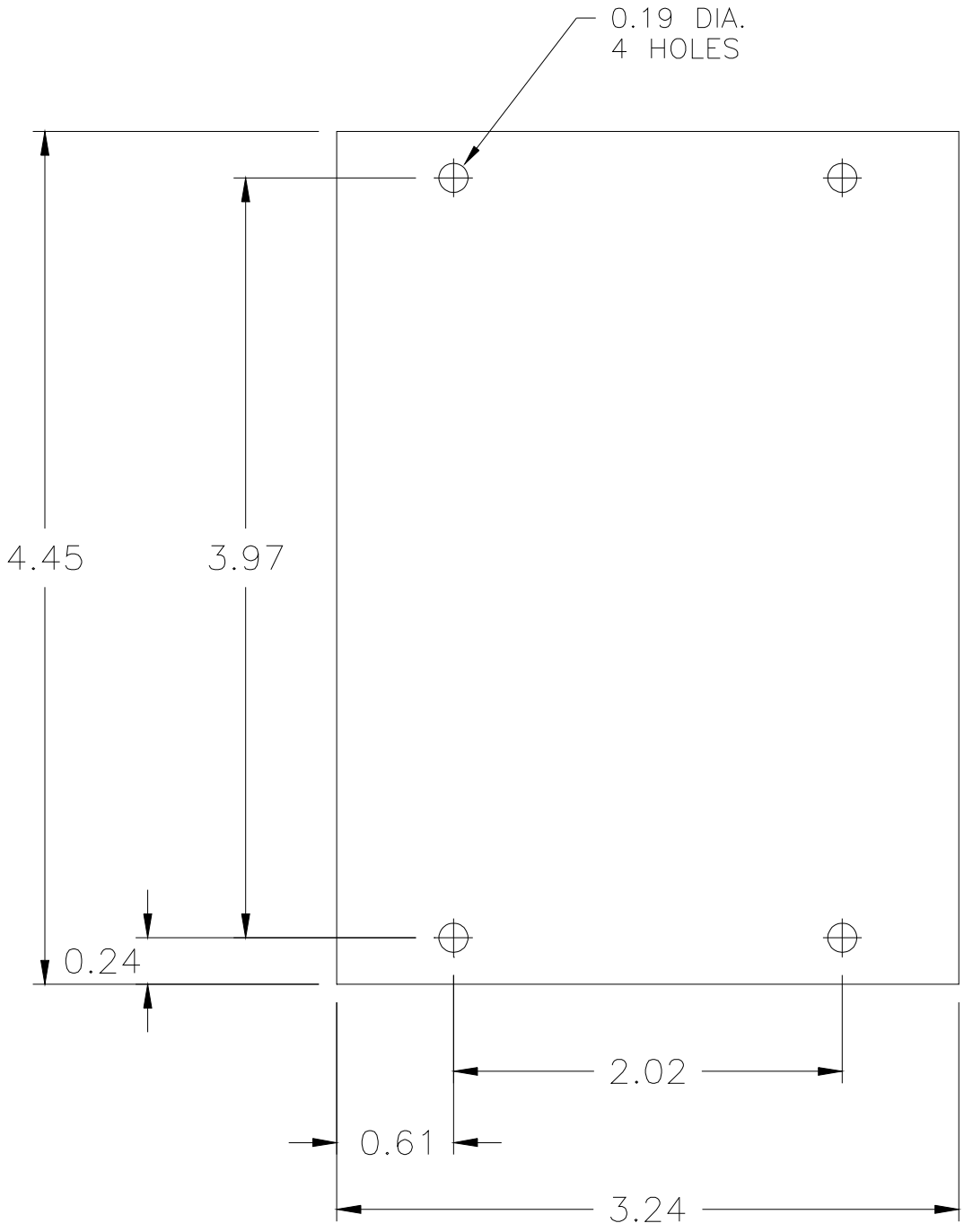


# Appendix 4

***Trigger Board Mounting***

(Not Drawn To Scale)

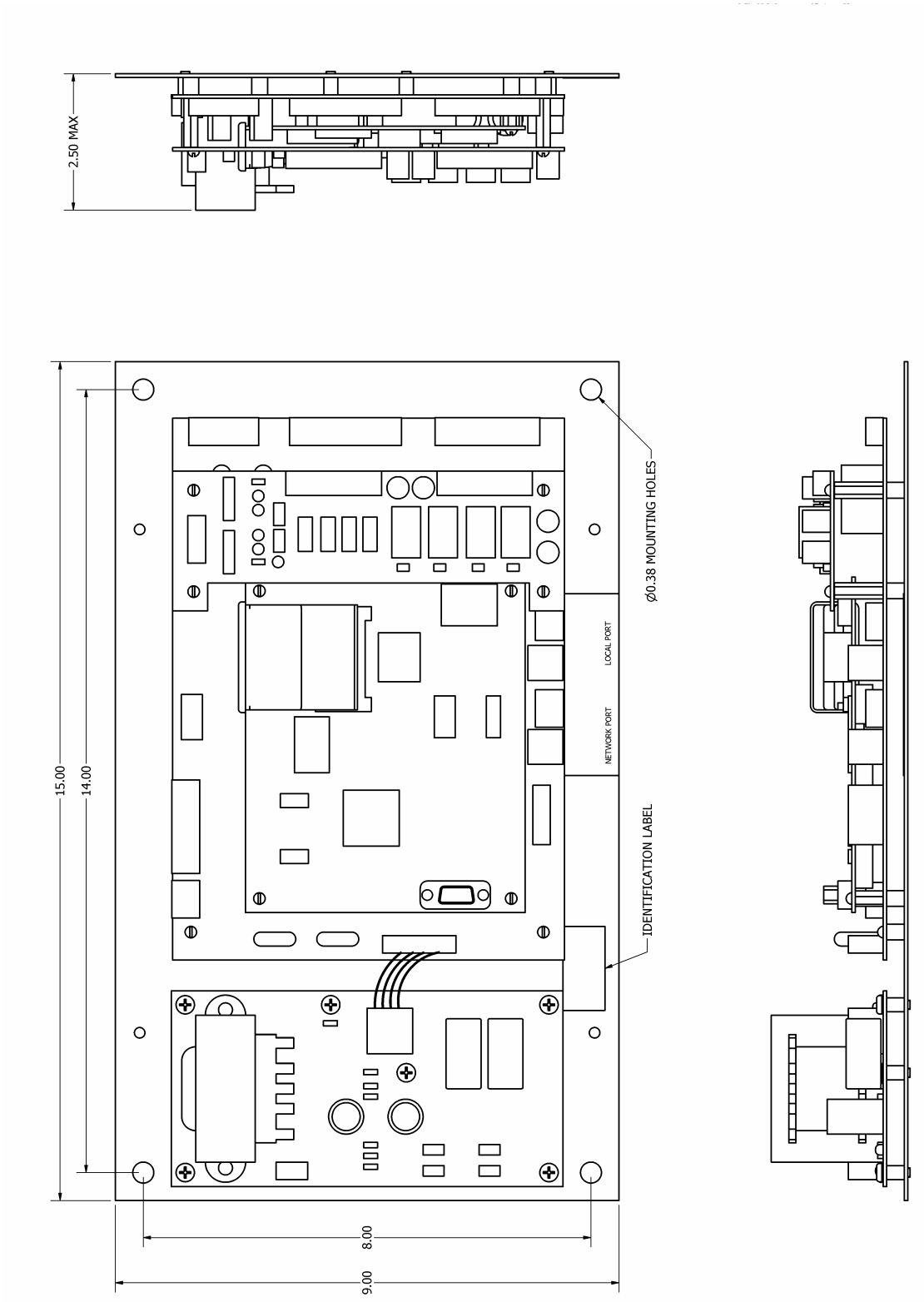
## Mounting Layout
## Trigger Board, P/N G70050



# Appendix 5

## *Control Module Mounting*

(Not Drawn To Scale)



# Appendix 6

## *Connection Cross Reference for Replacing a G20808 with a G20808-01*

| New Optimizer-DSP G20808-01 | Old Optimizer G20808 |
|---|---|
| | **TB1** |
| J14-1 Primary Voltage Feedback | 1 |
| J14-2 Primary Current Feedback | 2 |
| J14-3 kVDC (Bushing #1) Feedback | 3 |
| J14-4 kVDC (Bushing #2) Feedback | 4 |
| J14-5 mADC Feedback | 5 |
| J14-6 Feedback Common/Ground | 6 |
| | |
| J15-1 AC Overcurrent Alarm Input | 7 |
| J15-2 SCR Overtemperature Alarm Input | 8 |
| J15-3 T/R Overtemperature Alarm Input | 9 |
| J15-4 T/R Low Oil Level Alarm Input | 10 |
| J15-5 Remote Enable Input | 11 |
| J15-6 Remote On Input | 12 |
| J15-7 Alarm Common/Return | 13 |
| | |
| J16-1 Remote Alarm Relay Contact – N.C. | n/a |
| J16-2 Remote Alarm Relay Contact – COM. | 17 |
| J16-3 Remote Alarm Relay Contact – N.O. | 18 |
| J16-4 Option Voltage Source Terminal (Internally tied to J16-5) | n/a |
| J16-5 Voltage Source for Contactor Coil (120 VAC typ.) | 15 |
| J16-6 Output to Energize Contactor Coil | 16 |
| | |
| | **TB2** |
| J17-1 Aux. Alarm #1 | 1 |
| J17-2 Aux. Alarm #2 | 2 |
| J17-3 Aux. Alarm #3 | 3 |
| J17-4 Aux. Alarm #4 | 4 |
| J17-5 Aux. Alarm Common/Return | 5 |
| J17-6 Aux. Alarm Common/Return | |
| J17-7 Aux. Alarm Common/Return | |
| J17-8 Aux. Alarm Common/Return | |