
DSP Graphic Voltage Controller (GVC) User's Guide



Dwg. A132249

Revisions

Rev.	Date	Author	Description
0	11/19/10	FGS	Original
A	1/20/12	FGS	Included SD card, Rapper Board changes
B	12/28/12	FGS	Updated features current for DSP firmware V5.18 and Display firmware V5.13



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This manual is supplied for the convenience of GVC users. We have tried to make it as comprehensive and error-free as possible, but we assume no responsibility or liability for any errors or inaccuracies that may appear in it. We also reserve the right to improve it or otherwise change its contents without notice.

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WARNING! High Voltage!

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

- Do not attempt to install the GVC into a T/R set 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.**

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The Graphic Voltage Controller (GVC)

Now one easy-to-use hand-holdable keypad/display module can manage, track, and display the behavior of every transformer/rectifier (T/R) in your system.

Based on the comprehensive Precipitator Systems Architecture from NWL, the GVC makes clean-air management more complete and convenient.

Its name describes what it does: optimizing the average kilovolt output that your T/R set delivers to the ESP. This gives you both lower overall energy costs and easier compliance with clean air regulations.

The GVC tells you all you need to know about your T/R's behavior. It also lets you control all key operations parameters of the T/R (transformer/rectifier) power supply on any ESP. You can control a single local T/R set or a network as large as 90 T/R sets, all from one location.

If you plan to computerize, the GVC works seamlessly with NWL's innovative PC-based software package, the Precipitator Control and Monitoring System (PCAMS). Couple the GVC with PCAMS and you can run your entire plant's precipitator energy management system from up to a mile away.

A rugged NEMA 4 rated enclosure protects the keypad/display module. The display is the most informative in the industry, featuring up to 16 lines of text with 40 characters per line. It can also display graphs of all key operation characteristics. Backlighting makes it highly readable in any light – or no light at all.

Other features include:

- software calibration for higher accuracy, reliability
- auto-off backlight for typical display life of 30 years
- simple 9-key operation
- built-in help text.

The GVC offers a comprehensive suite of operational and reporting functions. Among them:

- spark and arc detection
- back corona detection and response
- comprehensive alarm provisions, including four user defined auxiliary alarms
- optional tumbling hammer control
- 24-hour trend plots
- 30-minute trend plots
- detailed 30-second trend plots
- high-voltage control
- setback offset
- current and voltage limiting
- automatic ramp rate adjustment for non-sparking conditions
- optional onboard fieldbus converter for communications with other host computers or your DCS.
- This latest version of the NWL GVC utilizes a digital signal processor (DSP) for faster waveform analysis and computational ability.
- Onboard SD card for storage of operating programs, system configuration, VI curves, and alarm logs.

As you will see, these sophisticated features are remarkably easy to use.



How to Use This Manual

What's in the User's Guide

The Guide is divided into four chapters. Each chapter covers a crucial aspect of GVC operation.

Chapter One: Monitoring the System

Chapter Two: Alarm Sensing

Chapter Three: Changing Parameters

Chapter Four: Setup, Configuration, Networking

The manual is designed to be a practical, user-oriented description of each function and procedure. You'll find it easy to understand. Representations of on-screen displays are included to make the text easier to follow.

What and How to Read

Most users will want to read the first two chapters of the Guide. These cover functions everyone should understand, including the monitoring and reporting options available on the system.

Chapters Three and Four show you how to change the automatic control functions of the GVC and how to set it up for your specific T/R set and ESP. If you're not involved in system configuration, or if you don't have password access to these levels of the system, you can skip some or all of both chapters.

Whatever sections of the guide you read, however, read them in front of the keypad/display module. Try to operate the unit as you read. *This is a functional guide, and what it says will make much more sense if you're putting it into practice right on the spot.*

What the Symbols Mean

Throughout this Guide we make use of some special typefaces and print conventions to represent what you see on the display and the keys you push to operate the GVC.

Options you choose from a list or menu are written in upper/lower case bold, such as **Setup**.

Informational displays on screen will be identified by upper case italics: *PRIM. VOLTS*.

On-screen fields that allow you to make choices or set parameters will be in upper/lower case bold italic: ***Spark Setback, Comm Status.***

Examples of information you enter into a field will be in upper/lower case italics: *Local, 15 Min.*

The names of the keys you use to enter information on the keypad will appear inside angle brackets: <Arrow>, <Enter>.

Side Headings

Each chapter is organized into major divisions and related topics and subtopics. The major divisions fall under headlines that always appear at the top of a new page, such as “How To Use This Manual” on the previous page. To make it easy to find your place, we’ve used side headings in bold (heavy) type to identify main topics. Side headings in italic (slanted) type call out important information in subtopics.

Basics of Keypad/Display Use

The Keypad

The GVC has one of the simplest control schemes on the market. You manage the whole system with just nine keys on a membrane keypad.

These keys demand positive operation. In other words, you must exert some pressure on them before they register. This helps eliminate accidental activation. However, they are also remarkably tough. Don't be afraid to press hard. There is a tactile response when they engage.

By default the keypad also emits a “beep” each time you press a key. You can turn off this sound if you wish.

Key Arrangement

The keys include, from left to right (fig. I-1):

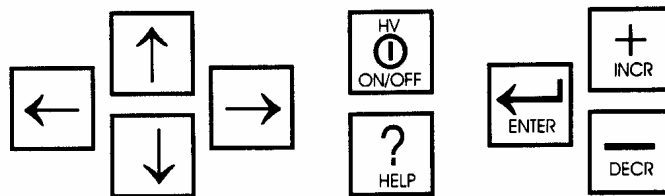


Figure I-1

- four <Arrow> keys (left, right, up, down) for moving around within any window in the display area-called “scrolling” in this manual
- a key marked <HV On/Off> which turns on the T/R (transformer/rectifier) set's high voltage, thus “energizing” the ESP's power supply
- one key labeled <? Help> to access built-in instructions for operating the GVC.
- the <Enter> key, used to
 - √ move from the main menu at the top of the screen to the windows where you enter operational settings
 - √ register a choice or setting you have made
 - √ return you to the main menu at the top of the display

- two keys labeled <+Incr> and <-Decr>, through which you change settings in the entry windows.

Shortcut to Main Menu

Sometimes you may wish to return to the main menu quickly, without changing any other settings in the entry window. There's a keypad shortcut, similar to the "Escape" on a computer keyboard, that lets you do this. Simply press any two <Arrow> keys at the same time. You'll go right back to the top of the display.

The Display

A glance at the GVC display (fig. I-2) *in any screen but Meter or when generating V/I curves* (see Chapter One) shows that the screen is divided into four distinct sections, or "windows."

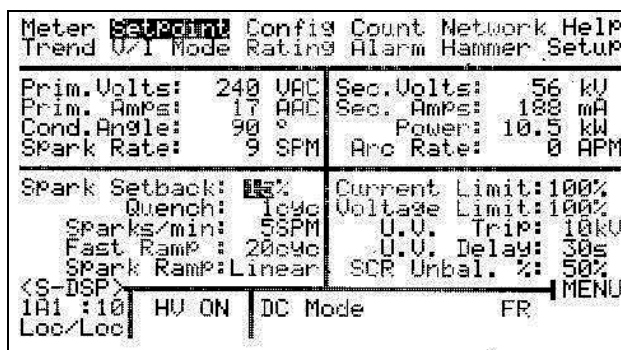


Figure I-2

- Across the top, a *main menu* window lists display modes and functions you can access by choosing one of the items with <Arrow> and <Enter> keys. This appears as a menu "bar" with choices arranged in two lines.
- Just beneath the menu bar, the *electrical readings* window shows the current operating conditions of the T/R set.
- The third section of the screen is the *parameter entry* window, where you enter choices or change parameter settings to adjust T/R operation.
- At bottom, a two-line *status window* constantly displays which T/R set this keypad is currently addressing, with information about the operating status of that system.

Blinking Cursor and Highlight

When you scroll around on the main menu or parameter entry windows, the choice you're on will blink. We call this the "cursor," similar to one on a computer display. When an item is blinking you can make changes to it (assuming you're authorized to do so). The



only exception is the access code fields you use to sign onto the system. These digits do not blink.

An unblinking cursor, called a “highlight,” stays on the main menu choice while you’re in the parameter entry window to remind you what screen you’re in.

Dim or Blank Screen

If the screen appears to be dim or blank, the keypad/display may have turned off its illumination to extend screen life.

To restore the display to full brightness, simply press any of the keys on the keypad.

The display will stay at full brightness for a preset period of time after you touch any key. Then it will go dark again. This automatic feature lets the display last up to 30 years under normal conditions.

For further instructions on using this keypad/display to access the functions of the GVC, proceed to Chapter One.

Before Using the GVC

System Startup

To properly control your T/R set, the GVC must be configured and calibrated for T/R ratings, default operating parameters, and other functions.

If you retrofitted the GVC into an existing T/R control enclosure, you have already completed these procedures. They are found in Chapters Five and Six of the **Installation and Startup Guide** supplied with the retrofit kit. The **Installation and Startup Guide** is supplied only as part of a retrofit kit.

If NWL or a third party installed the GVC and started it up, they have calibrated and configured it for you.

*To prevent damage to the T/R set, the precipitator, or the GVC, you must calibrate and configure it before use in two cases: when setting up a complete T/R control enclosure that includes it, and when it loses calibration, as described in Chapter Four of this **GVC User's Guide**.*

For your convenience, calibration and configuration instructions adapted from the **Installation and Startup Guide** are included in this **User's Guide** as Appendix A.

Please turn to Appendix A and follow those instructions before attempting to use an uncalibrated GVC.

Preface

The procedure listed below is a consolidated start-up guide for the GVC. The displays and parameters referenced in each step are fully explained in the corresponding chapters that follow. The procedure is intended to allow quick operation of the system while utilizing the pre-programmed default control setpoints. When completed the system will be operating, but may not be optimized for your specific installation. It is strongly recommended that you refer to the corresponding chapters to get a good understanding of all of the available parameters and their functions. It is also strongly recommended that you follow the Calibration procedure listed within this manual.

Procedure

Before Turning the HV ON, perform the following steps:

1. **Sign On** the Keypad/Display module.
2. If NWL has supplied you with a complete control enclosure, skip to Step # 6. If you are starting up a retrofit control (an NWL GVC installed in an older control enclosure) please continue.
3. Go to the **Rating** screen and enter the following ratings of the T/R set being controlled. The ratings can usually be found on the T/R set nameplate.
 - a) **VAC Rate:** This is the primary voltage rating of the T/R set.
 - b) **AAC Rate:** This is the primary current rating of the T/R set.
 - c) **KVDC Rate:** This is the KVDC rating of the T/R set.
 - d) **mADC Rate:** This is the mADC rating of the T/R set.
4. Go to the **CAL SETUP** option in the **Rating** screen and enter the following information:
 - a) **VAC Turns Ratio:** This is the ratio of the primary metering transformer being used to measure the primary voltage at the T/R set. This transformer is usually located in the control enclosure.
 - b) **AAC Turns Ratio:** This is the turns ratio of the current transformer being used to measure the primary current of the T/R set. This CT is usually located in the control enclosure.

- c) **Volt Div Hi Res:** This is the value of the high voltage divider resistor being used to measure the KVDC. This resistor is usually located in the T/R tank
 - d) **Volt Div Low Res:** This is the value of the low voltage KVDC feedback resistor that is in series with the above referenced high voltage divider. It can be located in either the T/R junction box or in the control enclosure.
 - e) **Sec Current Shunt:** This is the value of the mADC feedback resistor that is used to measure the T/R output current. It can be located in either the T/R junction box or in the control enclosure.
 - f) Initially set the **KV Spk Sen**, the **mA Spk Sen**, and the **Arc Sense** all to HI.
5. Go to the **Alarm** screen and configure the **Logic** and **Type** of response for each of the applicable alarms. If an alarm is not being used, it can be disabled. If you are not using the external OC Relay (Overcurrent Relay) set the logic to N.O.
 6. Go to the **Mode** screen and set the **Control Mode** to *Manual Mode*.
 7. Push the <HV ON/OFF> button on the keypad. With the cursor in the **Manual Power Level:** location, press and hold the <(+) INCR> button on the keypad. The meters should all start to increase. If the current meters increase very quickly, but the voltage meters don't, there may be a short in the load. If the voltage meters increase quickly, but the current meters don't, there may be an open in the load. Turn the HV OFF and correct the problem.
 8. If all of the meters increase properly, return the **Control Mode** to the *DC Mode* (Automatic).

The controller will now ramp up the T/R set output voltage until a spark/arc occurs, or it reaches current limit, voltage limit, or conduction angle limit.

What this chapter covers

Monitoring the System

With NWL's GVC you're always aware of the operating parameters of your T/R set. The GVC

- *monitors the T/R set's primary and secondary voltage and current*
- *displays all key electrical parameters and operating conditions even while you're changing settings*
- *presents operating conditions in bar graphs*
- *creates and displays V/I curves on demand*
- *provides trend information over three time periods.*

Another important feature, alarm monitoring, will be covered in Chapter Two.

This chapter will introduce you to the GVC's monitoring functions and show you how to access them, from initial sign-on to operating procedures.

Since the keypad/display module can control either a single GVC or act as a master unit controlling up to 90, we will also describe its local/network functions.

This chapter assumes that you have read "Basics of Keypad/display Use" above.

Startup and Sign-on

For most users, the GVC's keypad/display is the only part of the system they need to know. This Guide will focus on it almost exclusively. You'll find it an informative, easy-to-use "front end" for monitoring and controlling the system.

However, you should know that the keypad/display is only one of three main components of the system. The other two, the GVC control module and the SCR trigger board, work behind the scenes to operate each T/R set.

When you use the keypad/display to set values on a T/R set, you are actually giving instructions to the GVC. The GVC stores and executes these instructions until you issue new ones.

As a result, you can unplug the keypad/display from a GVC, and it will continue to operate using the parameters you have set.

In this Chapter we will explore how to use the GVC's keypad/display to monitor the operation of precipitator power supplies.

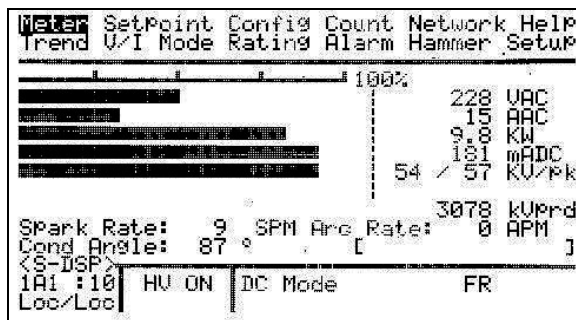


Figure 1-1

The GVC's monitoring functions are quite comprehensive. As you can see in fig.1-1, the menu bar at the top of the display gives you a choice of 13 different screens. (If you are not in the highest access level, you will see only 10 choices, one of which is **SignOn**.) You select the screen you want to reach by scrolling (moving) the blinking cursor to it with the <Arrow> keys. Press <Enter> to move the cursor into the screen's parameter entry window.

Each of these screens, except for **Meter** and **V/I**, show the T/R set's current parameter settings in a window just below the main menu bar. As you'll see in Chapter Two, you can



change these settings to fine-tune T/R operation or adapt to changing circumstances. The window under this readout is the parameter entry area, where you change controller settings (except in the **Meter** and **V/I** screens). The two-line window at the bottom of the screen displays current operating conditions for the T/R.

Starting Up

If the GVC is permanently connected to and mounted on a T/R set control cabinet, it is probably already properly connected and powered up.

If you are using the keypad/display as a hand-held unit, power it up and start the monitoring process by inserting its RJ45 telephone-style modular plug into the matching jack on the T/R controller.

Be sure to use the correct RJ45 jack. Do not insert the plug into a non-GVC jack. There are two GVC jacks, labeled “Local” and “Network,” select the right one for the functions you want to carry out (see “Local and Remote Operation,” below).

Also be sure you are connected into the proper jack on the rear of the keypad/display. Use the jack labeled “Run – RS485”.

If the display appears blank, the screen blanker may be engaged. Press any key and the display will return to full brightness.

Screens for Local and Network

Which screen appears at startup depends on whether you are plugged into a local or network jack.

When you are connected to a local port, the display will switch directly to the **Meter** screen (fig. 1-1). The Meter item on the main menu bar will be highlighted.

When you are connected to the network port, the display will search the network and find all of the units on it. They will be displayed based on the parameters entered in the **Control Settings** screen (fig. 1-2b), which is accessed from the **Setup** screen (fig. 1-2a).

- The network display must have an address that is unique to other displays plugged into network ports. This address is defined by the **GVC Addr** parameter in fig. 1-2. It is selectable from 3 to 9 (A

maximum of four network displays can exist on a network).

- The individual GVC controls on the network must also have unique addresses. These are defined in the **Serial Addr** parameter in fig. 1-2b. The **Unit ID** parameter is a 4 character alpha-numeric designator that can also be assigned to uniquely identify each T/R set being controlled.

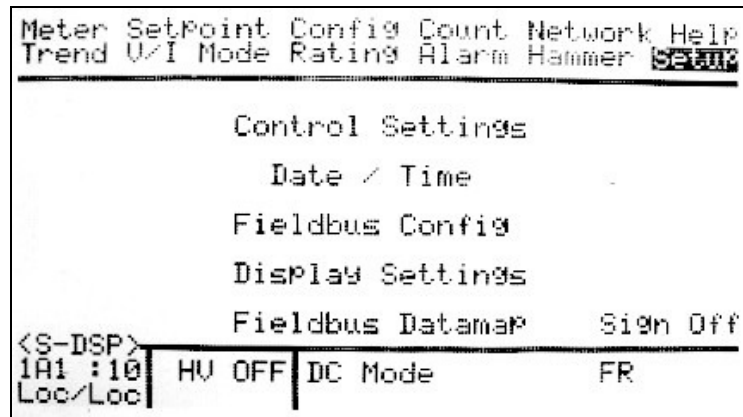


Figure 1-2a

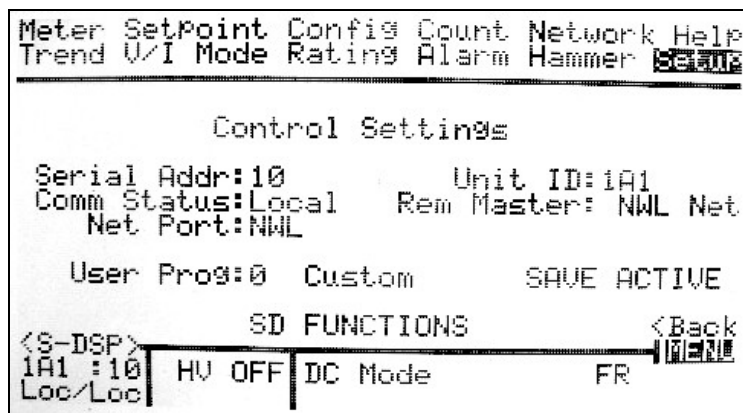


Figure 1-2b

- The GVC addresses that are to be displayed on the network display screen must also be defined. This parameter is found on the **Display Settings** screen (fig. 1-2c), which is also accessed from the **Setup** screen. The display range is set in the **Network Range** parameters.

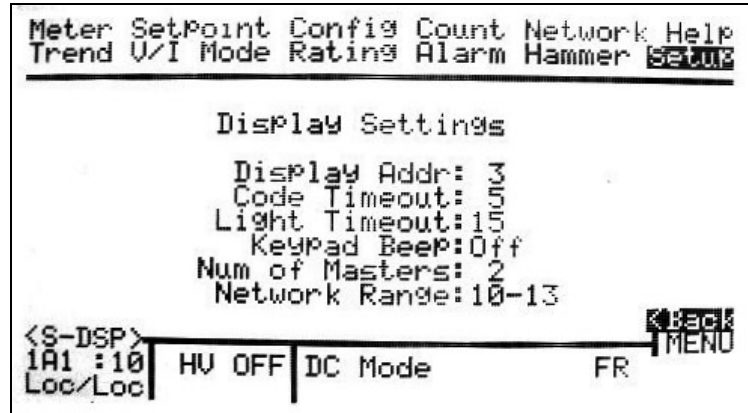


Figure 1-2c

- Once all these parameters are set and the **Network** screen is selected, the network summary screen will be displayed (fig. 1-3).

ID	kV	mADC	kW	Duty	SPN	APM	HV	ALM
1A1	43	168	7.2	76%	11	4	On	No
1A2	0	0	0.0	0%	0	0	Off	Yes
1A3 +	0	0	0.0	0%	0	0	Off	No
>1A4 +	0	0	0.0	0%	0	0	Off	Yes

Figure 1-3

The list will show three types of T/R controllers:

- T/Rs with existing IDs, displayed in up to four alphanumeric characters such as 1A1. The + next to the ID indicates the unit is a PowerPlus switchmode power supply. An ° in the Duty column signifies that the unit is a conventional SCR controller. A % signifies the unit is a PowerPlus switchmode power supply.
- T/Rs with an address on the network that do not yet have IDs, displayed as two numbers in brackets such as [13].
- T/Rs not on the network link, displayed with a trailing question mark such as 13-?. It will also say *Network Busy –Please Wait!* This will also be displayed if there is a problem with the number of

master devices on the network. A master device is defined as a network display, a PCAMS computer system, or a DCSi. If numerous masters are present, the chances of communication “collisions” increases. To better regulate the network communication timing, enter the total number of masters present on the network in the **Num of Masters** parameter on the **Display Settings** screen.

To select a T/R controller from the list, use the <Arrow> keys to highlight the correct ID, then press <Enter> to register your choice.

If the controller does not yet have an ID, see Chapter Four: Setup, Configuration, Networking for instructions on how to assign an address to a T/R controller. You are now ready to start monitoring.

Signing On/Off

Signing on to the GVC allows you to make changes in settings and, at the highest level, access more than the initial nine screens. If you're not signed on you'll not only be restricted to the first nine screens, you'll be able to make changes to the certain parameters on the **Control Settings** and **Display Settings** screens only.

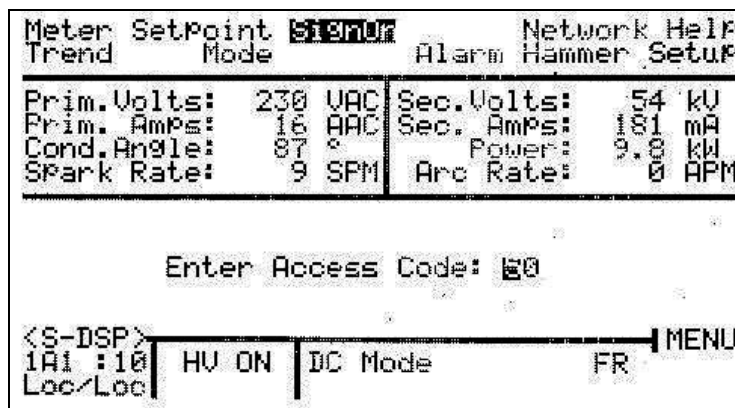


Figure 1-4

To sign onto the GVC, scroll the cursor to the **SignOn** menu bar choice. The parameter entry window on the screen that appears (fig. 1-4) allows you to enter your access code. Then:

1. press the <Enter> key – the display will highlight the first digit in the **Enter Access Code** window



2. use the <+Incr> key to reach the first number of your access code and press <Enter> to move to the second digit
3. use the <+Incr> key again to reach the second number and push <Enter>.

Your access code entitles you to one of two access levels.

- Level 2 gives you the ability to change settings in eight of the initial screens (excluding **Help**).
- Level 3 gives access to and complete control over all 12 display areas and their parameters.

If you have Level 2 access the cursor will return to the **Sign On** menu item, and the words *LEVEL 2 ACCESS* will appear in the parameter entry window.

If you have entered the code for Level 3, the highest access, the display will return the cursor to the **Meter** menu item. The main menu now gives you access to 12 screens (**Sign On** will be replaced by **Config**), and you can change all available settings that control T/R set parameters.

Access Protection

To protect against unauthorized tampering with ESP operation, the GVC will revert to Level I view-only a few minutes after you stop using the keyboard. The exact length of time can be set in the **Display Settings** screen as follows.

1. Use the <Arrow> keys to navigate to the **Display Settings** option on the **Setup** screen, then press <Enter>. See fig. 1-5
2. Scroll the blinking cursor to **Code Timeout** with the <Arrow> keys. Use <+Incr> or <-Decr> to change the setting. Default is *5 Min*.
3. Press <Enter> to register your settings.

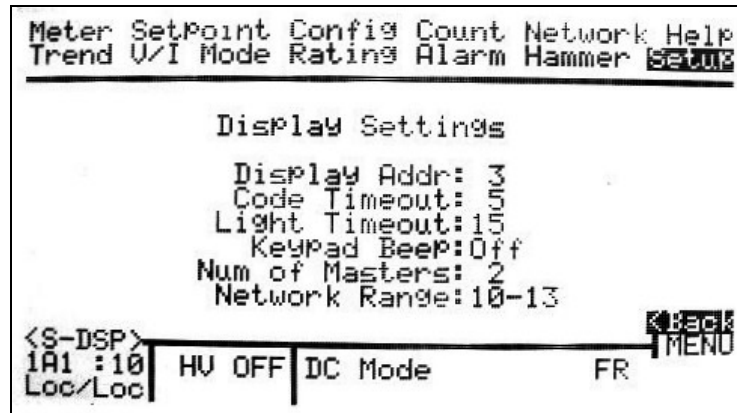


Figure 1-5

Then scroll to **Menu** and press <Enter> to return to the main menu bar.

Signing Off

If you want positive protection against tampering, manually signing off the system will return it to Level I access. To sign off,

- scroll the cursor to the **Setup** main menu item and use the <Enter> key to move into the parameter entry window;
- scroll to the **Sign Off** choice and press <Enter>.

The GVC will return to Level I. with the cursor back in the **Meter** main menu item.

Getting Help

The GVC has an on-screen help system (fig. 1-6) that can answer many of your questions about accessing features and using the keypad/display efficiently. To reach the help facility

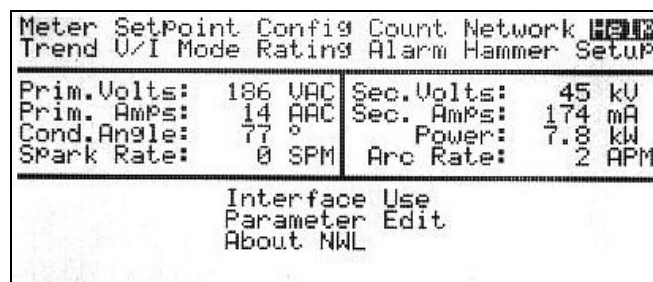


Figure 1-6

1. scroll to **Help** on the main menu, and press



<Enter>

2. scroll to the topic you want (***Interface Use, Parameter Edit***, etc.) and press <Enter>
3. use <+Incr> and <-Decr> to move through the pages, and press <Enter> when you want to return to the main **Help** display.

Pressing the <? Help> key on the keypad/display will display information relevant to the screen you're in. NWL is constantly expanding and improving this feature.

Monitoring the System

NWL's GVC makes it easy to keep track of the performance of your precipitator. We'll now look at the basic monitoring features of the system.

Meter Display and Readouts

The first informational screen you'll see when you start the GVC is the **Meter** display (fig. 1-7). The display reverts to this screen automatically whenever your access code times out or you sign off the system. *This is a display-only screen.*

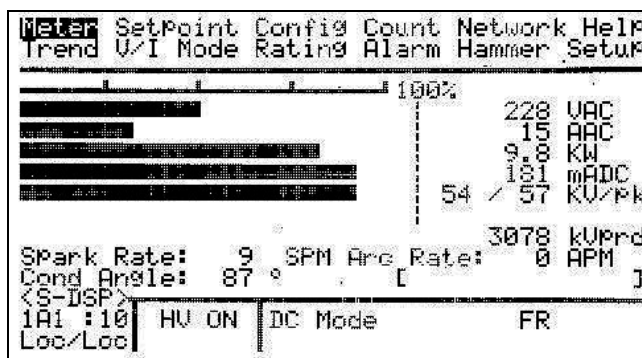


Figure 1-7

The **Meter** screen will show either of two graphic displays, depending on which has been selected as the default during **Setup** of the system:

- bar charts and numeric readouts of the current operational readings
 - * primary voltage (VAC)
 - * primary current (AAC)
 - * output power (KW)
 - * output current (mADC)
 - * output average & peak voltage (KV/pk)
 - * output average & peak voltage (KV/pk)-used only for dual-bushing T/Rs
 - * kV product – the product of the kVDC & kVpk

This is an index to the relative efficiency of the ESP collection. The higher the (kVprd) the better the collection should be.

- the spark rate, arc rate, and conduction angle are also displayed numerically
- a trend graph on any one of these operational readings over a selected period of time (if both KV1 and KV2 are used, the trend will average the two readings). This procedure is described in the **Trends** section later in this chapter.

Hold Readings

The meter readings that are displayed can be temporarily held or locked by pressing the < Enter > key at any time. The readings will not change until any other key is pressed, or until approximately 30 seconds has lapsed. After the timeout, the screen will continually update the readings again. This feature is only functional on the **Meter** screen.

Bar Chart

The bar chart screen gives you a quick overview of how the unit is operating. Each bar and its accompanying numeric readout represent actual T/R set output. The bars are on a scale of zero to 100% of the maximum rating of the T/R set for each value.

Trend Graphs

NWL's ESP GVC can track power supply behavior in any of the above performance areas. The results are displayed as a graph as shown in fig. 1-8.

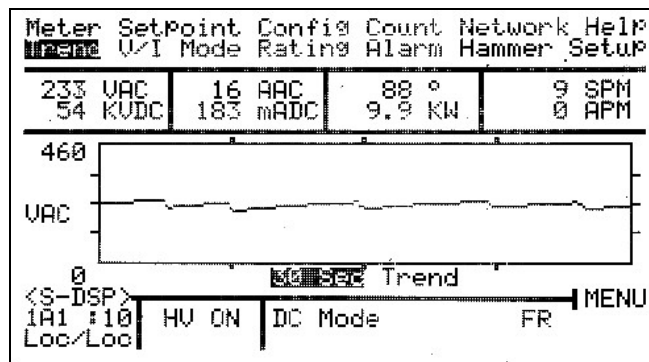


Figure 1-8

Only one graph may be displayed at a time. The **Trends** section later in this chapter explains the process of selecting the type of trend and period of time you wish to track.

Local and Remote Operation

The keypad/display module can monitor and control a single T/R set or a network of up to 90. Network operation offers more flexibility than single-unit use. On a network you can tap into any T/R set.

Local Operation

To use the display for monitoring and control of a single unit, insert the mod plug into its local jack for automatic connection to that power supply. The following procedure automatically sets up the T/R controller for local operation:

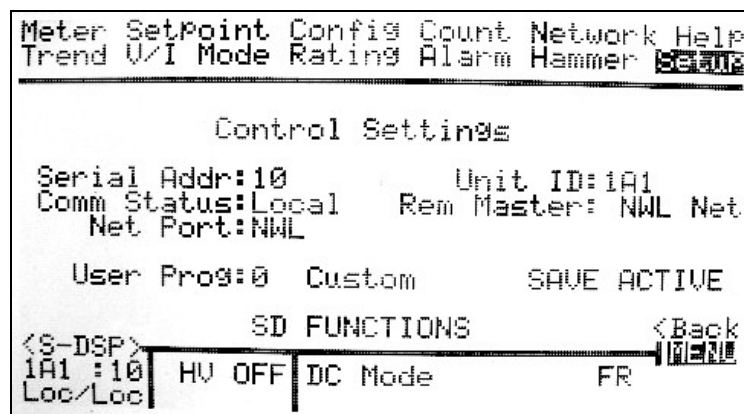


Figure 1-9

1. scroll to the **Control Settings** option on the **Setup** screen, then press <Enter>.
2. move to **Comm Status** (fig. 1-9) and change it to *Local*
 - PCAMS software and any other display/keypads on the network will be able to monitor your changes, but will not be able to make parameter changes of their own until **Comm Status** is changed back to *Remote*
3. press any two <Arrow> keys simultaneously to access the main menu, from which you can select the screens you need to access for changes to this

T/R's parameters.

Be certain to change **Comm Status** back to *Remote* when you no longer need local control.

Remote Operation

It's easy to monitor and control any T/R set on the network. Simply plug the keypad/display module into the network jack on the control module. The keypad/display automatically displays the network summary screen for the range of T/R's that were programmed in the **Display Settings** screen.

1. use the <Arrow> keys to choose the T/R from the displayed list
2. register your choice with <Enter>

As long as the remote T/R set's **Comm Status** is *Remote*, you can now change its parameters just as if the keypad/display module was plugged into the local jack. Note that **Comm Status** (local or remote) can only be set from the local port.

Some functions of the GVC are assigned exclusively to local or remote mode. See the table of remote and local functions in Chapter Four: Setup, Configuration, and Networking for a breakdown of function assignments.

Ext.Dis. (External Discrete)

This option should be selected if an external Local – Remote switch is to be used with external discrete On signal. The PCAMS or the DCSi cannot turn the controller On or Off in this mode. Other parameters can still be modified by the PCAMS or DCSi, however. With this option the terminals J15-5 and J15-6 on the GVC control board are redefined as follows:

Terminal J15-5: This will be the input terminal for the Local – Remote switch. If 120 VAC is present on the terminal, the unit is in Remote. If there is no voltage on the terminal, the unit is in Local. If the Unit is in Local, the only way to energize the HV and change the parameters is from the local keypad/display. The communications port or the Remote On input will not initiate any changes. If the unit is in Remote, the only way to energize the HV is by using the Remote On input on terminal J15-6, described below.

Terminal J15-6: This will be the Remote On/Off input.
When 120 VAC is present on terminal J15-6, the controller will turn the HV On.
When the 120 VAC is removed, the controller will turn off.

Ext.Net (External Network)

This option also allows the use of an external Local – Remote switch. The features and terminal definitions are the same as the *Ext.Dis.* option, however if the external switch is in the Remote position, the controller can only be energized over the network port by either a PCAMS, DCSi or network Display.

Basic Monitoring Functions

Monitoring begins with the default **Meter** display screen. This display contains a bar chart with accompanying numeric readouts. Three additional numeric values (fig. 1-10) are displayed beneath the chart. These readings cover

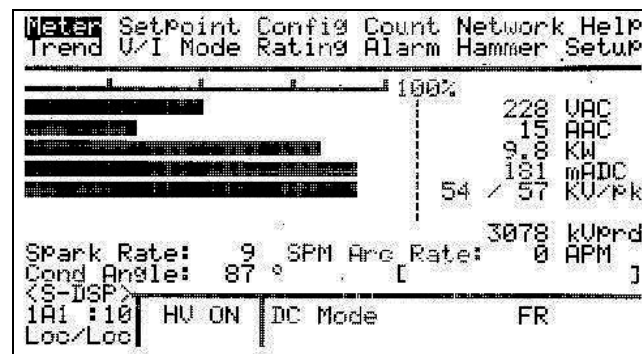


Figure 1-10

1. primary voltage (VAC) monitoring: if there is no secondary voltage monitoring, this is also used to
 - control the amount of power delivered to the T/R set
 - to display a calculated kVDC which is used to prevent under and over voltages.
2. primary current (AAC), monitored to
 - control the amount of power delivered to the T/R set

- ensure that the T/R is not operated at greater than rated primary current.
3. secondary power (*KW*) to show T/R output in kilowatts
 4. secondary current (*mADC*) monitoring to detect sparks and arcs, which appear as sudden current peaks
 5. secondary voltage, both waveform average and peak (*KV/pk*), are monitored to
 - control the amount of power delivered to the T/R set
 - prevent under- and over-voltage
 - detect sparks and back-corona
 6. kV product – the product of the kVDC & kVpk gives an index to the relative efficiency of the ESP collection from the electrical performance aspect. The higher the (kVprd) the better the collection should be.
 7. *SPARK RATE* in **SPM** (sparks per minute) and *ARC RATE* in **APM** (arcs per minute) to show spark/arc frequency:
 - 5 to 15 times per minute is a typical range for sparks, depending on gas flow conditions.
 - Arcs should be kept to a minimum, zero if possible.
 8. *COND ANGLE*, which indicates how long each SCR (rectifier) in a T/R control cabinet is conducting on one half of a line cycle. The GVC will never exceed 160.

Electrical Values Window

Every screen except **Meter** and the **V/I Curve** display contains an electrical values window just below the main menu bar (see fig. 1-11).

Prim. Volts:	240 VAC	Sec. Volts:	56 kV
Prim. Amps:	17 AAC	Sec. Amps:	188 mA
Cond. Angle:	90 °	Power:	10.5 kW
Spark Rate:	9 SPM	Arc Rate:	0 APM

Figure 1-11

This display area includes all the information contained in the bar charts and readouts named above, but in numeric form only. By referring to this window you can see what the precipitator is doing regardless of the screen you're in.

Status Bar

The bottom two lines of every screen except **V/I Curve** make up the status bar (fig. 1-12), which tracks current operating conditions at the precipitator.

<S-DSP>	HV ON	DC Mode	FR	MENU
1A1 :10		Voltage Limit		
Loc/Loc				

Figure 1-12

The left side of the status bar tells you the T/R ID and address of the T/R set the GVC is now monitoring. It also shows whether it is in *LOCAL* or *REMOTE* mode. Just above the T/R ID is either a <S-DSP>, to indicate that the display is communicating with a new DSP version SCR style controller, a <SCR>, to indicate that the display is communicating with an older non-DSP SCR style controller, or a <P+>, to indicate the display is communicating with a switchmode power supply (PowerPlus).

The middle section alerts you to any sparks or arcs and indicates whether the high voltage is On or Off (*HV ON/OFF*). The right-hand area contains important information on the T/R set's operating parameters. The first line may show any of the following.

- An *FR* indication shows that Fast Recovery mode is on to optimize precipitator performance after heavy sparking and multiple setbacks. These conditions would normally cause very slow recovery. But FR will restore power quickly if there is no further sparking for 10 seconds.

- An *IE* indicates Intermittent Energization mode, which may improve collector efficiencies with higher resistivity loads by pulsing the SCRs. This also may reduce energy consumption while maintaining desired opacity.
- If *BC* appears, the GVC's automatic back corona detection and correction feature is engaged. Chapter Three: Changing T/R Parameters, describes back corona in detail.
- The word *Manual Mode* shows the controller is being operated manually, rather than allowing the GVC to automatically adjust its electrical values for optimum opacity and efficiency.
- The flashing word *ALARM* indicates there has been an alarm event that has not yet been cleared.

The second line indicates what limits and operating parameters are in effect.

- *CURRENT LIMIT* shows that the controller is holding the T/R's primary current to a preset value.
- *VOLTAGE LIMIT* shows that the controller is holding the T/R's secondary voltage to a preset value. (If there is no KVDC feedback, primary voltage feedback performs this function.)
- *FULL CONDUCTION* indicates the SCRs are operating at maximum conduction angle.
- *BACK CORONA DETECT* shows back corona is present.
- *V/I GEN. IN PROGRESS* displays while the GVC is generating a V/I curve.
- *BACK CORONA SEARCH* shows that the GVC is searching for a back corona condition.
- Help notices tell users what to do in specific situations. For example, they will direct users to turn off the <HV On/Off> key before accessing certain displays.
- *REMOTE ON/OFF: ON* indicates trouble: there is 120 VAC at both this input and the Remote Enable input, so the HV cannot be turned off.

- **REMOTE ENABLE: OFF** indicates that 120 VAC is not available at this input, so HV cannot be turned on.

V/I Curve

The GVC will generate a V/I Curve, allowing you to compare voltage versus current on an easy-to-read graph. You can also set certain criteria for each curve.

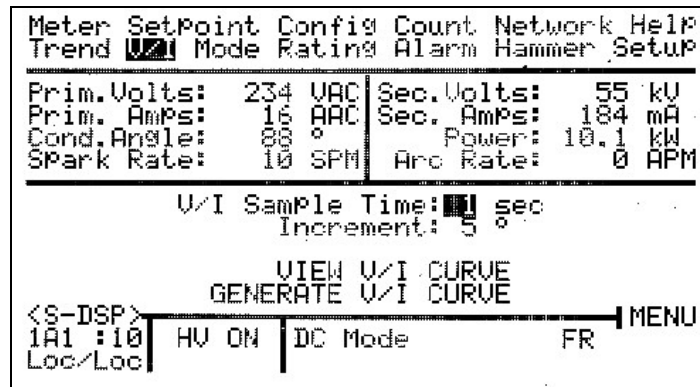


Figure 1-13

To see a V/I curve for any precipitator

1. select **V/I** from the main menu and press <Enter>
2. on the **V/I** display (fig. 1-13) move to **View V/I Curve** and press <Enter> again.

The GVC will display the most recently generated V/I curve. A sample can be seen in fig. 1-14. To cancel the display, press <Enter> again.

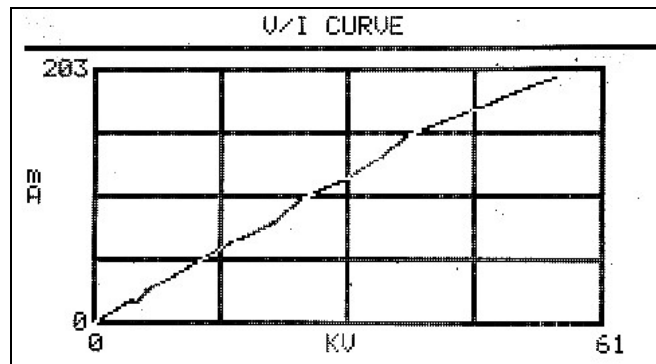


Figure 1-14

You can generate a new V/I curve just as easily. On the same screen

1. move to **V/I Sample Time**, choose a value from 1 to 10 seconds to select dwell time for each point with the <+Incr> or <-Decr> and press <Enter>;
2. with the cursor on **Increment**, select a conduction change value from 1 to 10 and press <Enter>;
3. with the cursor now on **View V/I Curve**, press the down <Arrow> again to reach **Generate V/I Curve**;
4. press <Enter> to generate and view the new V/I curve.

This curve will be stored for display until you create a new one. The <Enter> key will return you to the V/I display.

The V/I curve data points are also saved to a comma separated values (.CSV) file on the SD card located on the DSP board. This file is appended every time a curve is generated. The SD card can be removed and read by any computer with a spreadsheet program capable of importing CSV files. The V/I data file name on the SD card is NWL_VI.CSV.

Trends

The GVC can track trends in precipitator performance automatically. This gives you the ability to manage ESP performance better by identifying the conditions that cause performance changes. Refer to fig. 1-15 below.

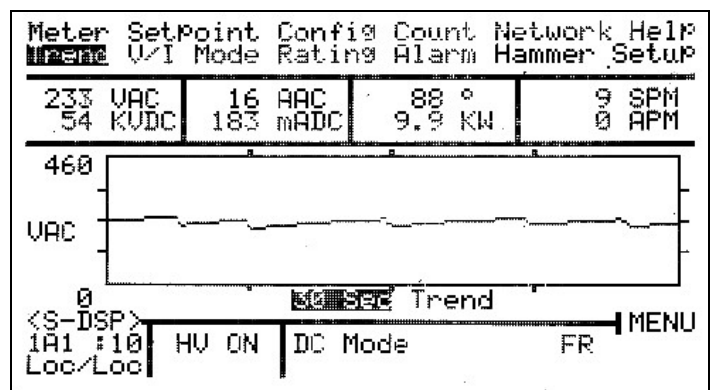


Figure 1-15

To begin trend tracking, scroll to **Trend** and press <Enter>. The cursor will go to the y axis label. Using the <+Incr>

and <-Decr> keys, choose among

- VAC, which tracks primary voltage at the T/R
- AAC or primary current
- KVDC, to track secondary voltage
- mADC (secondary current), which tracks sparks and arcs
- KW, or secondary output power.

Press <Enter> to register your choice.

At the **Trend Time** field you can choose to get a quick snapshot of T/R behavior or two longer views: *30 sec.*, *30 Min.*, or *24 Hrs.* Make your choice with the <+Incr> and <-Decr> keys and <Enter>.

Count Display

This screen is only available in Level 3 access.

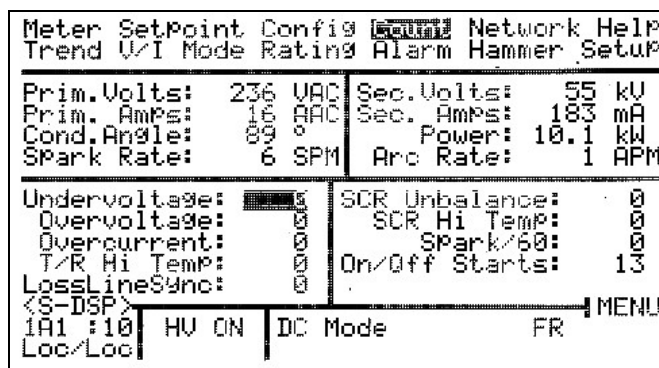


Figure 1-16

The **Count** display shows the number of times the T/R has experienced certain conditions since last checked and reset. To reach the screen (fig. 1-16) move the cursor to **Count** on the main menu. The screen's parameter entry window displays how many "events" the system has sustained in the following categories:

<i>Overvoltage</i>	<i>SCR Unbalance</i>
<i>Overcurrent</i>	<i>On/Off Starts</i>
<i>Spark/ 60</i>	<i>Undervoltage</i>
<i>T/R Hi Temp</i>	<i>SCR Hi Temp</i>

You can reset the counters to zero after you have reviewed



them using the <+Incr> and <-Decr> keys.

Other Displays

Each of the 12 displays listed in the main menu, and each of their sub-displays, provide information about precipitator and power supply settings and operation. You may scroll to any that are available to you and view their contents.

Most, however, are used primarily to make changes to settings. We will explore them in more detail in Chapter Three: Changing Parameters and Chapter Four: Setup, Configuration, Networking.

In the next chapter we will cover system alarms.

Alarm Functions

What This Chapter Covers

Most of your time with the GVC will be spent monitoring power supply operation and watching for alarms.

Chapter One surveyed the monitoring functions. In this chapter we will briefly cover the GVC's alarm reporting features.

If you have worked with precipitator alarms in the past, this information will be familiar to you. All the procedures are quite straightforward. However, the GVC offers some unique ways of handling alarms.

This chapter will explore

- *how alarms are announced*
- *how to view alarms*
- *how to acknowledge and clear them*
- *how to configure alarm sensing parameters.*

The last topic will lead logically to the power supply parameter changes you will explore in Chapter Three.



Alarm Sensing and Clearing

Available Alarms

With the ability to handle thirteen alarms, the GVC provides comprehensive protection against improper operation of and damage to T/R sets.

The GVC has three types of alarms: internal, standard, and auxiliary. Internal alarms, as the name implies, monitor internal operating conditions. Standard and auxiliary alarms respond to external signals, supplied through controller inputs.

Internal Alarms

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

- **Undervoltage:** occurs when the T/R set operates at or below a set value for a user-determined period of time, indicating a short circuit or high spark rates in the precipitator.
- **Overvoltage:** activated instantly if the primary or secondary voltage exceeds its rating by 10%.
- **Overcurrent:** activated instantly if the primary current exceeds its rating by 20%.
- **SCR Unbalance:** trips if an unbalance in output current feedback lasts longer than 100 msec. This parameter is programmable in the **Setpoints** window.
- **Blown Fuse:** activates if contactor coil fuse or the alarm relay coil fuse, located on the I/O board, fails.
- **Voltage Reference:** activates when a 1.5 VDC internal voltage reference drops below 1.35 VDC or exceeds 1.65 VDC. This is an indication of an internal board problem.
- **Low Battery:** activates when the battery in the controller's non-volatile RAM chip drops below an acceptable level.
- **Loss of Memory:** alerts you that the battery-backed RAM chip has failed to retain programmed parameters, and has reset to default values.

- **Loss of Line Sync:** indicates that the microprocessor is not receiving a line synchronization pulse from the system hardware.

Instructions on setting parameters for these alarms appear in Chapter Three: Changing Parameters.

Standard Alarms

The standard alarms appear on the main **Alarm** display screen (see fig. 2-1). They are:

OC (overcurrent)
T/R Hi Tmp

SCR Hi Tmp
Low Oil

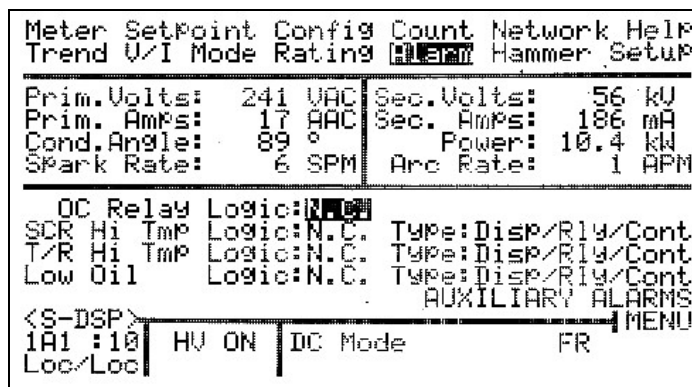


Figure 2-1

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. Instructions on configuring these alarms appear below. Directions for setting parameters for these alarms, where applicable, are in Chapter Three: Changing Parameters.

Auxiliary Alarms

You can add up to four auxiliary alarms to suit your system and procedures. Auxiliary alarms are completely user-definable and configurable. Each appears on a separate screen (see fig. 2-2). 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.

Meter	SetPoint	Config	Count	Network	Help
Trend	U/I	Mode	Rating	Alarm	Hammer Setup
Prim. Volts:	240 UAC	Sec. Volts:	56 kV		
Prim. Amps:	17 AAC	Sec. Amps:	184 mA		
Cond. Angle:	89 °	Power:	10.3 kW		
Spark Rate:	9 SPM	Arc Rate:	0 APM		
Alarm: AUX ALARM 1 < []					
Logic: N.C.					
Type: Disabled					
Count: 0					
Reduced KVDC Limit: 99%					
<S-DSP> RETURN TO SYS					
1A1 : 10 HV ON DC Mode FR MENU					
Loc/Loc					

Figure 2-2

To return to the main **Alarm** display, simply scroll to **Return to System** and press <Enter>.

Configuration procedures are covered later in this chapter.

Alarm Signals

If any alarm is tripped during precipitator operation, you will know it instantly. The GVC responds to an alarm with

- a double "beep" from the keypad/display
- an alarm message on screen (see fig. 2-3) regardless of the display you're currently viewing
- a signal to any auxiliary annunciator wired into the control board (optional)
- a contactor trip (optional).

SetPoint	Config	Count	Network	Help
Trend	U/I	Mode	Rating	Alarm
53 UAC	5 AAC	39 °	9 SPM	
0 KVDC	47 mADC	0 kW	11 APM	
Readings at Time of Alarm				
>>> UNDERVOLTAGE <<<				
Press ENTER to Clear Alarm				
<S-DSP>				
1A1 : 10	HV OFF	DC Mode	FR ALARM	
Loc/Loc READINGS AT ALARM				

Figure 2-3

All alarm messages appear on the **Meter Display** screen. If you're in another screen when an alarm trips, the GVC will switch to the meter display screen.

Alarm Information

When alarms appear on the **Meter Display** screen, the usual bar chart is replaced with:

- an alarm identification.
- electrical readings at the time of the alarm (if the contactor was tripped).

This helps you uncover the cause of the alarm event.

If the alarm caused the control to trip the contactor and de-energize the T/R set, the electrical readings displayed on all screens will be those taken just prior to the trip. These will not change until the alarm is cleared. You can use them to track down the cause of the problem. For information on an alarm and a recommended procedure for handling it, press the <? Help> key.

The alarm information is also saved to a comma separated values (.CSV) file on the SD card located on the DSP board. This file is appended every time an alarm is generated. The SD card can be removed and read by any computer with a spreadsheet program capable of importing CSV files. The alarm file name on the SD card is NWL_ALM.CSV.

The DSP board on the control module also has a four character LED display. This display will also give an indication of any active alarm, limit condition, and opening status. A complete table of the display messages is given in an appendix at the end of this manual.

How to Respond to Alarms

All alarms put messages on the display. Some shut down power to the SCRs by tripping the contactor. You respond to an alarm by acknowledging it and clearing it. In some cases you can scroll to other screens and change parameters while the alarm is still in force.

Acknowledging the Alarm

To acknowledge an alarm, simply press <Enter> while the alarm message is on the screen. The alarm warning screen will disappear.

- If the condition that triggered the alarm has been removed, the alarm will also clear and the GVC will operate normally.
- If the situation has not changed, the alarm will reappear and the display module will show the flashing *word ALARM* in the status bar (fig. 2-4). Correct the problem as described below and the alarm will clear.



Figure 2-4

Clearing Alarms

You clear an alarm by pressing <Enter> after the situation that caused the alarm has been corrected. Sometimes you must correct the problem manually. When this requires working on the T/R set or the precipitator, ***shut off all power to the T/R set and do not turn it back on until you have finished the work.***

Alarms can also be remotely cleared by configuring one of the auxiliary alarms for the Clear Alarm Input (***Clear Alm Inp***) function. Refer to the Auxiliary Alarm Configuration section of this manual for more information on this feature.

For *internal alarms*, follow these guidelines.

- ***Undervoltage*** can be caused by several conditions.

Cause: actual short circuit in the precipitator.

Solution: find short circuit and remove it.

Cause: incorrect settings for undervoltage, ramp, setback, fast recovery, spark and arc level.

Solution: change settings to correct values as described in Chapter Three: Changing Parameters.

Cause: readout not calibrated properly.

Solution: recalibrate following instructions **Installation and Startup Guide** or Appendix A in this Guide.

- **Overvoltage** alarms signal either incorrect calibration or a problem with the GVC control board.

Cause: incorrect parameters for T/R set.

Solution: change settings to correct values as described in Chapter Three: Changing Parameters.

Cause: incorrect feedback levels.

Solution: check feedback levels going to I/O board, correct to real values if necessary.

Cause: readout not calibrated properly.

Solution: recalibrate following instructions in **Installation and Startup Guide** or Appendix A, below.

Cause: bad I/O board.

Solution: replace I/O board.

- **Overcurrent** alarms signal either excessive primary current is present or incorrect calibration exists.

Cause: shorted SCR

Solution: test SCR and replace if shorted.

Cause: excessive primary current

Solution: make sure that the current limit is properly set and that the controller is properly sensing arcs. Set the arc sensitivity to Hi.

Cause: readout not calibrated properly.

Solution: recalibrate following instructions in **Installation and Startup Guide** or Appendix A, below.

- **SCR Unbalance** indicates an unbalance in the output current feedback.

Cause: SCR unbalance parameter is set too low.

Solution: change SCR unbalance setting. See the Setpoint Parameters instructions under T/R Electrical Settings in Chapter Three: Changing T/R Parameters, below.



Cause: bad SCR, SCR trigger board, or GVC I/O board.

Solution: replace faulty hardware component.

- **Blown Fuse** alarms signal that the small fuses that protect the onboard relay contacts have failed. The fuse are socketed and easily changed, but the condition that caused the failure must still be corrected.

Cause: short in wiring from contactor and/or alarm relay to external device.

Solution: find the short circuit and correct it.

Cause: the current draw from the external device is higher than the fuse rating.

Solution: use an interposing relay to reduce the current on the fuse.

- **Voltage Reference** signals that an internal voltage reference is outside of the allowable voltage range. This is an indication of a failed control board.

Cause: problem with control board.

Solution: replace complete control module.

- **Low Battery** signals that the battery in the controller's non-volatile RAM has dropped below an acceptable value.

Cause: problem with RAM chip

Solution: replace battery on RAM chip, then recalibrate following instructions in **Installation and Startup Guide** or Appendix A, below, and reprogram following instructions in Chapter Three: Changing Parameters.

- **Loss of Memory** shows that the parameters stored in RAM have been wiped out.

Cause: line surge or other electrical anomaly scrambles memory.

Solution: recalibrate following instructions in

Installation and Startup Guide or Appendix A. below, and reprogram following instructions in Chapter Three: Changing Parameters.

Cause: failure of battery backup or RAM.

Solution: replace battery or RAM; then recalibrate following instructions in **Installation and Startup Guide** or Appendix A, below, and reprogram following instructions in Chapter Three: Changing Parameters.

- **Loss of Line Sync** indicates that the control circuit has lost its synchronization or timing reference to properly energize the SCR's.

Cause: Electrical noise around the zero crossing of the incoming voltage waveform. Often caused by variable speed motor drives on the same power feed as the controller.

Solution: Remove the electrical noise from the incoming voltage.

Standard alarms indicate problems with the T/R set or the AC switch. Clear them after correcting the AC overcurrent, the high T/R oil temperature, the high SCR temperature, or low T/R oil level conditions.

The causes of *Auxiliary* alarms depend on how you have defined the alarms themselves. Correct as required.

Emergency Operation

It's possible to use the GVC when an alarm has not been cleared. You can still scroll through the other screens and make program changes. *ALARM* will continue to flash in the status bar.

It is also possible in some circumstances to use the keypad to clear an alarm without correcting the fault. For example, if you know that the event is a false alarm caused by a failed relay, you can scroll to the **Alarm** screen and change the relay logic from N.C. to N.O. so you can continue operating until the relay is replaced.

Do not use this feature to defeat protective safety devices. NWL will not be responsible for damage or injury caused by unsafe operation of the GVC.

Alarm Configuration

Parameters on alarms can be configured to match the actual devices in your system. You view current settings and make all changes on the **Alarm** screen and the **Auxiliary Alarms** subdisplays.

The only configurable internal alarms are the **Undervoltage** and **SCR Unbalance** alarms. See the Setpoint Parameters instructions under T/R Electrical Settings in Chapter Three: Changing T/R Parameters, below.

Standard Alarms

We will first configure the four standard alarms pre-programmed into every GVC. These appear on the main **Alarm** display (fig. 2-5).

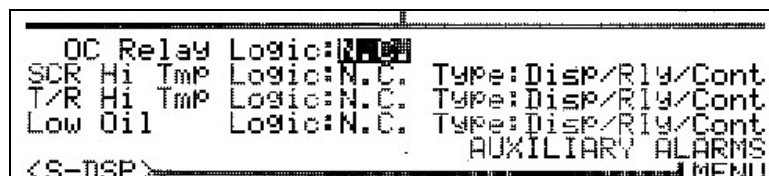


Figure 2-5

Scroll to that display with the <Arrow> keys and move into the parameter entry windows with the <Enter> key. Use the <+Incr> 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/Cont[actor]*: 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 (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 cannot be changed, and it will always trip the contactor.

Auxiliary Alarms

At the beginning of this chapter we saw how each auxiliary alarm appears on its own screen (fig. 2-2. above). We also saw how to reach the screen for each one, and return to the main **Alarm** display. You will use the same procedures to reach the auxiliary alarm screens for alarm configuration.

Once 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. However, Auxiliary Alarms add two new parameters: **Count, Reduced KVDC Limit, and Clear Alarm Input.**

Counts and Clearance

Each of the four auxiliary alarm displays includes a **Count** field. This shows you how many events of this type have taken place since the alarm was last cleared.

To clear the count, simply scroll to the field and press either the <+Incr> or <-Decr> key. The count will return to zero.

Reduced KVDC Limit

Each of the four auxiliary inputs can also be configured to reduce the KVDC voltage limit in the controller. This can be used for reduced power rapping of a field or for the wash cycle of a wet precipitator. Simply set the alarm **Type** to **Reduced KVDC** and use the <+Incr> or <-Decr> key to set the **Reduced KVDC Limit** to the desired level. When the input contact is closed (or opened, depending on the configuration) the output KVDC will be reduced to this temporary limit. When the contact is reversed the output will ramp up to the original level. The Undervoltage trip is disabled when this feature is active. If you are using this



feature while operating in the Intermittent Energization mode, the **Reduced KVDC Limit** parameter will change the max. conduction angle parameter instead of the KV limit.

Clear Alarm Input

Each of the four auxiliary inputs can also be configured to clear alarms. This can be used for clearing alarms from a remote location. Simply set the alarm **Type** to *Clear Alm Inp*. When the input contact is closed (or opened, depending on the configuration) the active alarm will be cleared.

Alarm IDs

By default, auxiliary alarms are displayed as numbers: *Aux Alarm 1*, *Aux Alarm 2*, etc. You can set them up to display as actual names.

To give each auxiliary alarm a unique ID, scroll to the **Alarm** field in the **Auxiliary Alarms** submenu. Select the alarm you wish to identify. Then use the <+Incr> and <-Decr> keys to highlight each letter of the name. The <Arrow> keys allow you to edit the characters.

What This Chapter Covers

Changing T/R Parameters

The second section of Chapter Two showed how easy it is to change alarm configurations on the GVC. Changing electrical and other parameters is just as simple.

However, the choices available and the results they produce are quite different. Parameter changes affect the overall performance of your T/R set and the precipitator it powers. We will cover the configuration of parameters for sparks, arcs, and overall operating conditions.

*With the addition of an optional daughterboard the GVC will also control tumbling hammers. We do not cover tumbling hammer operation here-instructions for configuring tumbling hammers accompany the daughterboard. If your GVC does not include this option, simply ignore the **Hammer** main menu item.*

Parameter changes can have a profound effect on the final opacity of the gas flow out of the precipitator, and on the cost-effectiveness of its operation. But once the proper settings are established, operation is virtually automatic.

So it pays to make any parameter changes carefully. This chapter will demonstrate how.

Sparks and Arcs

The GVC monitors the T/R set's primary voltage, primary current, secondary voltage, and secondary current to control the power to the T/R. Through these feedback lines it also detects sparks and arcs to prevent damage to the T/R.

Properly configured, the GVC not only corrects for these conditions, but helps insure effective, economical particulate removal.

All configurations are reached through the displays listed in the main menu bar. We'll look at the controls for each kind of event one at a time.

Spark Control

The T/R controller constantly monitors secondary voltage and current to detect the occurrence of sparks. A spark is a flashover in the precipitator that extinguishes itself in less than a half-cycle of incoming voltage. Since the SCR's can not respond any quicker than a half-cycle there is no need to stop firing or energizing the SCR's when a spark occurs.

Once it senses a spark, the GVC controls it by setting back the SCR's conduction angle slightly in the next half-cycle, thus reducing the voltage to a level lower to stop the occurrence of another spark. It then performs a *slow ramp* back to pre-spark level.

Settings that affect the control of sparks appear in four screens: **Setpoint**, **Config**, the **Cal Setup** submenu of the **Rating** screen, and **Mode**. We'll begin with the **Setpoint** parameters.

Setpoint Parameters

Scroll through the main menu to the **Setpoint** menu item (fig. 3-1) and press <Enter> to move to the parameter entry window. Three crucial settings on the left side of the window help control sparking and protect the power supply.

Meter	Setpoint	Config	Count	Network	Help
Trend	U/I	Mode	Rating	Alarm	Hammer
Setup					
Prim. Volts:	240 VAC	Sec. Volts:	56 kV		
Prim. Amps:	17 AAC	Sec. Amps:	188 mA		
Cond. Angle:	90 °	Power:	10.5 kW		
Spark Rate:	9 SPM	Arc Rate:	0 APM		
Spark Setback:	15%	Current Limit:	100%		
Quench:	1cyc	Voltage Limit:	100%		
Sparks/min:	55SPM	U.U. Trip:	10kV		
Fast Ramp:	20cyc	U.U. Delay:	30s		
Spark Ramp:	Linear	SCR Unbal. %:	50%		
<S-DSP>					MENU
1A1 :10	HV ON	DC Mode			
Loc/Loc					

Figure 3-1

You can change the settings to meet your needs, as follows.

- **Spark Setback (%)** determines how far T/R power will be set back in response to sparks. Use the <+Incr> and <-Decr> keys to change the setting.
 - Default is 10%.
 - Available range is 1% to 30%.
- **Sparks/Min** shows the desired operating condition. The "slow ramp" back to pre-spark levels is calculated on this basis. Use the <+Incr> and <-Decr> keys to program it for any setting between 1 and 120 (default is 6).
- **Spark Ramp** allows you to specify any of three rates at which power is restored to pre-spark level after a setback. For better response to changing spark levels via either the 3 or 4 Slope ramp.
 - *Linear*, a uniform ramp from setback to pre-spark level (shown below, fig. 3-2)

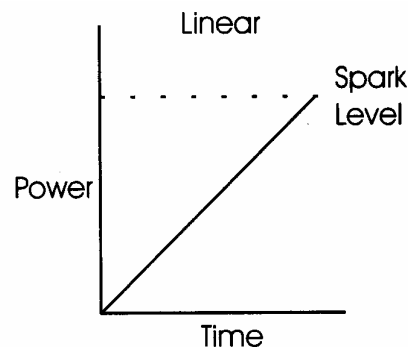


Figure 3-2

- **3 Slope:** steps through three different rates from setback to pre-spark levels for a recovery slope similar to that shown in see fig. 3.3, below. This method permits a longer distinguish time.

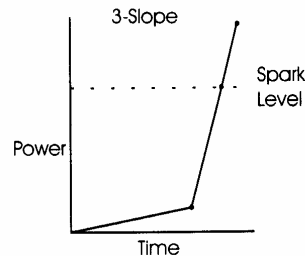


Figure 3-3

- **4 Slope:** performs four different ramp rates from setback to pre-spark levels for a recovery rate similar to that in fig. 3-4. It yields more average power than the 3 Slope ramp.

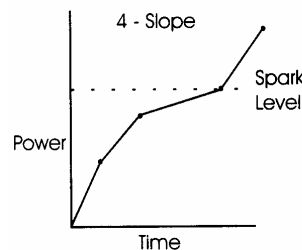


Figure 3-4

Configuration Parameters

Under the **Config** main menu item are two **Setback Offset** settings (fig. 3-5) that help control sparking. The **Setback Offset** feature adds an extra setback function after a spark occurs.

Max.Volt. Cond: 100%	Max. Cond. Sel: Volt
Max.Curr.Limit: 110%	KV1 Feedback: Yes
Max.Curr. Cond: 100%	KV2 Feedback: No
Setback Offset: Man	Level 2 Code: 11
Setback Offset: 30%	Level 3 Code: 51
<S-DSP>	MENU

Figure 3-5

The purpose is to limit the additional current used to recharge the precipitator's capacitive load in the first half cycle after a disruption. You can configure this feature as follows.

- Use the <+Incr> and <-Decr> keys in the first **Setback Offset** field to select *Auto* or *Man{ual}* mode.
 - *Auto* uses an internal algorithm to determine the optimum setback offset:
 - *Man.* allows you to enter your own value for the offset setback to be used.
- Use the <+Incr> and <-Decr> keys in the second **Setback Offset** field to enter the value for manual offset.
 - Values between 10% and 100% are permitted.
 - 15% is default.

Sensitivity Calibration

The GVC lets you control the sensitivity of its spark detection. If you are getting spark indications (shown in the status window) when there is no sparking, the sensitivity is set too high. If the unit does not detect actual sparking, it is set too low.

To determine whether the GVC is properly sensing sparks, connect a storage oscilloscope across the secondary current feedback signal. The signal should appear as a full-wave rectified waveform. Sparks will appear as high-frequency transients. Compare the actual sparks on the 'scope to the GVC's indications.

To change sensitivity, scroll to the **Rating** menu item. In the parameter entry window, select **Cal Setup** with the <Enter> key.

On the right-hand side of the window (fig. 3-6) are two fields that allow you to set spark sensitivity: secondary current feedback (***mA Spk Sen***) and secondary voltage feedback (***KV Spk Sen***).

Meter	Setpoint	Config	Count	Network	Help
Trend	U/I Mode	Rating	Alarm	Hammer	Setup
Prim.Volts:	224 VAC	Sec.Volts:	52 kV		
Prim. Amps:	16 AAC	Sec. Amps:	176 mA		
Cond.Angle:	87 °	Power:	9.2 kW		
Spark Rate:	4 SPM	Arc Rate:	1 APM		
UAC Turns Ratio:	50:1	KV Spk Sen:	Hi		
AAC Turns Ratio:	50:5	mA Spk Sen:	Md2		
Volt Div Hi Res:	80MΩ	Arc Sense:	Hi		
Volt Div Low Res:	10KΩ				
Sec Current Shunt:	50Ω				
<S-DSP>		RETURN TO CAL			
1A1 :10	HV ON	DC Mode	FR		
Loc/Loc					

Figure 3-6

Available sensitivity settings for each field are as follows:

- **KV Spk Sen:** *Low, Hi. Off*
- **mA Spk Sen:** *Low, Med. Md2. Hi.*

The GVC will not allow you to turn the mA spark sensing off.

When the proper settings are in place, select **Return to Cal** to reach the **Rating** display, then **Menu** to return to the main menu bar.

Fast Recovery

The GVC offers the option of a Fast Recovery (FR) mode to decrease the ramp time of the T/R set when multiple setbacks have been used to stop heavy sparking in the precipitator. This helps control opacity by bringing the T/R set quickly back to the proper power for the best combination of particulate removal and efficiency

Meter	Setpoint	Config	Count	Network	Help
Trend	U/I Mode	Rating	Alarm	Hammer	Setup
Prim.Volts:	227 VAC	Sec.Volts:	53 kV		
Prim. Amps:	16 AAC	Sec. Amps:	180 mA		
Cond.Angle:	87 °	Power:	9.5 kW		
Spark Rate:	6 SPM	Arc Rate:	0 APM		
Control Mode	B.C. Values	I.E. Values			
DC Mode	IncDec: 6%	1/2 Cyc.On: 1			
Manual Power	Time: 60s	Cyc.Off: 1			
Level: 0°	Delay: 1s				
FastRec: On	Phsbak: 0%	HV Pwr Up: Off			
<S-DSP>					
1A1 :10	HV ON	DC Mode	FR		
Loc/Loc					

Figure 3-7

To select fast recovery mode, scroll to the **Mode** item in the main menu, and press <Enter>. The cursor will move

to the **FastRec.** field in the parameter entry window (fig. 3-7). Use the <+Incr> and <-Decr> keys to select *On* or *Off* and press <Enter>. Return to the main menu by selecting the **Menu** item.

Arc Control

Arcs are flashovers that can last for several cycles. Because they pose a larger threat to precipitator operation than sparks, the remedies are stronger.

When it senses an arc, instead of simply phasing back the conduction angle, the GVC reduces it to zero degrees, effectively "quenching" power output to ensure the arc has been extinguished. You can program how long this quench lasts. After a quench, if the secondary current has dropped to near zero, the controller will increase the conduction angle (and thus the power) on a fast ramp back to the **Spark Setback** level. Then it will start a slow ramp up in power until either it reaches current limit, voltage limit, or a spark, as described above under "Spark Control."

After the quench period expires, if the controller senses that secondary current has not dropped to near zero, it will repeat the quench cycle. This will continue until the condition corrects itself or until the controller signals an undervoltage alarm and trips the contactor.

Setpoint Parameters

Two settings on the **Setpoint** screen (fig. 3-8) let you adjust arc control parameters.

Meter	Setpoint	Config	Count	Network	Help
Trend	U/I	Mode	Rating	Alarm	Hammer
Prim. Volts:	240 VAC	Sec. Volts:	56 kV		
Prim. Amps:	17 AAC	Sec. Amps:	188 mA		
Cond. Angle:	90 °	Power:	10.5 kW		
Spark Rate:	9 SPM	Arc Rate:	0 APM		
Spark Setback:	15%	Current Limit:	100%		
Quench:	1cy	Voltage Limit:	100%		
Sparks/min:	5SPM	U.U. Trip:	10kV		
Fast Ramp:	20cy	U.U. Delay:	30s		
Spark Ramp:	Linear	SCR Unbal. %:	50%		
<S-DSP>					
1A1 :10	HV ON	DC Mode			
Loc/Loc					

Figure 3-8

- **Quench** allows you to set the "off" time (conduction angle equals 0°) between 1 and 10 power cycles. Default is 1.

- **Fast Ramp** sets the number of cycles it takes to raise SCR conduction to the setback level. Fast ramp can be programmed from 2 to 20 cyc. Default is 5.

Sensitivity Calibration

The GVC lets you control the sensitivity of its arc detection as well as its spark detection, to compensate for conditions where the controller is either not responding or over-responding to arcs.

To see if the GVC is properly sensing arcs, hook up an oscilloscope as described in the section on sparks, above, also under *Sensitivity- Calibration*. An arc will appear as a high-frequency disturbance that shows an increase in base current for the rest of the half-cycle. The system should start a quench period when an arc appears.

To change sensitivity, scroll to the **Rating** menu item. In the parameter entry window, select **Cal Setup** with the <Enter> key.

Move to the **Arc Sense** field on the right side of the window (see fig. 3-6, above). Use the <+Incr> or <-Decr> keys to switch between *Low* and *Hi* and press <Enter>.

When the proper settings are in place, select **Return to Cal** to reach the **Rating** display, then **Menu** to return to the main menu bar.

T/R Electrical Settings

Reliable automated operation of your T/R set is just *one* of the benefits of the GVC. By controlling the electrical profile of the power supply, the GVC helps you

- maintain optimum opacity
- control energy usage, even dramatically reduce it.

This section identifies the electrical settings found in each relevant display, and describes their effects on T/R and precipitator operation.

Setpoint Parameters

In the **Setpoint** display (fig. 3-9) the right half of the parameter entry window shows you the established electrical limits for the T/R set you're looking at. You can move into the window with the <Enter> key to modify these settings. Move among them with the <Arrow> keys and change parameters with <+Incr> <-Decr> as usual.

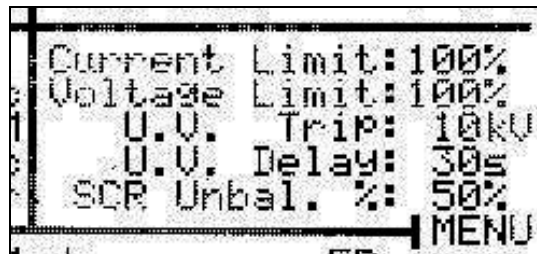


Figure 3-9

Change settings in this window with care. Certain settings affect the safe operation of the T/R set.

Five settings are available. The first two provide a defense against potentially damaging sparking or shorting conditions.

1. **Current Limit** lets you automatically maintain a pre-set primary current limit value at the T/R. It is expressed as a percentage of the T/R's current rating (set in the **Rating** display, below).
 - The safe range is from 10% to 110% of the T/R's mADC rating provided the primary

current rating is not exceeded.

- Typical setting: 100%.

2. **Voltage Limit** works the same way, but sets the secondary voltage limit as a percentage of the T/R's voltage rating.

Its control ranges are:

- 10% to 110%
- Typical setting: 100%.

3. **U.V. Trip** is the level at which the T/R controller registers an *undervoltage* condition in the secondary, indicating a short circuit or excessive sparking. It will shut off power to protect the T/R set under these conditions. Typical values:

- 10 KVDC when KV feedback is available.
- 50 VAC when secondary voltage feedback is not available.

Setting **U.V. Trip** to 0 KV disables it. *This is dangerous and should be done only for diagnostic purposes.*

4. **U.V. Delay** dictates for how many seconds the T/R will tolerate a U.V. condition before powering down.

- Typically you should not set this longer than 30 S[ec].

5. **SCR Unbalance** sets the level at which the GVC activates the internal alarm for this condition.

The range is 1% to 99%. Typical value is 50%.
Setting **SCR Unbalance** to 99% disables it. *This is dangerous and should be done only for diagnostic purposes.*

Mode Settings

The **Mode** display (fig. 3-10) provides access to key features of the GVC:

Meter	Setpoint	Config	Count	Network	Help
Trend	V/I	MODE	Rating	Alarm	Hammer Setup
Prim. Volts:	227 VAC	Sec. Volts:	53 kV		
Prim. Amps:	16 AAC	Sec. Amps:	180 mA		
Cond. Angle:	87 °	Power:	9.5 kW		
Spark Rate:	6 SPM	Arc Rate:	0 APM		
Control Mode	B.C. Values	I.E. Values			
DC Mode	IncDec: 6%	1/2 Cyc. On: 1			
Manual Power	Time: 60s	Cyc. Off: 1			
Level: 0°	Delay: 1s				
FastRec: On	Phsbak: 0%	HV Pwr UP: Off			
<S-DSP>					MENU
1A1 : 10	HV ON	DC Mode			FR
Loc/Loc					

Figure 3-10

Control Mode

The **Control Mode** parameter is where the user selects the desired mode of operation. The options are:

DC Mode – Automatic mode of operation

Manual Mode – User defines the operating level of the system.

I.E. Mode – Intermittent Energization mode whereby primary power is cycled on and off based on user defined times.

BC / DC Hold – Back Corona mode whereby the control optimizes operation in the DC mode with high resistivity loads.

BC/DC->IE – Back Corona mode whereby the control will automaticity switch to the IE mode if Back Corona is detected.

Use the <+Incr> and <-Decr> keys to select the desired mode.

Manual Operation

The first option, **Manual** operation, lets the user directly control power output with the keypad/display's <+Incr> and <-Decr> keys. It's normally used to do a controlled ramp up of power during initial system energization as a final

check for improper electrical connections and for troubleshooting purposes.

To access **Manual** operation, follow this procedure.

1. <Enter> the **Mode** screen and scroll to the **Control Mode** parameter.
2. Change the displayed option to *Manual Mode* with the <+Incr> <-Decr> keys and press <Enter>.
 - The status bar displays *MANUAL*.
3. Use the <+Incr> and <-Decr> keys to boost power to the desired level (range: 0° to 160°) while in the **Manual Power Level** field.
4. Scroll to *Menu* and press enter to leave the window.

In manual mode the controller still responds to sparks, arcs, current limit, voltage limit, and all alarms to help insure safe operation.

You can also control the power level manually while you monitor results.

1. Scroll to the **Meter** screen.
2. Press the <+Incr> or <-Decr> keys to raise or lower the value. The power level will change in the **Cond Angle** field.
3. The bar charts and numerical readouts will reflect the results of the changes.

This is a good way to instantly compare the effects of different power levels on T/R and precipitator performance.

BC / DC Hold

Back Corona (B.C.) can cause poor precipitator performance. When Back Corona occurs, applying more power to the T/R produces no corresponding increase in the secondary voltage -- sometimes the voltage actually drops. The **Mode** screen (fig. 3-11) lets you enter settings for a special feature that detects Back Corona and corrects for it by temporarily reducing power.

Control Mode	B.C. Values	I.E. Values
Manual Power	IncDec: 6%	1/2 Cyc.On: 1
Level: 0°	Time: 60s	Cyc.Off: 1
FastRec: On	Delay: 1s	HV Pwr UP: Off
<S-DSP>	Phsbak: 0%	MENU

Figure 3-11

The detection function works as follows.

- B.C. detection tests for a back corona condition 30 seconds after the feature is activated or the high voltage is turned on, whichever comes second. It then retests every 10 minutes.
- It tests by phasing back the SCRs by the amount shown in **IncDec** (increment/decrement).
- After the time shown in **Delay**, it takes a secondary voltage reading.
- The GVC then phases the SCRs back up to the starting point, rereads secondary voltage, and compares the two readings.
- If secondary voltage increases, the controller resumes normal operation.

However, if secondary voltage does not increase, back corona is present. The controller will go into *Back Corona Hold* mode and display a message indicating this state.

Back Corona Hold attempts to correct the problem.

1. First the controller phases back SCR conduction to 30°, waits for the time set in **Delay**, and reads secondary voltage again.
2. If it does not detect back corona, it continues to increase conduction angle until back corona is detected.
3. If back corona is present it phases output back by 1.5 times the percentage shown in **IncDec** plus that shown in **Phsbak**. It stays at this level for the period set in **Time**, then tests again.
4. This process repeats until back corona is not detected, at which point the GVC will continue to increase conduction angle until it occurs again.

Back Corona Hold mode ends when conduction angle reaches either 125° or the original pre-Hold level.

You can adjust back corona detection with these **Mode** screen settings (fig. 3-12), using the normal <Enter>, <Arrow>. and <+Incr> <-Decr> key methods.



Figure 3-12

- **IncDec** determines how far power is phased back and up in normal detection, and combines with **Phsbak** for the same purpose during Back Corona Hold. Range: 5% to 20%.
- **Time** sets how many seconds phasebacks last during Back Corona Hold. Range: 10 to 180 seconds.
- **Delay** determines how long the T/R set stays at a lower power level during the detection process and during the first phaseback after back corona is detected. Values are 1 to 60 seconds.
- **Phsbak** indicates the additional amount of phaseback applied in addition to the **IncDec** amount during Back Corona Hold. Limits are 0% to 20%.

Back corona detection and control is available only for T/R sets that provide secondary voltage feedback. If the GVC is controlling a double-bushing T/R, it will detect back corona on either secondary voltage feedback.

BC / DC->IE

This Back Corona mode follows the same detection procedure as previously described in the **BC / DC Hold** function. The difference occurs when Back Corona is detected. In this mode the controller automatically switches over to the **I.E. Mode** of operation. The **I.E. Values** are used as the timing parameters. These



parameters are fixed. The controller will enter the **DC Mode** and recheck for the presence of Back Corona every 10 minutes. If Back Corona does not exist, the controller will stay in the **DC Mode**. If it is still present the controller will return to the **I.E. Mode**. Please refer to the Intermittent Energization section below.

Intermittent Energization (IE)

IE is an operating mode that can save substantial energy by pulsing the SCRs to enhance efficiency while still holding opacity to acceptable levels. You must experiment with each precipitator to find the optimum IE ratio that will produce reduced energy consumption at the desired opacity. It has also been found to improve precipitator operation with high resistivity loads.

The mode works by programming separate "on" half-cycles and "off" full cycles for the SCRs, using the standard GVC key functions.

1. Choose **I.E. Mode** in the **Control Mode** field.
2. In **1/2 Cyc. On** (under I.E. Values), set the number of half-cycles the SCRs are to be On (range: 1 to 20).
3. Use **Cyc. Off** to set the number of full cycles during which the SCRs are phased back to a small percentage of the "on" half-cycle conduction angle before the next half-cycle pulse. (Range: 1 to 20.)

Note that full spark and arc control are still in effect during IE operation. However, the undervoltage trip alarm is disabled.

HV Pwr Up

This feature defines what action the controller should take if the incoming power is removed, then re-applied while the HV is turned On. This can occur from a momentary loss of power feeding the controller or from de-energizing the controllers circuit breaker before turning off the HV. There are two options for the HV state after the power has been returned to the controller.

Off – Upon power up, the controller will keep the HV Off, regardless of whether it was previously On or not.

Prev – Upon power up, the controller will return the HV to

it's previous state, prior to the loss of power. If the HV was On, it will turn back on automatically. If the HV was Off, it will stay off.

Config Settings

The ESP load will rarely let the T/R set's SCRs operate at their rated conduction angle of 160 degrees. Usually it will run at either a sparking level, a voltage limit, or a current limit.

In either voltage or current limit mode the conduction angle will continually rise and fall in response to changes in the feedback, to maintain the limit while the load in the precipitator changes. The controller will always seek to use the highest possible conduction angle, delivering maximum power for best particulate collection.

The GVC's default mode of conduction control is voltage conduction angle limit. Current conduction angle limit is also available for more precise control of systems with high reactance.

Meter	SetPoint	Config	Count	Network	Help
Trend	V/I	Mode	Rating	Alarm	Hammer
					Setup
Prim. Volts:	112	UAC	Sec. Volts:	28	KV
Prim. Amps:	9.2	AAC	Sec. Amps:	104	mA
Cond. Angle:	58	°	Power:	2.9	kW
Spark Rate:	7	SPM	Arc Rate:	1	APM
Max. Volt. Cond:	160	°	Max. Cond. Sel:	Volt	
Max. Curr. Limit:	110	%	KV1 Feedback:	Yes	
Max. Curr. Cond:	100	%	KV2 Feedback:	No	
Setback Offset:	Man		Level 2 Code:	11	
Setback Offset:	30	%	Level 3 Code:	51	
<S-DSP>					MENU
1A1 :10	HV ON	DC Mode			FR
Loc/Loc					

Figure 3-13

Four parameters on the **Config** display (fig. 3-13) let you set the conduction limits for the T/R set, using the normal keypad controls.

- **Max. Volt. Cond** is the maximum conduction angle in degrees when using voltage conduction angle control. Range is 90° to 160° with a default of 160°.
- **Max. Cur. Limit** holds the primary and secondary current at or below its value no matter what PCAMS, a user, or a timeout algorithm request. The value can be set between 110% (the default) and 30%.



- **Max. Cur. Cond** sets a percentage value for maximum allowed level under current conduction angle control. The range is 50% to 100%. Default is 50%.
- **Max. Cond. Sel** switches between voltage (*Volt*) and current (*Curr*) conduction angle control using the <+Incr> or <-Decr> keys.

Note that even when the control is programmed to operate using the current maximum conduction angle, the controller will not try to operate the SCRs at a voltage conduction angle greater than 160°.

Saving Operating Programs

The control is capable of saving up to nine operating programs in its internal memory. Program 0 acts as the editor of the custom programs. Once Program 0 is setup with the desired parameters, it can be stored as Program 1 through 9. Each program can also be given a user specified name. These programs can be recalled and run at any time.

To save the active program, scroll to the SAVE ACTIVE field in the Control Settings screen.

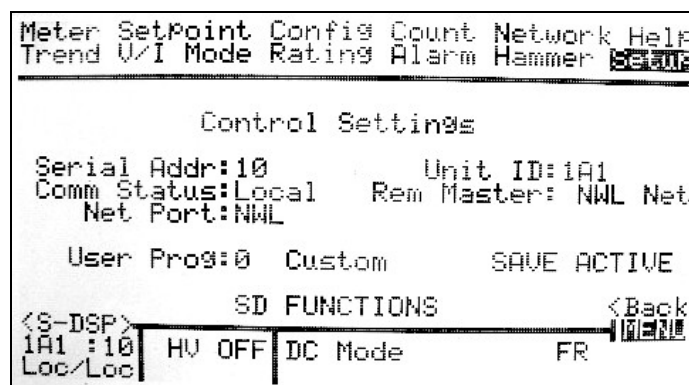


Figure 3-14

Press the <Enter> button.

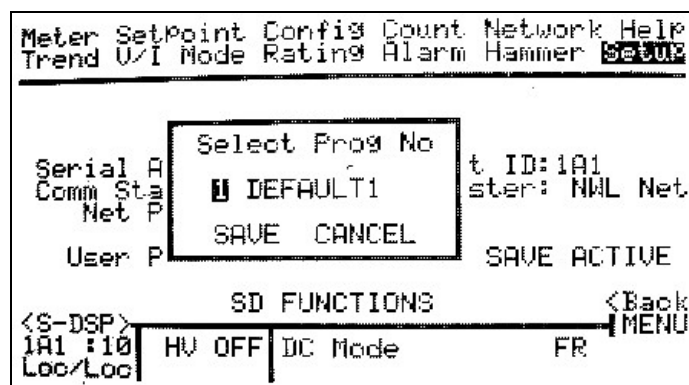


Figure 3-15

Use the <+Incr> or <-Decr> keys to select the program number (1-9) where the active program will be saved. Press the <Enter> button. If you wish to assign a



preprogram name, use the <+Incr> and <-Decr> keys to edit the characters on the highlight letter. Press <Enter> after each letter has been selected, and enter all the way through to the next line.

Press <Enter> at the **Save** field to save the program or at the **Cancel** field to cancel the operation.

Once programs have been saved in memory, they can be recalled by entering the desired program number in the **User Prog:** field. The operating program will be identified in the status section of the display screen. If any changes are made to a parameter of an operating stored program, the controller will accept the change, but will classify the operating program as Program 0 Custom, since the program has now changed. The stored program is not changed.

Setup, Configuration, and Networking

What This Chapter Covers

*If your NWL DSP GVC was provided in a complete NWL control enclosure, the initial setup, included configuring it to the ratings of your T/R set was performed at the factory. If your NWL NWL DSP GVC is installed as a retrofit control package in an older control enclosure, a complete system configuration must be performed prior to first energization. You may also want to refer to the **Installation and Startup Guide** used to retrofit older T/Rs with the GVC.*

This short chapter tells you how to adapt the GVC to your users and your organization. It covers assigning access codes, entering T/R ratings, connecting to a computer network, adjusting timeouts, and establishing defaults. These are simple procedures, and don't require much explanation.

Users will need Level 3 clearance to access most of the functions described in this chapter. It is intended primarily for systems managers.

All of the setup functions can be found in two display screens: **Setup** and **Config**. If you are a systems manager these are the places where you'll adapt the GVC to the needs of your organization.

Security Settings

First we'll set up the security features of the GVC.

The system includes three levels of access, as described in Chapter One. This helps protect it from tampering by people not qualified or authorized to run a precipitator power supply.

Codes

Scroll to the **Config** menu choice. Use <Enter> to reach the parameter entry window and the <Arrow> keys to reach the last two fields (fig. 4-1).

Meter	SetPoint	Config	Count	Network	Help
Trend	V/I	Mode	Rating	Alarm	Hammer
Setup					
Prim. Volts:	112 VAC	Sec. Volts:	28 kV		
Prim. Amps:	9.2 AAC	Sec. Amps:	104 mA		
Cond. Angle:	58 °	Power:	2.9 kW		
Spark Rate:	7 SPM	Arc Rate:	1 APM		
Max. Volt. Cond:	100%	Max. Cond. Sel:	Volt		
Max. Curr. Limit:	110%	KV1 Feedback:	Yes		
Max. Curr. Cond:	100%	KV2 Feedback:	No		
Setback Offset:	Man	Level 2 Code:	11		
Setback Offset:	30%	Level 3 Code:	51		
<S-DSP>					
1A1 :10	HV ON	DC Mode	FR		
Loc/Loc					

Figure 4-1

These allow you to set up codes that users must enter to reach either Level 2 or Level 3 access.

- Use the <+Incr> and <-Decr> keys to select a different alphanumeric code for **Level 2 Code** and **Level 3 Code**.
- Press <Enter> after each selection.

The codes are now stored in the CPU board's memory.

Do not forget these codes. Without them you will not be able to access the control and setup functions of the GVC.

Do not distribute these codes freely. Only those authorized to change T/R set parameters should have them.

If you do lose the codes you must clear the GVC's memory to restore default operating parameters (see Operating at Default Settings, below). All of your parameter settings will be lost.

However, if you are using NWL's PCAMS software for centralized computer-based control of precipitators, your system manager can use the software to recover the stored codes for you.

Code Timeout

Now that the codes are established, this function determines how long the GVC will stay at Level 2 or Level 3 access after the authorized operator has stopped using the keypad/display. To set this parameter, scroll to the **Display Settings** option on the **Setup** menu and use <Enter> to move into the parameter entry window.

Scroll to **Code Time** (fig. 4-2) with the <Arrow> keys. Use the <+Incr> and <-Decr> to change settings, and <Enter> to register the new details.

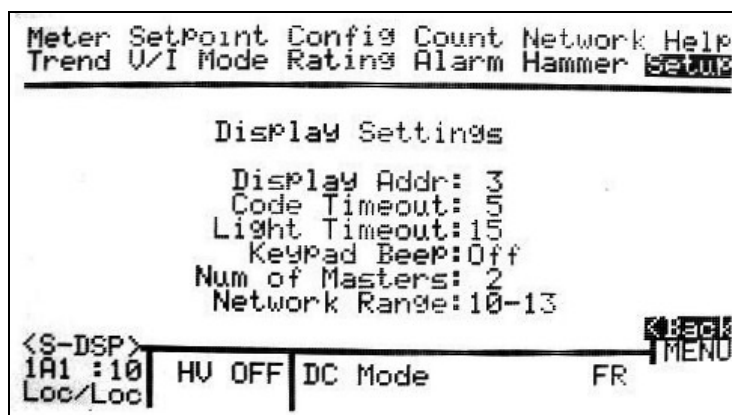


Figure 4-2

The field has a range of 1 Min to 30 Min.

Choose an interval that gives users time to think between entries, but not one so long that high-level access is likely to be available to anyone who enters the room.



Sign Off

It's a good idea for Level 3 users to return the system to Level 1 (view only) when they are finished with the GVC. Otherwise, a Level 1 or 2 user who picks up the display/keypad before the code "times out" could inadvertently make changes to crucial operating parameters.

To return the system to Level 1, simply scroll to the **Sign Off** field and press <Enter>.

Convenience Features

Backlight Timeout

The **Light Time** field determines how long the backlight will continue to illuminate the keypad/display screen after keyboard activity stops. When the time is up, the screen "blanks" - the backlight goes out and you can no longer read the display.

The purpose of the **Light Time** is to extend the life of the display. Under normal conditions its expected service life with the timeout engaged is 30 years.

Set the timeout with the <+Incr> and <-Decr> keys. When the display "times out" and the backlight goes off, pressing any key will restore the illumination for the same interval as before.

Beep Signal

Keypad Beep lets you select whether the keyboard/display will sound a signal with each key you press. *The beep sounds only when you release the key.*

Assuming your surroundings are not too noisy to hear it, the beep tells you your keyboard choices have registered with the GVC.

Date/Time

The Date and Time are used when logging alarms to the SD card. To set them scroll to the **Date/Time** option in the Setup screen.

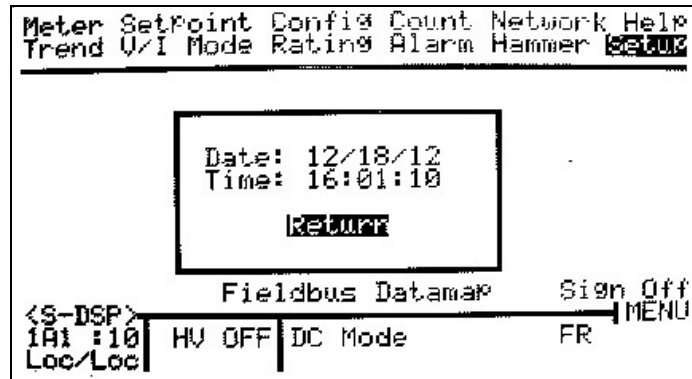


Figure 4-3

Scroll through and enter the current month/day/year as well as the hour/minute/seconds. Press enter to move to the next field. The clock uses the 24 hour format. When done place the cursor on Return and press <Enter>.

System Configuration

You must configure the GVC before using it for the first time. 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.

If you are simply replacing a NWL DSP GVC that has been previously configured, and that configuration has been stored to the SD card, the process is easy. Simply remove the SD card from the older GVC and install it in the newer GVC. Follow the instructions detailed in the SD Card section of this manual to restore the configuration from the SD card back into the GVC. The stored operating programs can also be loaded from the SD card.

Configuration is necessary when retrofitting an existing T/R controller with a new NWL DSP GVC 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.

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.

Configuring the System

Power up the T/R controller by moving the circuit breaker handle on the control cabinet to the "ON" position. *Do not push the <HV On/Off> 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 <+ Incr> 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.)

You will be entering parameters in four display screens:

- configuration (**Config**)
- **Rating**
- **Cal Setup**
- **Setup**

The Config Screen

Scroll to the **Config** option on the menu bar and press <Enter> to reach the configuration screen (fig. 4-4). You will be entering values for the kilovolt feedback parameter.

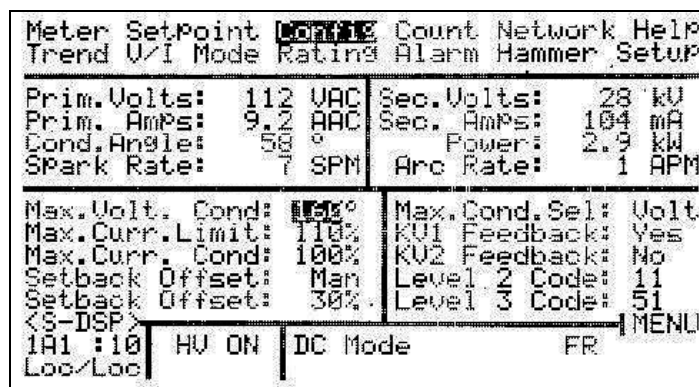


Figure 4-4

Check the **KV1 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.

<i>T/R Type</i>	<i>KV1 Feedback</i>	<i>KV2 Feedback</i>
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 <+ Incr> or <-Decr> key at each of these items to change the setting, then <Enter> to register the value
4. scroll to Menu and press <Enter> to 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 (fig. 4-5) allows you to enter the voltage ratings for your T/R set, so the GVC can prevent it from exceeding safe values.

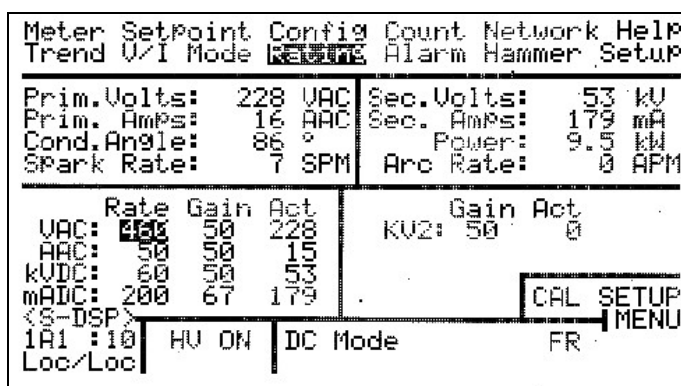


Figure 4-5

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

•**Pri Volt (VAC) Rating**

•**Pri Amps (AAC) Rating**

•**Sec Volt (kVDC) Rating**

•**Sec Amps (mADC) Rating**

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.

1. Scroll to **Cal Setup** in the middle window and press <Enter>.
2. On the screen that appears (fig. 4-6), 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.

Meter	SetPoint	Config	Count	Network	Help
Trend	U/I Mode	25.000	Alarm	Hammer	Setup
Prim.Volts:	224 VAC	Sec.Volts:	52 kV		
Prim. Amps:	16 AAC	Sec. Amps:	176 mA		
Cond.Angle:	87 °	Power:	9.2 kW		
Spark Rate:	4 SPM	Arc Rate:	1 APM		
VAC Turns Ratio:	4:1	KV Spk Sen:	Hi		
AAC Turns Ratio:	50:5	mA Spk Sen:	Md2		
Volt Div Hi Res:	80kΩ	Arc Sense:	Hi		
Volt Div Low Res:	10kΩ				
Sec Current Shunt:	50Ω				
<S-DSP>					
1A1 :10	HV ON	DC Mode	FR		
Loc/Loc					

Figure 4-6

VAC Turns Ratio

VAC Turns Ratio is the value of the transformer used in the Primary Voltage Feedback circuit. Most transformers use a 4:1 ratio. See the chart below for typical values.

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 necessary, change the value here to the one used in your T/R set.

AAC Turns Ratio

AAC Turns Ratio is the value of the current transformer used in the primary current feedback circuit. If necessary, derive it by dividing the primary value of the CT by the number of loops. Or use the appropriate value under "Panel Meter (Full Scale)" below.

Panel Meter (Full Scale)	Possible T/R Amps AC Rating	Suggest 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

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 Ω).

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 (1 -50 Ω). Enter the actual value of the mADC shunt resistor used in your T/R set.

Contact NWL Technical support if you have any questions.

Sensitivity Levels

There are three sensitivity levels to set, all listed in the right-hand section of this parameter entry window: ***KV Spk 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.

Use the arrow keys and <Enter> to return to the "Cal" screen and then to the main menu.

Networking

The GVC is equipped to work on a computer network. In fact, the "Network" jack on the control module is actually an isolated RS-485 serial port for such a network.

This port is commonly used for two purposes:

- to permit any keypad/display to access and control any T/R set on the network
- to permit NWL's PCAMS (Precipitator Control and Management System) to perform PC-based centralized control of all T/R sets

If a keypad/display is connected to any Network port, it can access, monitor, and control any other GVC equipped T/R set on the network. The T/R set must have a valid network address.

Assigning an Address

To assign a network address to a T/R controller,

1. plug the keypad/display into the local jack
2. scroll to the **Control Settings** option on the **Setup** menu and press <Enter> to move into the parameter entry window.
3. at the **Serial Addr** field (fig. 4-7), use the <+Incr> and <-Decr> keys to assign a port number between 10 and 99
4. press <Enter> to register your choice.

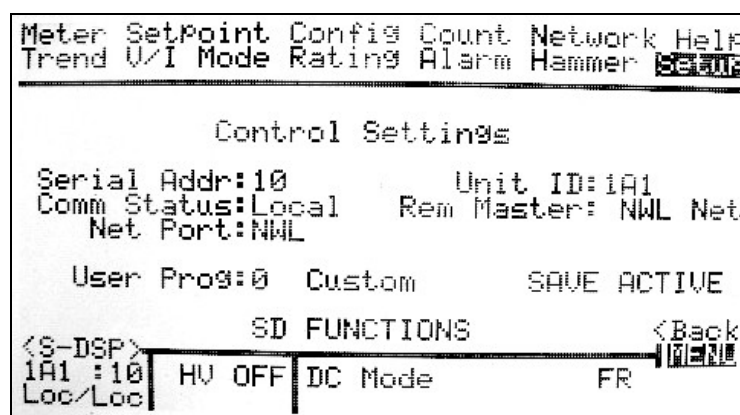


Figure 4-7

Once port numbers have been assigned, you can access each T/R set remotely through the Network jack as described in Chapter One: Monitoring the System.

Be sure each T/R set has its own unique number. Otherwise neither the GVC's remote feature nor PCAMS central control will work properly. (If you are using PCAMS, the correct addresses are listed on the software's programming sheets.)

Setting IDs

For easy access through the network jack, assign an individual ID to each T/R set with an address on the network. To do this

1. plug the keypad/display into the local jack
2. scroll to the **Control Settings** option on the **Setup** menu and press <Enter> to move into the parameter entry window.
3. at the **Unit ID** field, use the <+Incr> and <-Decr> keys to assign an alphanumeric character in each space, pressing <Enter> to register each character.

The T/R ID is now registered.

Net Port

The Net Port parameter in the **Control Settings** 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 controller 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. The datamap for the Net Port is in the appendix to this manual.

1. Scroll to the **Control Settings** option on the **Setup** menu and press <Enter> to move into the parameter entry window.
 2. Scroll down to the **Net Port** parameter and select the desired protocol. Press the <Enter> key.
-

Field Bus Converter (Optional)

If the controller has an optional field bus converter installed on the DSP board, the specific field bus will be designated in the **Fieldbus** parameter on the **Fieldbus Config.** option of the **Setup** menu. 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 the **Fieldbus Config.** option on the **Setup** menu and press <Enter> to move into the parameter entry window.
2. A new screen will be displayed with the specific protocol parameters for the field bus being used (fig. 4-8). Enter the appropriate data for each parameter. Press <Enter> after each entry. Consult with your network administrator for the proper parameter values to be entered.
3. When complete scroll down to the **APPLY CHANGES** and press <Enter>. The cursor will move to the **RETURN TO SETUP** field. Press <Enter> to return.

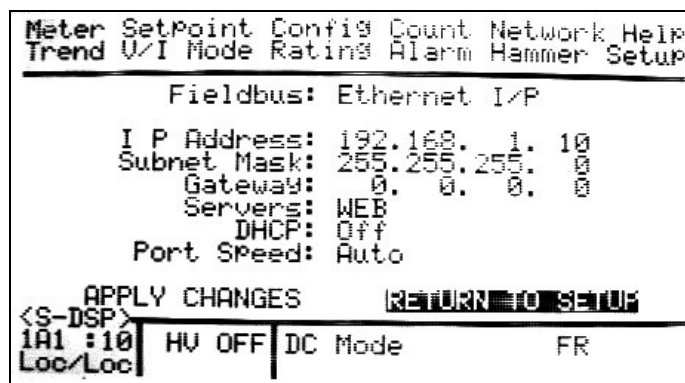


Figure 4-8

The Fieldbus Configuration Screens will vary slightly depending upon the specific Fieldbus being used. Ethernet I/P and Modbus TCP use the display shown above. Other examples of Fieldbus displays are shown below.

```

Meter SetPoint Config Count Network Help
Trend U/I Mode Rating Alarm Hammer Setup
-----
Fieldbus: Modbus TCP
I P Address: 192.168. 1. 10
Subnet Mask: 255.255.255. 0
Gateway: 0. 0. 0. 0
Servers: WEB
DHCP: Off
Port Speed: Auto
APPLY CHANGES RETURN TO SETUP
<S-DSP>
1A1 :10 HV OFF DC Mode FR
Loc/Loc

```

Figure 4-8a

```

Meter SetPoint Config Count Network Help
Trend U/I Mode Rating Alarm Hammer Setup
-----
Fieldbus: Modbus RTU
Device Address: 1
Baud Rate: 19200 bps
Parity: None-1Stop
Mode: RTU 8 bit
Timeout: 0 mSec 0=Disabled
APPLY CHANGES RETURN TO SETUP
<S-DSP>
1A1 :10 HV OFF DC Mode FR
Loc/Loc

```

Figure 4-8b

```

Meter SetPoint Config Count Network Help
Trend U/I Mode Rating Alarm Hammer Setup
-----
Fieldbus: ProfibusDPV1
Device Address: 1
APPLY CHANGES RETURN TO SETUP
<S-DSP>
1A1 :10 HV OFF DC Mode FR
Loc/Loc

```

Figure 4-8c

```

Meter SetPoint Config Count Network Help
Trend U/I Mode Rating Alarm Hammer Setup
-----
Fieldbus:  Profinet

I P Address: 192.168.  1. 10
Subnet Mask: 255.255.255. 0
Gateway:    0.  0.  0.  0
Servers:    WEB

APPLY CHANGES  RETURN TO SETUP
<S-DSP>
1A1 :10 HV OFF DC Mode FR
Loc/Loc
  
```

Figure 4-8d

```

Meter SetPoint Config Count Network Help
Trend U/I Mode Rating Alarm Hammer Setup
-----
Fieldbus:  DeviceNet

Device Address:  1
Baud Rate: 125 kbps

APPLY CHANGES  RETURN TO SETUP
<S-DSP>
1A1 :10 HV OFF DC Mode FR
Loc/Loc
  
```

Figure 4-8e

- Once back at the **Setup** screen, scroll to the **Control Settings** option and press <Enter>

```

Meter SetPoint Config Count Network Help
Trend U/I Mode Rating Alarm Hammer Setup
-----
Control Settings

Serial Addr:10      Unit ID:1A1
Comm Status:Local   Rem Master: NWL Net
Net Port:NWL

User Prog:0 Custom  SAVE ACTIVE

SD FUNCTIONS
<S-DSP>
1A1 :10 HV OFF DC Mode FR
Loc/Loc
  
```

Figure 4-9

Scroll down to the **Rem Master:** parameter and use the <+Incr> and <-Decr> keys to select between the following choices.

NWL Net: When the **Comm Status** is set to *Remote*, the fieldbus port will only be able to read data from the controller. It will not be able to write or change parameters. Changes can only be made from a network device on the NWL network port.

Fieldbus: When the **Comm Status** is set to *Remote*, the fieldbus port will be able to read or write data to the controller. Any network device on the NWL network port will also be able to read or write data to the controller.

If the fieldbus being used is not Modbus (RTU or TCP), it is possible to configure which parameters the fieldbus will be allowed to write to. This can be used to shorten the length of the write command used by the fieldbus.

Scroll to the **Fieldbus Datamap** option in the **Setup** display and press the <Enter> key. A warning message will be displayed.

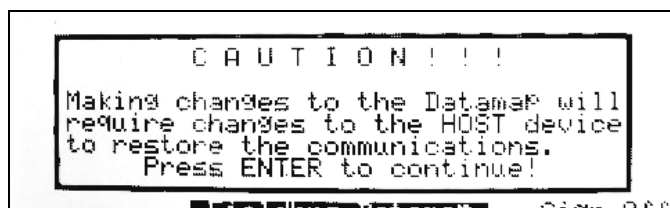


Figure 4-10

Making changes to the datamap will require changes to the HOST device to restore communications. Consult with your network administrator prior to making any changes on this page.

Press the <Enter> key to acknowledge the message.

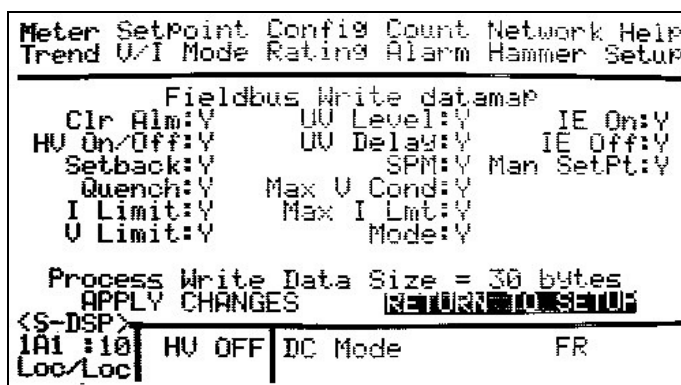


Figure 4-11



This screen allows you to define which parameters will be capable of being written to by the fieldbus device. Use the <+Incr> and <-Decr> keys to select Y (Yes) or N (No) for each of the parameter choices. Press <Enter> to register each choice. The **Process Write Data Size** will indicate the size of the configured write command.

When complete scroll down to the **APPLY CHANGES** and press <Enter>. The cursor will move to the **RETURN TO SETUP** field. Press <Enter> to return.

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. The connector pin outs for the various fieldbus modules, as well the complete datamap, are shown in the appendix at the end of this manual.

Installing the Optional Field Bus Converter

If you are using the optional Fieldbus Converter and are replacing the control module, the converter must be moved from the old control to the new control. To remove the old converter:

1. Remove the field wiring connector that plugs into the converter.
2. Turn the two screws on the front plate of the converter counter-clockwise to release the converter from the DSP board.
3. Grab the sides of the converter and gently pull it from the multi-pin jack.

Once removed follow the steps below to install it on the new board.

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 and 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.

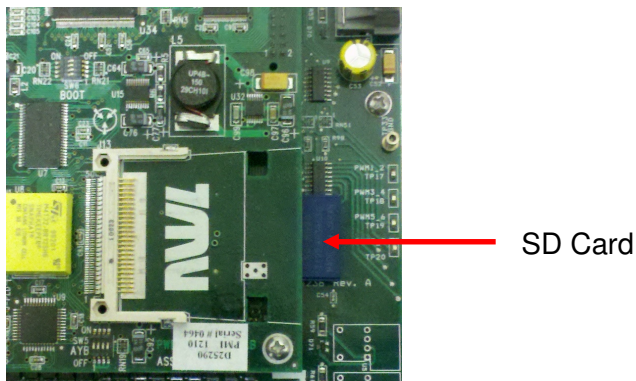
Local and Remote Functions

When you set **Comm Status** for a T/R to local or remote in the **Setup** screen, you will not have full access to all GVC functions. Some are compatible with both local and remote control, but others are exclusive to one or the other. The table below shows the breakdown by **Comm Status**. The Ext.Dis (External Discrete) and Ext.Net (External Network) were previously described in Chapter 1.

Function	Local Mode	Remote Mode
Monitor all parameters locally	Yes	Yes
Monitor all parameters remotely	Yes	Yes
Change parameters by PCAMS/2 or Network display/keypad	No	Yes
Change parameters by Local display/keypad	Yes	No
Clear alarm trips by PCAMS/2 or Network display/keypad	No	Yes
Clear alarm trips by Local display/keypad	Yes	No
Control contactor remotely by PCAMS/2	No	Yes
Control contactor remotely by Network display/keypad	Turn off only	Yes
Control contactor by Local display/keypad	Yes	Yes
Change status to local by PCAMS/2 or Network display/keypad	NA	No
Change status to local by Local display/keypad	NA	Yes

SD Card

The DSP processor board also has provisions for a 2 or 4 GB SD memory card. The card is located under DSP board near the optional fieldbus module socket.



The SD card holds the following files:

- Program file containing the nine user saved operating programs
- Configuration files.
- Alarm log file
- V-I curve data file

The Alarm log and the V-I curve data files are automatically saved when new data is generated. The operating program file and the configuration file must be manually saved and retrieved. This is done by scrolling to the **SD FUNCTION** field in the **Control Settings** display.

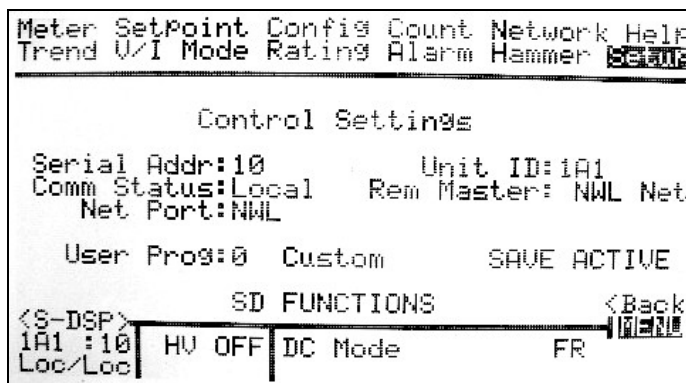


Figure 4-12

Press the <Enter> button.

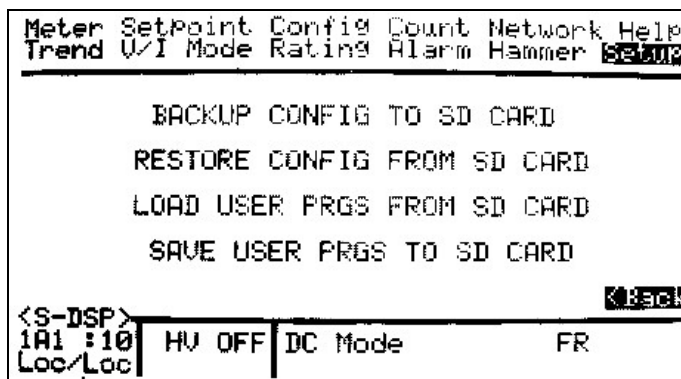


Figure 4-13

Scroll down to the appropriate choice and press the <Enter> button.

It is recommended to keep a backup copy of the Configuration file and the User Programs file on the SD card.

The SD card is also used to hold the new firmware to be uploaded to the controller. Complete instructions on uploading the new firmware are part of the firmware update package. Contact NWL for more information.

Reconfiguration

You should rarely if ever have to reconfigure such basic settings of your system as T/R ratings, default operating parameters, etc.

Sometimes, however, electrical anomalies and equipment failure require such action. If your GVC loses memory, following the procedures below will get the T/R up and running again.

*However, for proper operation, be sure to completely reconfigure and recalibrate your GVC. Follow the instructions in Appendix A, below. These are repeated from the **DSP GVC Retrofit Installation and Startup Guide**, Chapters Five and Six.*

Clearing the Memory

A loss of memory or any other situation that erases the configuration from your T/R set controller automatically resets the system to the operating defaults. You can also do this manually if you wish to totally reconfigure the system.

Prior to performing this operation, it is strongly recommended that you save the configuration file and the user programs file to the SD card as detailed in the previous section. These will need to be re-stored onto the controller at the conclusion of the operation.

Simply hold down the left and right <Arrow> keys while powering up the system (turning on the main power switch). This will

- clear the microprocessor of whatever it retains from the existing configuration (some of which may be scrambled)
- reprogram it with the default settings for all parameters.

Important: do not press the <HV On/Off> key until you have Reset the configuration, parameters, and operating programs as detailed below.



Resetting Parameters

Once the system is back to default settings you must re-enter the system parameters to their values from before the memory was cleared.

Scroll to the SD Functions option on the Control Settings screen and press <Enter>. Choose the *Restore Config from SD Card* option and the *Load User Prgs from SD Card* option.

If the settings are not correct for the T/R set, manually enter the proper value into each of the systems parameters.

System Energization and Checkout

What This Chapter Covers

Once the NWL DSP GVC has been configured, you can now proceed to energize the system, perform a quick check of the precipitator section, and do a final calibration of the metering circuits. .

This chapter tells you how to energize the unit in the manual mode, bringing the power up slowly to check out the precipitator section for any shorts or opens. It also gives the details for the final calibration of the metering circuits within the GVC and setting of the spark/arc sensitivities.

Users will need Level 3 clearance to access most of the functions described in this chapter. It is intended primarily for systems managers.



System Energization and Checkout

To ensure proper operation, we will now test the GVC and its T/R set and 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 keypad/display 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 **Control Mode** and change it to *Manual Mode* by pressing the <+Incr> or <-Decr> key; then press <Enter> to register the value.

Do not leave this screen yet.

Checking Power Control

We will now test for proper energization.

1. Scroll to **Manual Power Level**.
2. Press the <HV On/Off> 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 <+ Incr> 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 On/Off> 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 On/Off> key.
- Correct the problem and restart energization and check-out from the beginning.

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

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

Final Calibration

Calibration is best performed while there is no sparking activity in the precipitator. If the display indicates sparking is taking place, place the controller in the Manual mode and use the <-Decr> key to back the power down until the sparking stops. You can now fine-tune the 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 **Rating** with the <Enter> key.

Make sure that the T/R ratings are correctly entered.

Watch the digital readouts in the electrical readings window. Compare them to reference meters (external meters such as a calibrated multimeter or ammeter) as you adjust settings on this screen. By adjusting the values of the Gain parameters you are adjusting the digital reading s on the display. The default gain is 50. A gain of 0-49 is a negative gain. A gain of 51-99 is a positive gain. Raising the gain will increase the displayed meter value.

1. Start with **VAC Gain** and adjust it with the <+Incr > and <-Decr > keys until *PRIM. VOLTS* in the electrical readings window matches the VAC reference meter. This reference meter is usually external RMS voltmeter placed across the T/R primary.
2. Adjust **AAC Gain** until *PRIM. AMPS* matches the AC Amps reference. This reference meter is usually an RMS clamp-on ammeter on one of the main 480 VAC current carrying lines in the controller.
3. Adjust **KVDC Gain** and *KV2 Gain* to match the *SEC. VOLTS* reading to the Kilovolt DC reference. This reference meter is usually a VDC meter placed across the low end resistor of the voltage divider network. The proper scaling factor must be applied to this reading to obtain the measured kVDC.
4. Adjust the **mADC Gain** value to match the *SEC. AMPS* reading to its Milliamp DC reference. The reference meter is usually a VDC meter placed across the mADC shunt resistor. The proper scaling factor must be applied to obtain the measured mADC.

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

above gain setting values should be recorded for future reference. If the control electronics module is replaced, or if the memory is cleared, these gain settings should be re-entered to return the system to calibration.

Spark Sensing Calibration

The final step in fine-tuning the GVC is the prevention of false sparking and arcing. It is best to use an oscilloscope across the kV and mA feedback to check for the proper sensing of sparks and arcs.

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 **KV Spk Sen** and choose a higher or lower setting as needed from among *Dis(able)*, *Low*, and *Hi*
 - at **mA Spk Sen** choose among *Dis(able)*, *Low*, *Med*, *Md2*, and *Hi*
 - in **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 **Control Mode** field and select *DC Mode* with the <+Incr> or <-Decr> keys
4. press <Enter> to register 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 a potentially dangerous condition, controlling sparking, and saving energy.

Optional Rotating Hammer Rapper Board

What this Appendix covers

This appendix covers the operation of the optional rotating hammer type rapper board. It covers the programming parameters for the rappers and includes a wiring diagram.

Circuit Description

The rotating hammer rapper control board is mounted on top of the GVC control module and controls up to four motor starters for the rapper motors. Each output is rated for up to 250 VAC and fused for 2.5 amps.

The controller will provide a basic cycle timer function for each of the four outputs. It does not provide any anti-coincidence grouping between the four outputs or the rappers being controlled by any other GVC controller.

There are also inputs for feedback from each motor starter which can be used to provide an alarm if a problem occurs.

Programming Parameters

The programming parameters for the rapper board are as shown below.

Meter	SetPoint	Config	Count	Network	Help
Trend	U/I	Mode	Rating	Alarm	Hammer Setup
Prim.Volts:	253 VAC	Sec.Volts:	50 kV		
Prim. Amps:	17 AAC	Sec. Amps:	192 mA		
Cond.Angle:	93 °	Power:	11.1 kW		
Spark Rate:	8 SPM	Arc Rate:	0 APM		
[U]	ID:HAMMR1	Init.Wait:	00:00:00		
	Mode:Off	Duration:	00:00		
	Feedback:No Feedback	Wait:	00:00:00		
		Clean:	00:00:00		
<S-DSP>					
1A1:10	HV ON	DC Mode	FR		MENU
Loc/Loc					

ID: 6 character alpha-numeric representation of the rotating hammer used for monitoring activity with a GVC Display Module.

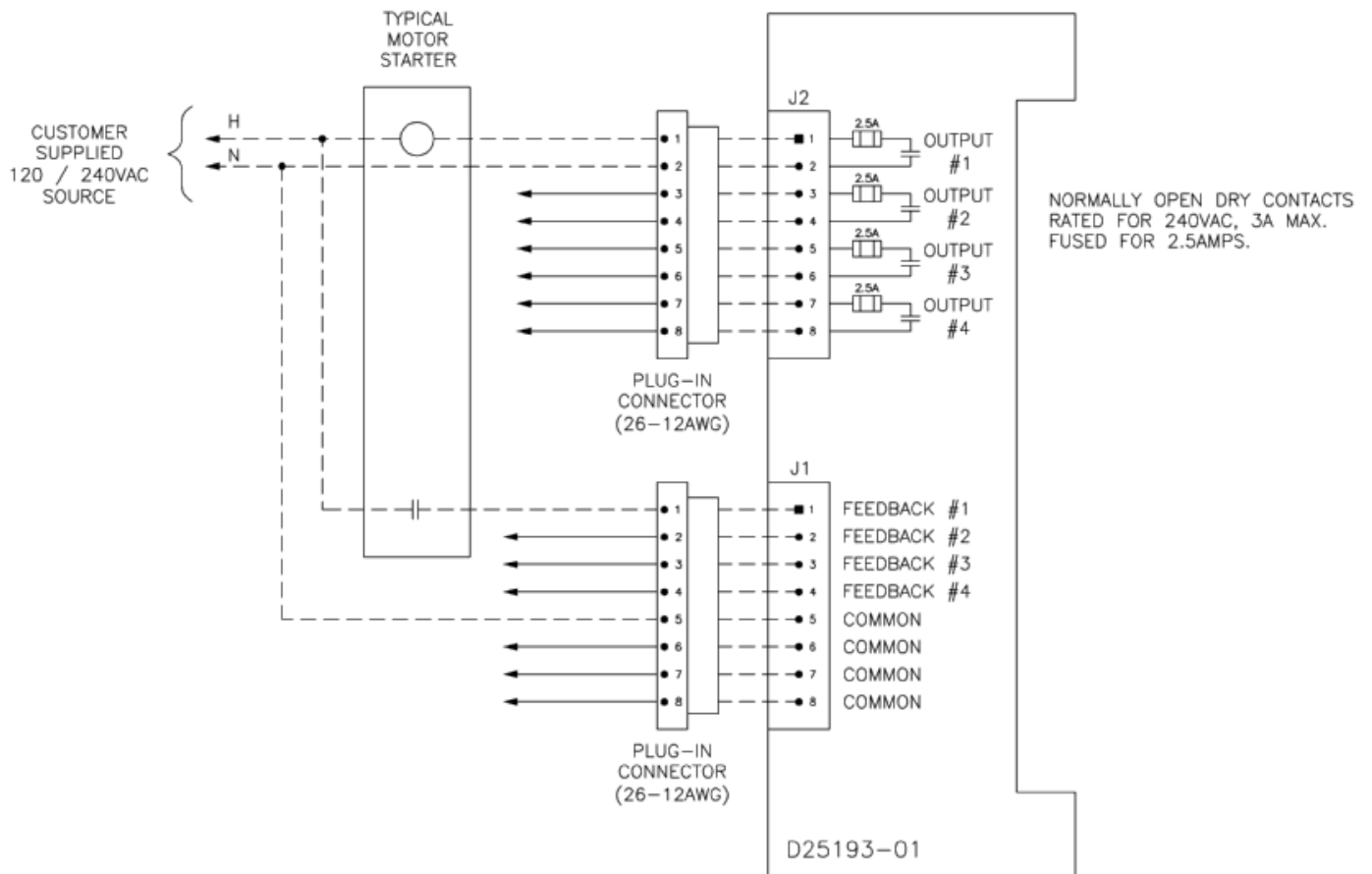
Modes: Off - The rotating hammer output will not energize.
Program Run - When power is applied to the Optimizer, the rotating hammer process will activate using the following time parameters; initial wait, duration, and wait time.
Program Run with Clean - Identical to Program Run mode except the hammer process is activated when high voltage is energized at the T/R, and when the high voltage is removed from the T/R, the rotating hammer output will energize for the amount of time defined in clean time then stop.
Continuous - The rotating hammer output will remain energized regardless of the high voltage status and the operating time parameters.

Feedback: No Feedback - The Optimizer will not monitor the rotating hammer feedback input.
Input Closed - The Optimizer will verify the rotating hammer input closes during hammer energization and opens during hammer de-energization. If this condition is not satisfied, the Display Module will indicate a hammer feedback alarm. The high voltage contactor is not effected.



- Initial Wait Time:** Amount of time after the hammer process is started, before energizing the rotating hammer output. This value is programmable from 00:00:00 to 23:59:59.
- Duration:** Amount of time the rotating hammer output remains energized. This value is programmable from 00:00 to 59:59.
- Wait Time:** Amount of time after the rotating hammer duration period before re-energizing the output. This value is programmable from 00:00:00 to 23:59:59.
- Clean Time:** Amount of time the rotating hammer output is energized after the high voltage to the T/R is removed when the "Program Run with Clean" mode is selected.

Optional Rapper Control Board Wiring



Appendix B

DSP Board Four Character Display Messages

During operation, the 4-character display on Optimizer-DSP circuit board allows user to monitor the behavior of the system. Due to limited size of the display, messages are either abbreviated to 4 characters or scrolled at a rate of 4 characters per second. A short message (4 characters or less) will remain on the display for 2 seconds if another message is pending.

There are 3 categories of messages that may be shown on the 4-character display, grouped by priority. Messages of higher priority will interrupt lower-priority messages. If a higher-priority condition is active (e.g., alarm), lower-priority messages are not displayed.

1. **Event messages (high priority).** These messages are displayed immediately when various events occur on the system. Event messages are displayed only once.

Message	Description
SCR Vx.xx	Firmware version displayed on start-up
Arc	Arc detected
KV1S	Spark detected on kV1 terminal
KV2S	Spark detected on kV2 terminal
mA S	Spark detected via current measurement
OVP1	Over-voltage detected on kV1 terminal
OVP2	Over-voltage detected on kV2 terminal
Clear alarm	Alarms cleared by user
SD write error	Error occurred while trying to write to SD card
SD read error	Error occurred while trying to read from SD card
SD config saved	Optimizer configuration parameters saved to SD card successfully
SD config restored	Optimizer configuration parameters loaded from SD card successfully
SD programs saved	Operating programs saved to SD card successfully
SD programs restored	Operating programs loaded from SD card successfully
No SD card	SD card read or write operation could not be performed because SD card was absent

Table 1: Event Messages

2. **Alarm messages (medium priority).** These messages are displayed as long as corresponding alarms are active (must be cleared by user). If multiple alarms are active at the same time, they will be displayed sequentially. Event message may interrupt alarm messages at any time.

Message	Description
Loss of Line Sync	Line voltage alarm (AC not detected or frequency not within supported range)
Int. Over-Current	Over-current alarm, measured current too high
Ext. Over-Current	Over-current alarm, detected via external logic input
SCR Over-Temp	SCR over-temperature alarm

Oil Over-Temp	Oil over-temperature alarm
Low Oil	Oil level alarm
Under-Voltage	Under-voltage alarm
Over-Voltage	Over-voltage alarm
SCR Unbalance	SCR unbalance condition detected
Aux1 Alarm	Aux1 alarm logic input active
Aux2 Alarm	Aux2 alarm logic input active
Aux3 Alarm	Aux3 alarm logic input active
Aux4 Alarm	Aux4 alarm logic input active
VRef Alarm	Voltage reference on DSP board is invalid
Low Battery	Backup battery voltage on DSP board is too low
Blown Fuse	Blown contactor or alarm output fuse

Table 2: Alarm Messages

3. **Operating mode messages (low priority).** One of these messages will be constantly displayed when there are no alarm or event messages to display.

Message	Description
Off	High voltage is off
HVon	High voltage is on
VL	Voltage limit is reached
CL	Current limit is reached
Max Conduction	Conduction angle is at maximum
V/I Curve	V/I curve is being generated
Back Corona Hold	Back corona is present
Running Back Corona Test	Back corona test is in progress
Manual Mode	Manual output mode

Table 3: Operating Mode Messages



Appendix C

DSP GVC Data Exchange Map for Network Port and Optional Fieldbus Ports

Firmware version: 5.18, 12/26/2012

Firmware version: 5.18, 12/26/2012													
Process READ Data (Data Read from Power Supply)													
Web Idx (Note 6)	Application Data Instance (ADI) #	Parameter	Bit Assignments	Data Type	Units	Max Value	Min Value	Default Value	Increment	Modbus Register # (Anybus-CC)	Modbus Register # (Network Port)	Notes	Firmware Version Notes
1	1	Device Status		UINT16		65,535	1	READ ONLY		30001	30001		modified in V5.16
			Bit 0 - Heartbeat					READ ONLY				Toggles every second	
			Bit 1 - Fieldbus Control Status					READ ONLY				1 = Fieldbus has control, 0 = Fieldbus Writes disabled	
			Bit 2 - Device = SCR DSP					READ ONLY					
			Bit 3 - Device = PowerPlus					READ ONLY					
			Bit 4 - Spare					READ ONLY					
			Bit 5 - Spare					READ ONLY					
			Bit 6 - Spare					READ ONLY					
			Bit 7 - Spare					READ ONLY					
			Bit 8 - Spare					READ ONLY					
			Bit 9 - Spare					READ ONLY					
			Bit 10 - Spare					READ ONLY					
			Bit 11 - Spare					READ ONLY					
			Bit 12 - Spare					READ ONLY					
			Bit 13 - Spare					READ ONLY					
			Bit 14 - Spare					READ ONLY					
			Bit 15 - Spare					READ ONLY					
2	2	Conduction Angle		UINT16	Degrees	160	0	READ ONLY		30002	30002		
3	3	Primary Voltage		UINT16	VAC	720	0	READ ONLY		30003	30003		
4	4	Primary Current		UINT16	AAC x 10	7500	0	READ ONLY		30004	30004		
5	5	KVDC1		UINT16	KVDC	200	0	READ ONLY		30005	30005		
6	6	Output Current		UINT16	mADC	5000	0	READ ONLY		30006	30006		
7	7	KVDC2 / KVDC1 Peak		UINT16	KVDC	283	0	READ ONLY		30007	30007		
8	8	Output Voltage Product		UINT16		65,535	0	READ ONLY		30008	30008		
9	9	Output Power		UINT16	KW x10	9999	0	READ ONLY		30009	30009		
10	10	Spark Rate		UINT16	SPM	999	0	READ ONLY		30010	30010		
11	11	Arc Rate		UINT16	APM	99	0	READ ONLY		30011	30011		
12	12	Operating Status		UINT16		65,535	0	READ ONLY		30012	30012		
			Bit 0 - I.E. Mode					READ ONLY					
			Bit 1 - Manual Mode					READ ONLY					
			Bit 2 - Fast Recovery					READ ONLY					
			Bit 3 - Reserved					READ ONLY					
			Bit 4 - Local / Remote					READ ONLY				0 = Local, 1 = Remote	
			Bit 5 - Contactor Status					READ ONLY				0 = Off, 1 = On	
			Bit 6 - Back Corona Detected					READ ONLY					
			Bit 7 - Reserved					READ ONLY					
			Bit 8 - Setback Offset Auto/Man					READ ONLY				0 = Manual, 1 = Auto	
			Bit 9 - KV1 Feedback					READ ONLY					
			Bit 10 - KV2 Feedback					READ ONLY					
			Bit 11 - Reserved					READ ONLY					
			Bit 12 - Max Conduction Select					READ ONLY				0 = Voltage, 1 = Current	
			Bit 13 - Power Control Active					READ ONLY					
			Bit 14 - Loss of Line Sync					READ ONLY					
			Bit 15 - Reserved					READ ONLY					
13	13	Discrete Logic		UINT16		65,535	0	READ ONLY		30013	30013		
			Bit 0 - Hammer 1 Output					READ ONLY				0 = Off, 1 = On	
			Bit 1 - Hammer 2 Output					READ ONLY					
			Bit 2 - Hammer 3 Output					READ ONLY					
			Bit 3 - Reserved					READ ONLY					
			Bit 4 - Hammer 4 Output					READ ONLY					
			Bit 5 - Hammer 1 Feedback					READ ONLY					
			Bit 6 - Hammer 2 Feedback					READ ONLY					
			Bit 7 - Reserved					READ ONLY					
			Bit 8 - Hammer 3 Feedback					READ ONLY					
			Bit 9 - Hammer 4 Feedback					READ ONLY					
			Bit 10 - Over-Cur Alarm Source					READ ONLY				0 = OC detected by ext. relay, 1 = detected by firmware	
			Bit 11 - Reserved					READ ONLY					
			Bit 12 - Reduced Voltage					READ ONLY					
			Bit 13 - Remote On					READ ONLY					
			Bit 14 - Remote Enable					READ ONLY					
			Bit 15 - Reserved					READ ONLY					

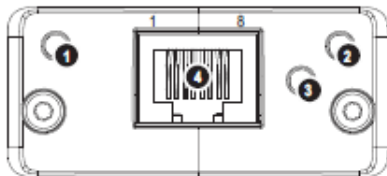
		Process READ Data (Data Read from Power Supply)													
Web Idx (Note 6)	Application Data Instance (ADI) #	Parameter	Bit Assignments	Data Type	Units	Max Value	Min Value	Default Value	Increment	Modbus Register # (Anybus-CC)	Modbus Register # (Network Port)	Notes	Firmware Version Notes		
14	14	Limit Status		UINT16		65,535	0	READ ONLY		30014	30014				
			Bit 0 - Current Limit					READ ONLY							
			Bit 1 - Voltage Limit					READ ONLY							
			Bit 2 - Full Conduction					READ ONLY							
			Bit 3 - Reserved					READ ONLY							
			Bit 4 - Back Corona Hold					READ ONLY							
			Bit 5 - V/I Curve in Operation					READ ONLY							
			Bit 6 - Hammer 1 Feedback Alarm					READ ONLY							
			Bit 7 - Reserved					READ ONLY							
			Bit 8 - Hammer 2 Feedback Alarm					READ ONLY							
			Bit 9 - Hammer 3 Feedback Alarm					READ ONLY							
			Bit 10 - Hammer 4 Feedback Alarm					READ ONLY							
			Bit 11 - Reserved					READ ONLY							
			Bit 12 - Spark Occurred					READ ONLY							
			Bit 13 - Arc Occurred					READ ONLY							
			Bit 14 - BC Check in Progress					READ ONLY							
			Bit 15 - Reserved					READ ONLY							
15	15	Alarm Status		UINT16		65,535	0	READ ONLY		30015	30015				
			Bit 0 - T/R Over-Current					READ ONLY							
			Bit 1 - SCR Over-Temperature					READ ONLY							
			Bit 2 - T/R Oil Over-Temperature					READ ONLY							
			Bit 3 - Reserved					READ ONLY							
			Bit 4 - T/R Low Oil					READ ONLY							
			Bit 5 - Under Voltage					READ ONLY							
			Bit 6 - Over Voltage					READ ONLY							
			Bit 7 - Reserved					READ ONLY							
			Bit 8 - SCR Unbalance					READ ONLY							
			Bit 9 - Loss of Line Sync					READ ONLY							
			Bit 10 - Aux. Alarm 1					READ ONLY							
			Bit 11 - Reserved					READ ONLY							
			Bit 12 - Aux. Alarm 2					READ ONLY							
			Bit 13 - Aux. Alarm 3					READ ONLY							
			Bit 14 - Aux. Alarm 4					READ ONLY							
			Bit 15 - Reserved					READ ONLY							
16	16	Alarm Status 2		UINT16		65,535	0	READ ONLY		30016	30016				
			Bit 0 - Vref Abnormal					READ ONLY							
			Bit 1 - Spare					READ ONLY							
			Bit 2 - Spare					READ ONLY							
			Bit 3 - Reserved					READ ONLY							
			Bit 4 - Spare					READ ONLY							
			Bit 5 - Spare					READ ONLY							
			Bit 6 - Spare					READ ONLY							
			Bit 7 - Reserved					READ ONLY							
			Bit 8 - Spare					READ ONLY							
			Bit 9 - Spare					READ ONLY							
			Bit 10 - Spare					READ ONLY							
			Bit 11 - Reserved					READ ONLY							
			Bit 12 - Low Battery					READ ONLY							
			Bit 13 - Blown Fuse					READ ONLY							
			Bit 14 - Spare					READ ONLY							
			Bit 15 - Reserved					READ ONLY							
17	17	Spare						READ ONLY		30017	30017				
18	18	Spare						READ ONLY		30018	30018				
19	19	Spare						READ ONLY		30019	30019				
20	20	Spare						READ ONLY		30020	30020				
21	21	I.E. On (Actual)		UINT16	1/2 Cycles	20	1	READ ONLY		30021	30021				
22	22	I.E. Off (Actual)		UINT16	Cycles	20	1	READ ONLY		30022	30022				

Process WRITE Data (Data Written to Power Supply)											Note: 'Comm Status' must be set to Remote before writing to any register		
Web Idx. (Note 6)	Application Data Instance (ADI) #	Parameter	Bit Assignments	Data Type	Units	Max Value	Min Value	Default Value	Increment	Modbus Register # (Anybus-CC)	Modbus Register # (Network Port)	Notes	Firmware Version Notes
23	50	Clear Alarm		UINT16		1	0	0	1	40578	40001	Remote Enable has to be off in V5.11 and earlier	See Notes 3, 4, 5
24	51	HV On/Off Control		UINT16		2	0	0	1	40579	40002	1 = HV Off, 2 = HV On	See Notes 3, 4, 5
25	52	Spark Setback		UINT16	%	30	1	15	1	40580	40003		See Notes 3, 4, 5
26	53	Quench		UINT16	Cycles	10	1	1	1	40581	40004		See Notes 3, 4, 5
27	54	Current Limit		UINT16	%	110	10	100	1	40582	40005		See Notes 3, 4, 5
28	55	Secondary Voltage Limit		UINT16	%	110	10	100	1	40583	40006		See Notes 3, 4, 5
29	56	U.V. Trip Level		UINT16	KVDC	30	0	10	1	40584	40007		See Notes 3, 4, 5
30	57	U.V. Trip Delay		UINT16	Seconds	45	5	30	1	40585	40008		See Notes 3, 4, 5
31	58	Spark Rate (setpoint)		UINT16	SPM	120	1	12	1	40586	40009		See Notes 3, 4, 5
32	59	Max. Voltage Conduction		UINT16	Degrees	160	90	160	1	40587	40010		See Notes 3, 4, 5
32	60	Max. Current Limit		UINT16	%	110	30	110	1	40588	40011		See Notes 3, 4, 5
34	61	Mode Control		UINT16		5	1	1	1	40589	40012	1 = DC Mode 2 = Manual Mode 3 = I.E. Mode 4 = Back Corona / DC Hold 5 = Back Corona / DC -> IE	See Notes 3, 4, 5 See Notes 3, 4, 5 See Notes 3, 4, 5 See Notes 3, 4, 5 See Notes 3, 4, 5
35	62	I.E. Half-Cycles On		UINT16	1/2 Cycles	20	1	1	1	40590	40013		See Notes 3, 4, 5
36	63	I.E. Cycles Off		UINT16	Cycles	20	1	1	1	40591	40014		See Notes 3, 4, 5
37	64	Manual Mode Setpoint		UINT16	Degrees	160	0	0	1	40592	40015	0 - 160 degrees conduction angle	See Notes 3, 4, 5
Notes:													
1. For Ethernet/IP Class													
Device Application Object = A2 (hex) for explicit data exchange													
Instance attribute for all values is 5													
CIP class 1 connection parameters:													
Configuration connection instance = 1													
Originator -> Target Connection Point = 150, Data Size = 30 bytes													
Target -> Originator Connection Point = 100, Data Size = 44 bytes													
Default IP address is 192.168.1.10. Set IP address using NWL GVC setup screen.													
2. "Comm Status" must be set to Remote before writing to any register.													
3. Modbus registers 40578-40592 were mapped as 40001-40015 in firmware versions 5.17 and earlier. Starting with firmware 5.18, Modbus addressing for Anybus-CC adapter will be different from Modbus via Network port.													
This change affects Anybus-CC Modbus-RTU and -TCP only.													
4. Starting with firmware 5.18, it is possible to select (via GVC menu) which process WRITE variables are enabled (mapped) for cyclical data exchanges via Anybus-CC interface.													
By default, all process WRITE variables are enabled and network data exchange map is as shown in the table.													
For example, if user chooses not to map "Clear Alarm" ADI as a process WRITE variable, then the number of process WRITE variables will be reduced by one,													
and the first process WRITE variable will be "HV On/Off Control".													
User selections do not affect Modbus register addresses (Anybus-CC and Network port). For Modbus adapters (-RTU and -TCP), the entire process WRITE range is always accessible.													
5. PROFIBUS notes:													
- On PROFIBUS master side, map ADIs to process data exactly in the order they are listed in this document; otherwise network connection establishment will fail.													
- If user disables mapping of a process WRITE variable (see Note 5 above), it must be taken into account by PROFIBUS master before attempting to establish connection.													
6. Web Index of an ADI only applies to Anybus-CC adapters with a Web interface (Ethernet/IP, Modbus-TCP, Profinet, etc.) This index will be displayed in a Web browser. Web interface is enabled by default, but may be disabled by user.													
Revisions:													
8/30/2010 - JLS Discrete Logic Word, Bit 10 was changed to "0 = OC detected by ext. relay, 1 = detected by firmware" in order to match protocol document.													
7/7/2011 - JLS Modified the notes for 'Clear Alarm' (index # 23). The Remote Enable does not have to be off to clear an alarm in V5.12 and later.													
9/20/2011 - JLS Changed data instance #1 from 'Device Type ID' to 'Device Status'. Changed the 'Firmware Ref.' column to 'Firmware Version Notes'. Changed the 'Register #' column to 'Modbus Register #'.													
1/24/2012 - JLS In Note 2, the connection points were changed from hex to decimal and the data size was swapped on earlier spreadsheets													
9/10/2012 - PM Changed Modbus register numbers for Process WRITE data													

Appendix D

Fieldbus Module Additional Information

For Fieldbus modules that utilize a Ethernet style RJ45 jack (Ethernet IP, Modbus TCP, ProfiNet, etc.) :

#	Item	
1	Network Status LED	
2	Module Status LED	
3	Link/Activity	
4	Ethernet Interface	

Network Status LED

Note: A test sequence is performed on this LED during startup.

LED State	Description
Off	No power or no IP address
Green	On-line, one or more connections established (CIP Class 1 or 3)
Green, flashing	On-line, no connections established
Red	Duplicate IP address, FATAL error
Red, flashing	One or more connections timed out (CIP Class 1 or 3)

Module Status LED

Note: A test sequence is performed on this LED during startup.

LED State	Description
Off	No power
Green	Controlled by a Scanner in Run state
Green, flashing	Not configured, or Scanner in Idle state
Red	Major fault (EXCEPTION-state, FATAL error etc.)
Red, flashing	Recoverable fault(s)

LINK/Activity LED

LED State	Description
Off	No link, no activity
Green	Link established
Green, flickering	Activity

Ethernet Interface

The Ethernet interface supports 10/100Mbit, full or half duplex operation.

For Fieldbus modules that utilize a 9 pin D connector (Modbus RTU, Profibus DPV1, etc.) :

#	Item	
1	Communication LED	
2	Device Status LED	
3	Modbus Interface	

Communication LED

LED State	Description
Off	No power - or - no traffic
Yellow	Frame reception or transmission
Red	A fatal error has occurred

Device Status LED

LED State	Description
Off	Initializing - or - no power
Green	Module initialized, no error
Red	Internal error - or - major unrecoverable fault
Red, single flash	Communication fault or configuration error Case 1: Invalid settings in Network Configuration Object. Case 2: Settings in Network Configuration Object has been changed during runtime (i.e. the settings does not match the currently used configuration)
Red, double flash	Application diagnostics available

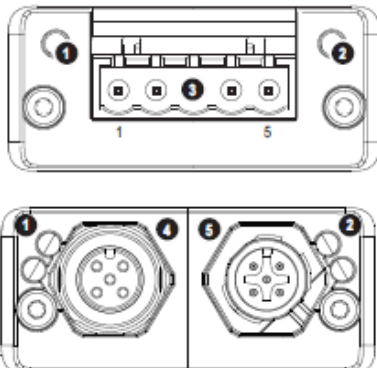
Modbus Interface

The Modbus interface is galvanically isolated, and provides both RS-232 and RS-485.

Pin	Direction	Signal	Comment
Housing	-	PE	Protective Earth
1	-	GND	Bus polarization, ground (isolated)
2	Output ^a	5V	Bus polarization power +5V DC (isolated)
3	Input	PMC	Connect to pin #2 for RS-232 operation. Leave unconnected for RS-485 operation.
4	-	-	-
5	Bidirectional	B-Line	RS-485 B-Line
6	-	-	-
7	Input	Rx	RS-232 Data Receive
8	Output	Tx	RS-232 Data Transmit
9	Bidirectional	A-Line	RS-485 A-Line

a. Any current drawn from this pin will affect the total power consumption. See also "Power Consumption" on page 32.

For DeviceNet Fieldbus Module :

#	Item	
1	Network Status LED	
2	Module status LED	
3	DeviceNet Connector	
4	M12 Female Connector	
5	M12 Male Connector	

Network Status

State	Indication
Off	Not online / No power
Green	On-line, one or more connections are established
Flashing Green (1 Hz)	On-line, no connections established
Red	Critical link failure
Flashing Red (1 Hz)	One or more connections timed-out
Alternating Red/Green	Self test

Module Status

State	Indication
Off	No power
Green	Operating in normal condition
Flashing Green (1 Hz)	Missing or incomplete configuration, device needs commissioning
Red	Unrecoverable Fault(s)
Flashing Red (1 Hz)	Recoverable Fault(s)
Alternating Red/Green	Self test

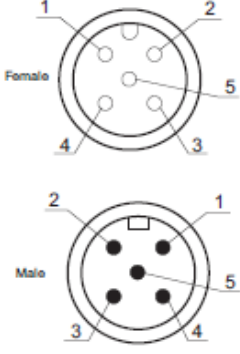
DeviceNet Connector

This connector provides DeviceNet connectivity.

Pin	Signal	Description
1	V-	Negative bus supply voltage ^a
2	CAN_L	CAN low bus line
3	SHIELD	Cable shield
4	CAN_H	CAN high bus line
5	V+	Positive bus supply voltage ^a

M12 Connectors, Code A

The female M12 connector is used when modules are used in a daisy-chain topology.

Pin	Name	Description	
1	Drain	Shield	
2	V+	Positive voltage bus power. 11 - 25 VDC	
3	V-	Ground bus power	
4	CAN_H	CAN high	
5	CAN_L	CAN low	

Additional information on the fieldbus modules can be obtained from the manufacturer at www.anybus.com