Graphic Voltage Controller (GVC)
User's Guide

Revisions

Rev.	Date	Author	Description
0	1/15/01		Original
1.1	8/22/06	FGS	Updated for new display screens

Copyright, warranty conditions

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.

Written and designed at:

NWL
312 Rising Sun Square
Bordentown, NJ 08505 U.S.A.
1-800-742-5695 • 1-609-298-7300
FAX: 1-609-298-8235

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.**

Table of Contents

One T/R Controller or 90 on a Network: The Graphic Voltage Controller

Now one easy-to-use hand-holdable voltage controller 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 Graphic Voltage controller (GVC) that makes clean-air management 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 GVC's display/keypad 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.

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 Optimizer 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 GVC 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 Optimizer.

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 Display/Keypad 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 GVC 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):

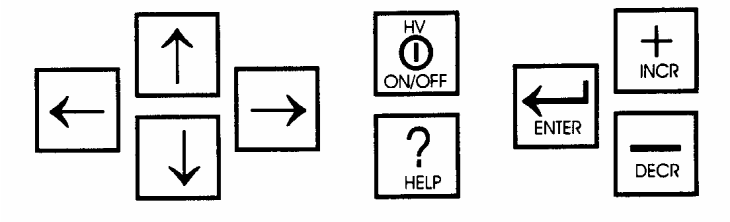


Figure I-1

- 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 he top of the display.

The Display

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

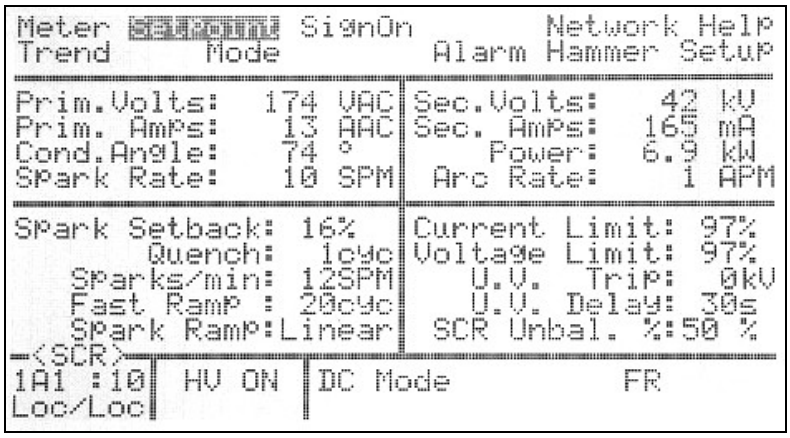


Figure I-2

- 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 GVC 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 GVC's 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 GVC display last up to 30 years under normal conditions.

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

Before Using the Optimizer

System Startup

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

If you retrofitted the Optimizer to an existing T/R set, 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 Optimizer and started it up, they have calibrated and configured the Optimizer for you.

To prevent damage to the T/R set, the precipitator, or the Optimizer, you must calibrate and configure it before use in two cases: when setting up a complete T/R set that includes it, and when it loses calibration, as described in Chapter Four of this ***ESP Power Optimizer 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 Optimizer.

Monitoring the System

What this chapter covers

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

- *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 Optimizer's monitoring functions and show you how to access them, from initial sign-on to operating procedures.

Since the Optimizer can operate either with single T/R sets or 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 Display/Keypad Use" above.

Startup and Sign-on

For most users, the ESP Power Optimizer's display/keypad 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 display/keypad is only one of three main Optimizer modules. The other two, the T/R control module and the SCR trigger board, work behind the scenes to operate each T/R set.

When you use the display/keypad to set values on a T/R set, you are actually giving instructions to its control module. The control module remembers and follows these instructions until you issue new ones.

As a result, you can unplug the display/keypad from a T/R set, and the power supply will continue to operate using the parameters you have set.

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

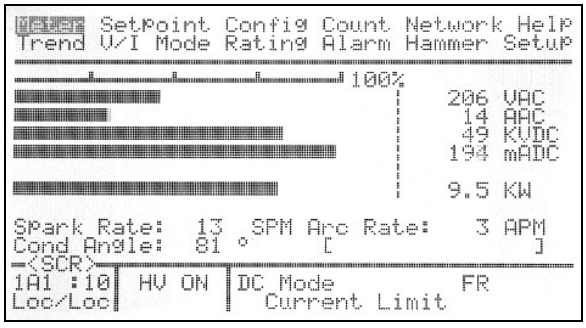


Figure 1-1

The Optimizer'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 Optimizer 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 Optimizer display/keypad as a hand-held unit, power it up and start the monitoring process by inserting its RJ45 telephone-style modular plug into the matching Optimizer jack on the T/R controller.

Be sure to use the correct RJ45 jack. Do not insert the plug into a non-Optimizer jack. If there are two Optimizer 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 display/keypad. 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 **Setup** screen (fig. 1-2)

- The network GVC 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 Optimizers on the network must also have unique addresses. These are defined in the ***T/R Address*** parameter in fig. 1-2.

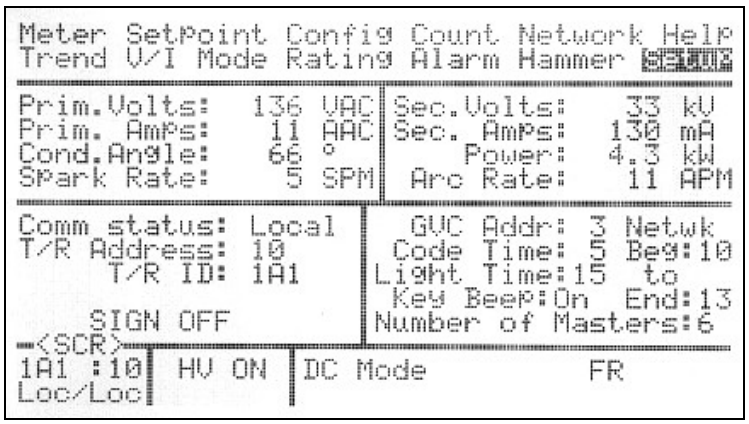


Figure 1-2

- The Optimizer addresses that are to be displayed on the network display screen must also be defined. The display range is set in the ***Netwk Beg*** **to** ***End*** parameters. Once all these parameters are set and the **Network** screen is selected, the network summary screen will be displayed (fig. 1-3).

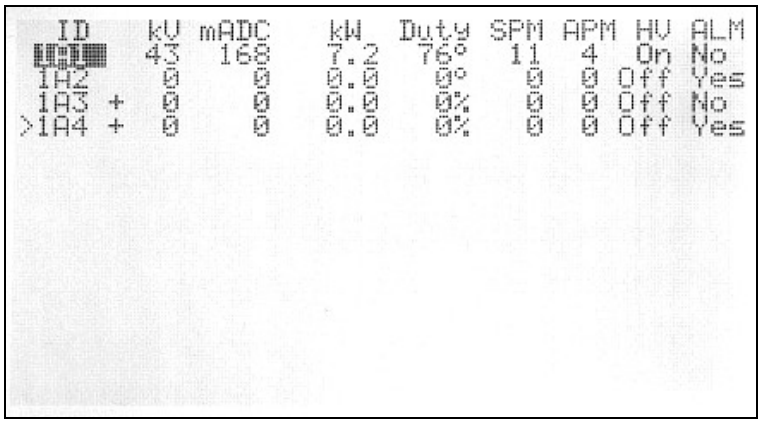


Figure 1-3

The list in the ***ID*** column will show three types of T/R controllers:

1. 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) type supply.

2. T/Rs with an address on the network that do not yet have IDs, displayed as two numbers in brackets such as [*13*]. Again, the + next to the ID indicates the unit is a PowerPlus (switchmode) type supply.

3. 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 ***Number of Masters*** parameter.

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 Optimizer allows you to make changes in settings and, at the highest level, access more than the initial nine screens (see fig.1-1). 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 **Setup** screen only.

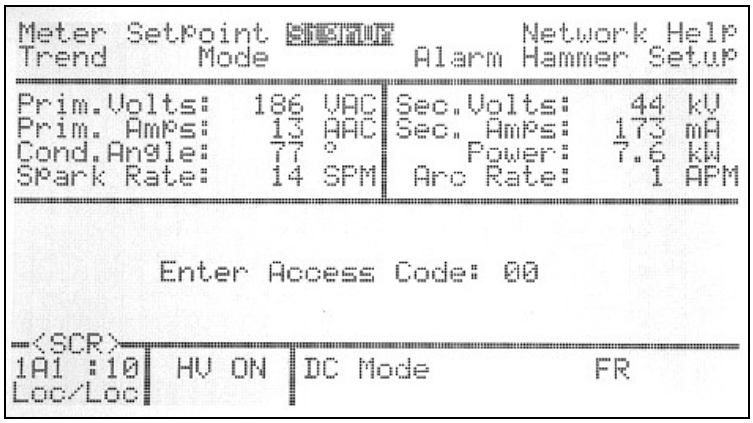


Figure 1-4

To sign onto the Optimizer, 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 Optimizer 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 Optimizer 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 **Setup** screen as follows.

1. Use the <Arrow> keys to highlight **Setup,** then press <Enter>. See fig. 1-5.

2. Scroll the blinking cursor to ***Code Time*** with the <Arrow> keys. Use <+Incr> or <-Decr> to change the setting. Default is *5 Min.*

3. Press <Enter> to register your settings.

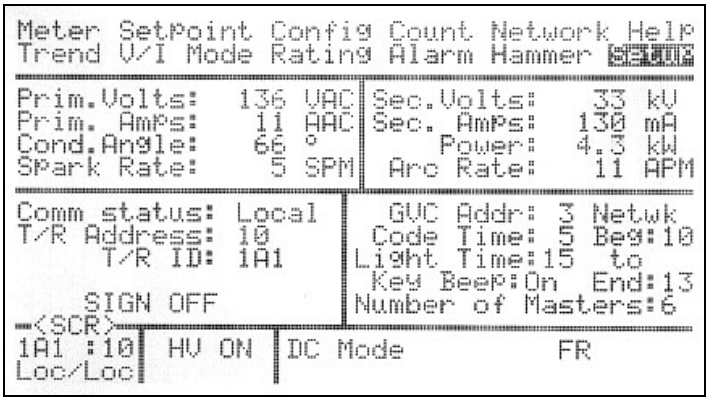


Figure 1-5

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

Getting Help

The Optimizer has an on-screen help system (fig. 1-6) that can answer many of your questions about accessing

features and using the display/keypad efficiently. To reach the help facility

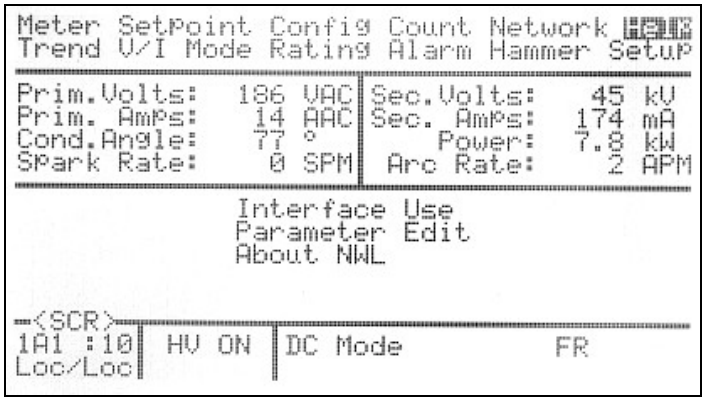


Figure 1-6

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 display/Keypad will display information relevant to the screen you're in. NWL is constantly expanding and improving this feature.

Monitoring the System

NWL's ESP Power Optimizer 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 Optimizer is the **Meter** display (fig. 1-7). The Optimizer reverts to this screen automatically whenever your access code times out or you sign off the system. *This is a display-only screen.*

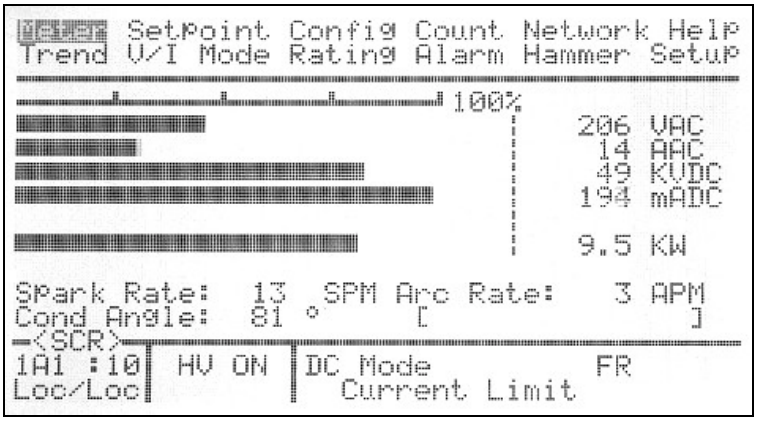


Figure 1-7

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)*

  * secondary voltage *(KVDC)*

  * secondary voltage 2 *(KVDC2)-used* only for dual- bushing T/Rs

  * secondary current *(mADC)*

  * power *(KW)*

- a trend graph on any one of these operational readings over a selected period of time

  (if both KVDCI and KVDC2 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 first four bars in the bar chart display (see fig. 1 -7 again) conform to the analog meters on most T/R set control cabinets.

The bar chart screen gives you a quick overview of how much power your Optimizer is using. Each bar and its accompanying numeric readout represents actual T/R set usage. 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 Power Optimizer 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.

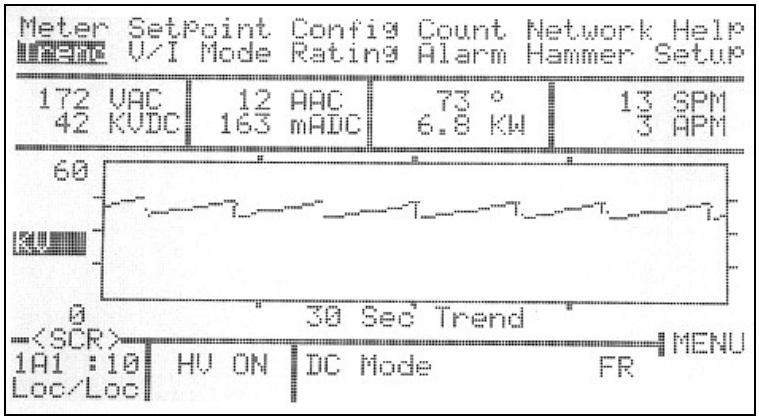


Figure 1-8

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

An NWL ESP Power Optimizer display/keypad module can monitor and control a single precipitator 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 Optimizer 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:

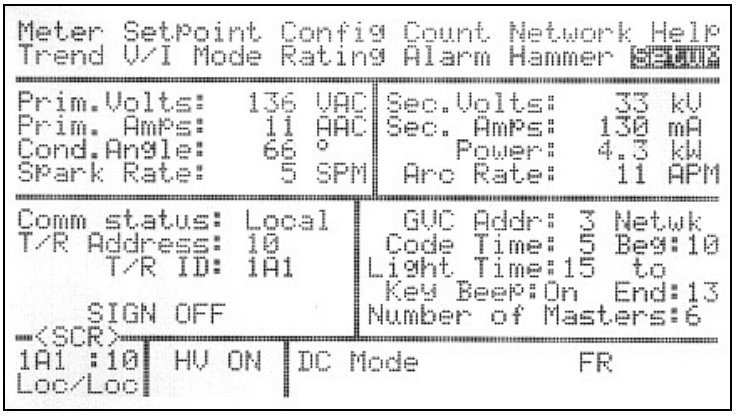


Figure 1-9

1. scroll to the **Setup** screen
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 into the network jack. The display/keypad automatically displays the network summary screen for the range of T/R's that were programmed in the **Setup** 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 Optimizer was plugged into its local jack. Note that ***Comm Status*** (local or remote) can only be set from the local port. Some functions of the Optimizer 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 11 and 12 on 1TB of the Optimizer control board are redefined as follows:

Terminal 11: 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 GVC 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 12, described below.

Terminal 12: This will be the Remote On/Off input. When 120 VAC is present on terminal 12, 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

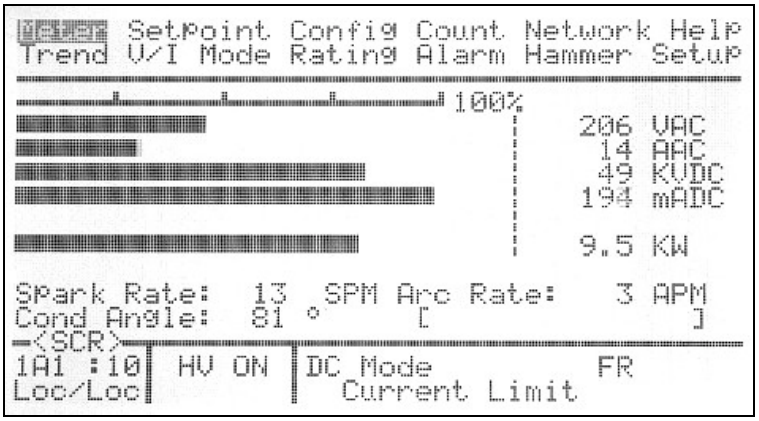


Figure 1-10

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

   - prevent under- and over-voltage

2. pr imary current *(AAC),* monitored to

   - control the amount of power delivered to the T/R
     set

   - ensure that the SCRs in the power supply are

not half-waving

3. secondar y voltage *(KVDC),* monitored to

   - control the amount of power delivered to the T/R set
   - prevent under- and over-voltage
   - detect sparks and back-corona

4. secondary current *(mADC)* monitoring to detect sparks and arcs, which appear as sudden current peaks

5. secondary power *(KW)* to show T/R output in kilowatts

6. *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.

7. *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 Optimizer 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).

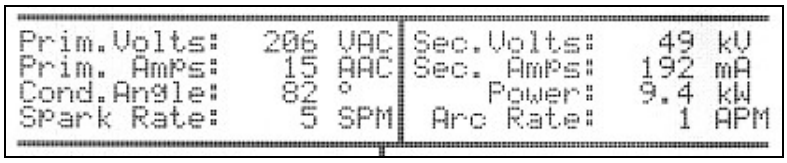


Figure 1-11

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.

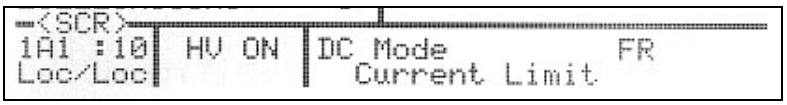


Figure 1-12

The left side of the status bar tells you the T/R ID and address of the T/R set the Optimizer is now monitoring. It also shows whether it is in *LOCAL* or *REMOTE* mode. Just above the T/R ID is either a <SCR>, to indicate that the display is communicating with a conventional SCR style controller (Optimizer), 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 at the SCRs 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 mode, which improves collector efficiencies by pulsing the SCRs. This reduces energy consumption while Intermittent Energization maintaining desired opacity.
- If *BC* appears, the Optimizer's automatic back corona detection and correction feature is engaged. Chapter Three: Changing T/R Parameters, describes back corona in detail.

- The word *DC Mode* shows the controller is being operated manually, rather than allowing the Optimizer to automatically adjust its electrical values for optimum opacity and efficiency.

- T he 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 Optimizer is generating a V/I curve.
- *BACK CORONA SEARCH* shows that the Optimizer 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 0n/0ff> 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 ESP Power Optimizer 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.

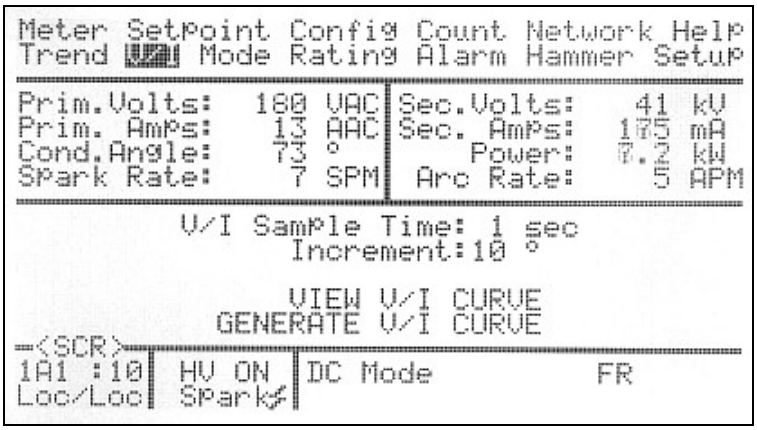


Figure 1-13

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 Optimizer 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.

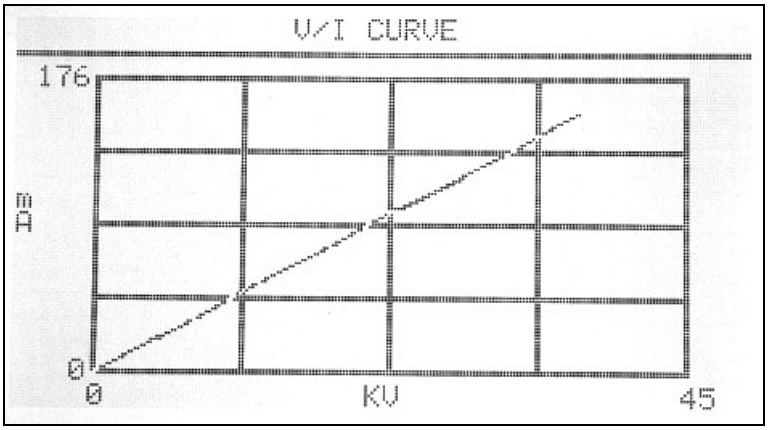


Figure 1-14

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 I 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.

Trends

The Optimizer 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.

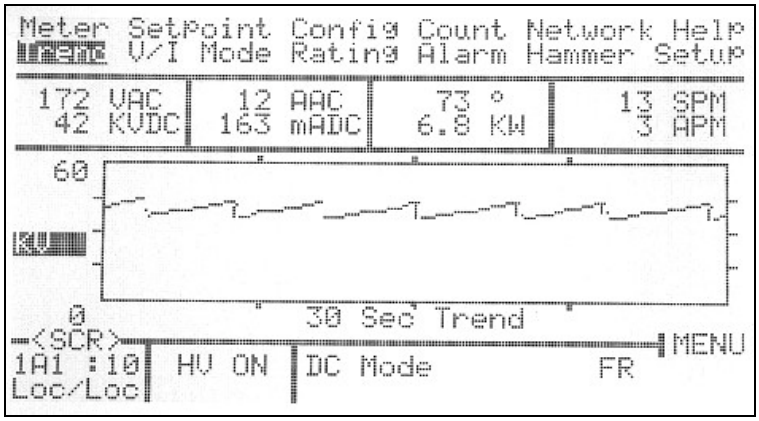


Figure 1-15

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.

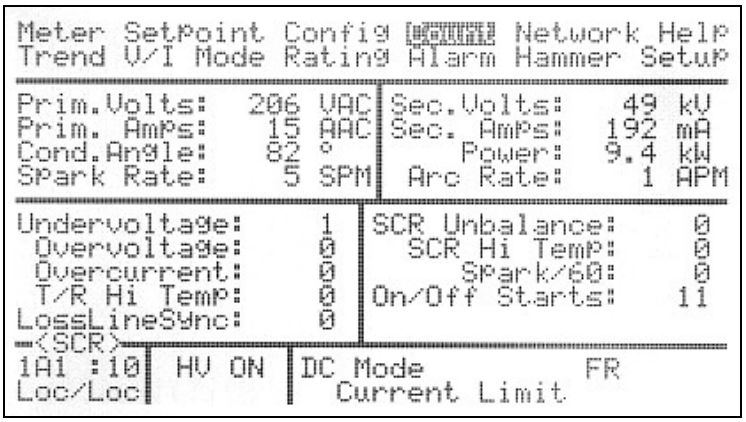


Figure 1-16

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:

Overvoltage	*SCR Unbalance*
Overcurrent	*On/Off Starts*
Spark/ 60	*Undervoltage*
T/R Hi Temp	*SCR Hi Temp*

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.

Chapter Two

Alarm Functions

What This Chapter Covers

Most of your time with the ESP Power Optimizer 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 Optimizer'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 Optimizer 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 ESP Power Optimizer provides comprehensive protection against improper operation of and damage to T/R sets.

The Optimizer 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 Optimizer 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 secondary voltage exceeds its rating by 115%.
- ***Overcurrent***: activated instantly if the primary current exceeds its rating by 115%.
- ***SCR Unbalance****:* trips if an unbalance in primary current feedback lasts longer than 15 seconds. This parameter is programmable in the **Setpoints** window.
- ***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)	SCR Hi Tmp
T/R Hi Tmp	Low Oil

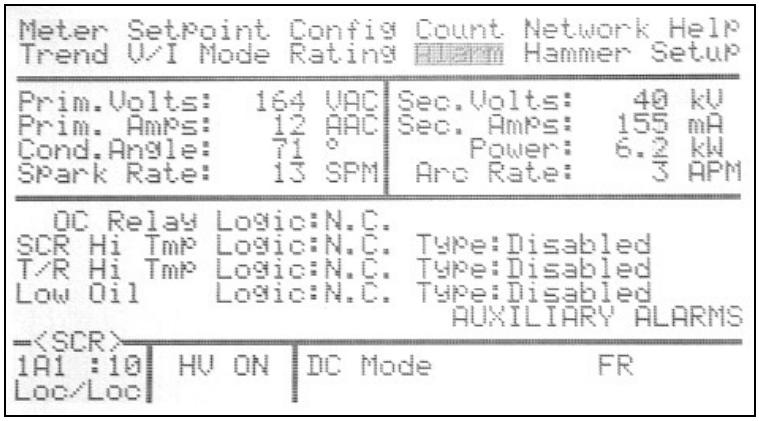


Figure 2-1

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> kevs.

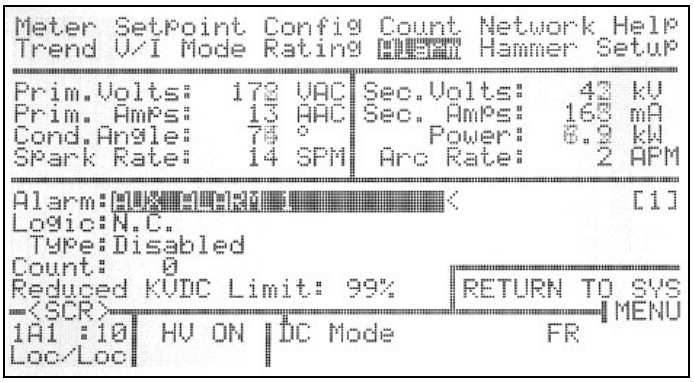


Figure 2-2

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 Optimizer responds to an alarm with

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

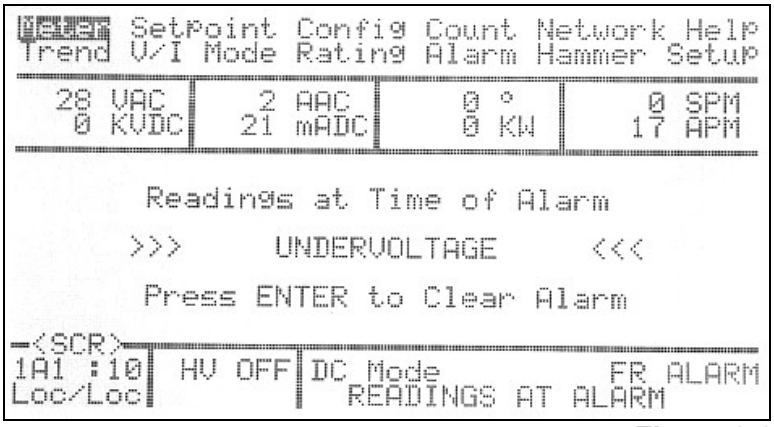


Figure 2-3

All alarm messages appear on the **Meter Display** screen. If you're in another screen when an alarm trips, the Optimizer 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 Optimizer 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.

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 Optimizer 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.

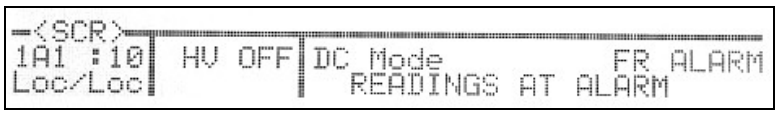


Figure 2-4

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.***

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.

- Fr equent ***Overvoltage*** alarms signal either incorrect calibration or a problem with the Optimizer 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.

- ***SCR Unbalance*** indicates an unbalance in the primary 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, Optimizer trigger board, or Optimizer I/O board.

  Solution: replace faulty hardware component.

- ***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:* usually the ESP Power Optimizer control module must be replaced to solve this problem.

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 Optimizer 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 ESP Power Optimizer.

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 alarm is ***SCR Unbalance***. 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 Optimizer. These appear on the main **Alarm** display (fig. 2-5).

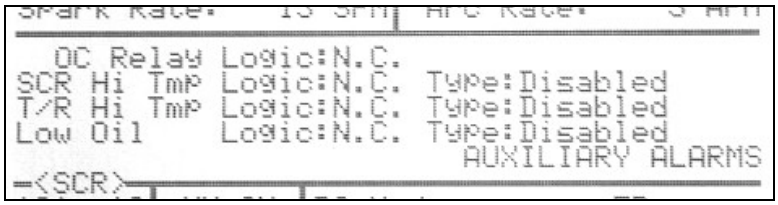


Figure 2-5

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*** and ***Reduced KVDC Limit.***

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.

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.

Changing T/R Parameters

What This Chapter Covers

The second section of Chapter Two showed how easy it is to change alarm configurations on the NWL ESP Power Optimizer. 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 Optimizer will also control tumbling hammers. We do not cover tumbling hammer operation here-instructions for configuring tumbling hammers accompany the daughterboard. If your Optimizer 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 Power Optimizer 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 Optimizer 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 multiple energy levels of sparks and spit-sparks. Sparks in the precipitator cause less than a half-cycle disruption of performance. Spit-sparks are even shorter and are usually self-extinguishing. The Optimizer can be programmed to ignore lower energy sparks.

Once it senses a spark, the Optimizer controls it by phasing back the SCRs' conduction angle slightly in the next half-cycle, thus cutting power to stop the sparking. It then performs a *slow ramp* back to pre-spark level.

Settings that affect the Optimizer's control of sparks and spit-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.

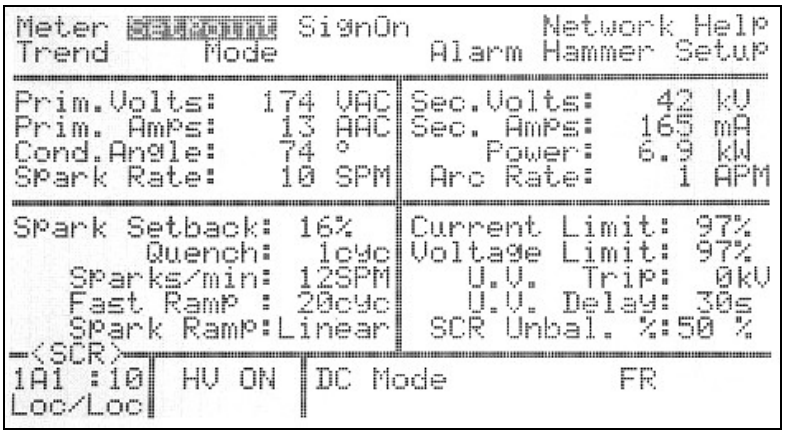


Figure 3-1

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.

  - Def ault 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)

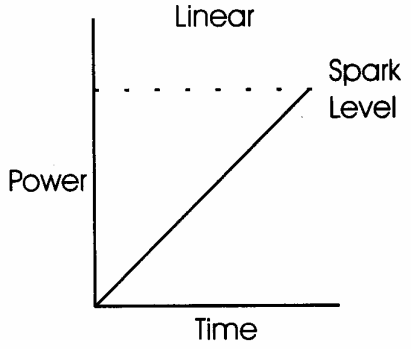


Figure 3-2

- *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.

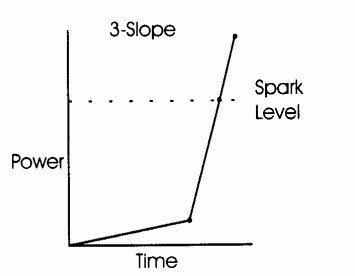


Figure 3-3

- *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.

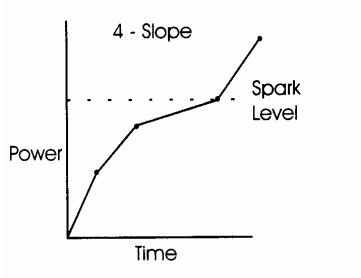


Figure 3-4

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.

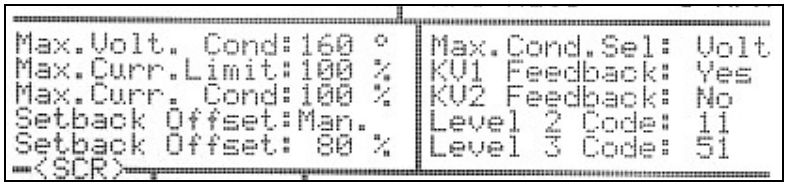


Figure 3-5

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 Optimizer 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 Optimizer 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 Optimizer'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**).*

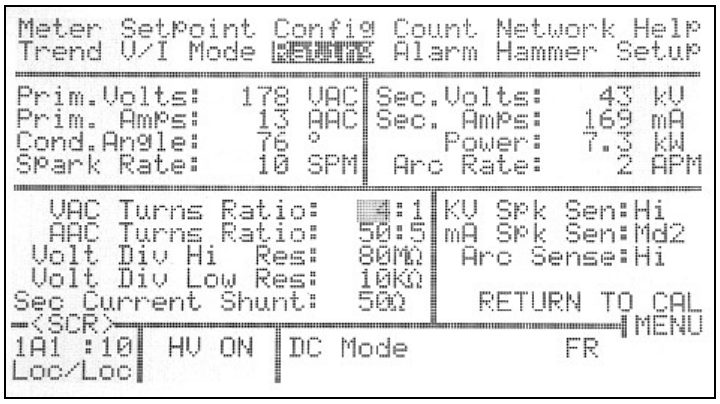


Figure 3-6

Available sensitivity settings for each field are as follows:

- **KV Spk Sen:** *Low, Hi. Dis[able]*
- **mA Spk Sen:** *Low, Med. Md2. Hi.* Dis[able]

You must have at least one of these fields sensing sparks. The Optimizer will not let you select *Dis* for both.

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 Optimizer 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

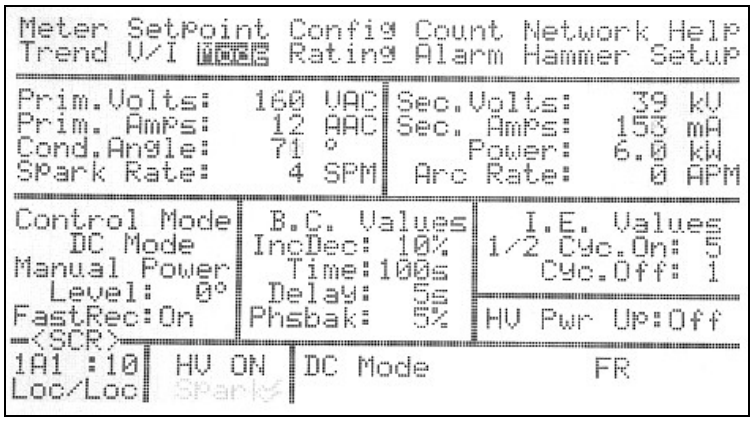


Figure 3-7

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 cause performance disruptions 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 Optimizer 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.

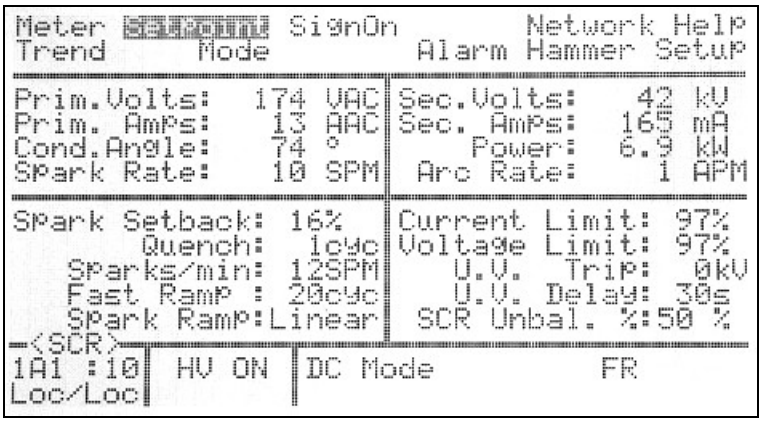


Figure 3-8

- ***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 c*yc.* Default is *5.*

Sensitivity Calibration

The Optimizer 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 Optimizer 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.

Reliable automated operation of your T/R set is just *one* of the benefits of the Optimizer. By controlling the electrical profile of the power supply, the Optimizer 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 *30%* to *110%* of the

T/R's primary rating.

- Ty pical 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:

   - *50%* to *102%* when KV feedback is available.
   - *30%* to *!07%* when secondary voltage feedback is not available.
   - Ty pical 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 Optimizer
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 Optimizer:

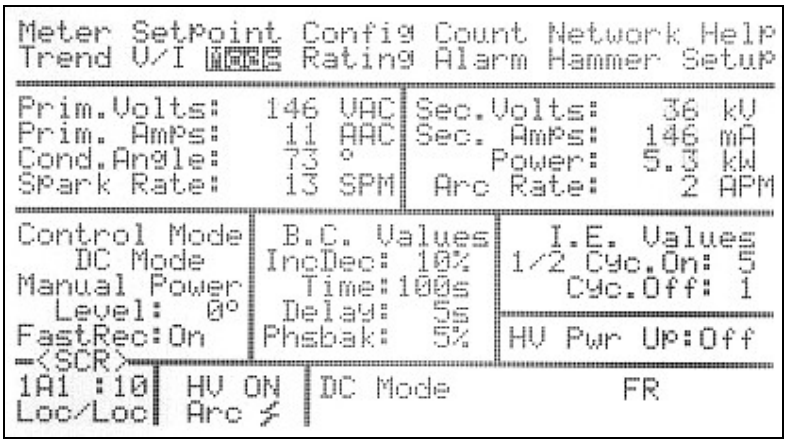


Figure 3-10

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 display/keypad'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.

You might use it, for example, to make sure the sparking indication on the Optimizer represents the onset of actual sparking. To do so you would raise the power level (conduction angle) until you get an indication of sparking in the precipitator.

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

1. <Ent er> 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. Scr oll 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.

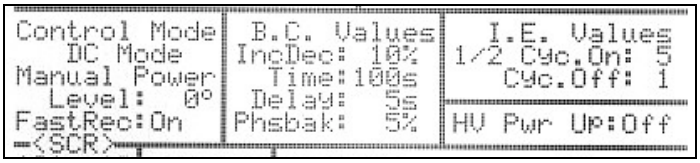


Figure 3-11

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 Optimizer 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 Optimizer 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.

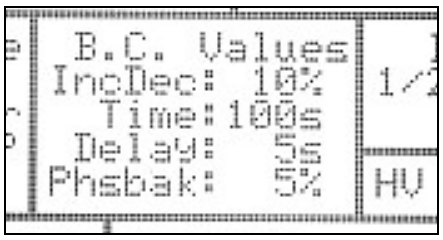


Figure 3-12

- ***B.C.*** shows whether the feature is active. Use the <+Incr> <-Decr> keys to toggle between *On* and *Off*

- ***IncDec*** determines how far power is phased back and up in normal detection, and combines wlth ***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 Optimizer 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 Optimizer key functions.

1. Choose ***I.E. Mode*** in the ***DC Mode*** field.

2. I n ***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 Optimizer 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 Optimizer'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.

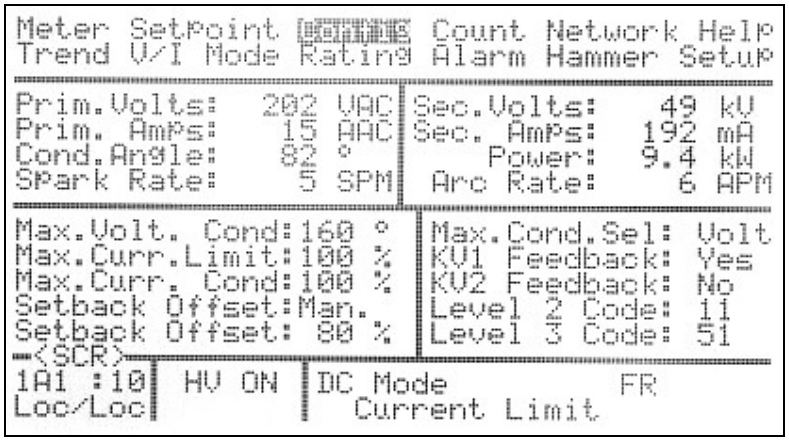


Figure 3-13

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 current at or below its value no matter what PCAMS/2, 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°.

Chapter Four

Setup, Configuration, and Networking

What This Chapter Covers

When your NWL Environmental Technologies ESP Power Optimizer was first installed, initial setup included configuring it to the ratings of your T/R set.

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

There is also a brief section on doing basic reconfiguration. It's here for convenience, in case an emergency requires that you reprogram T/R ratings and other values into the Optimizer. You will find a more comprehensive presentation in Appendix A, which reprints instructions originally prepared for the ***Installation and Startup Guide*** *used to retrofit older T/Rs with the Optimizer.*

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 and networking 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 Optimizer to the needs of your organization.

Security Settings

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

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).

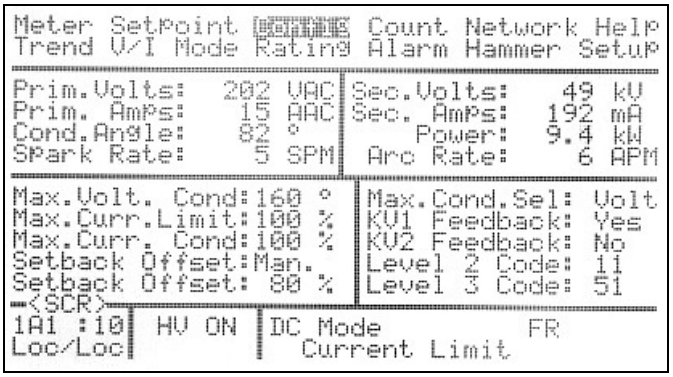


Figure 4-1

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 Optimizer 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 Optimizer.

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 Optimizer'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 Optimizer will stay at Level 2 or Level 3 access after the authorized operator has stopped using the display/keypad. To set this parameter, scroll to the **Setup** menu choice and use <Enter> to move into the parameter entry window.

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

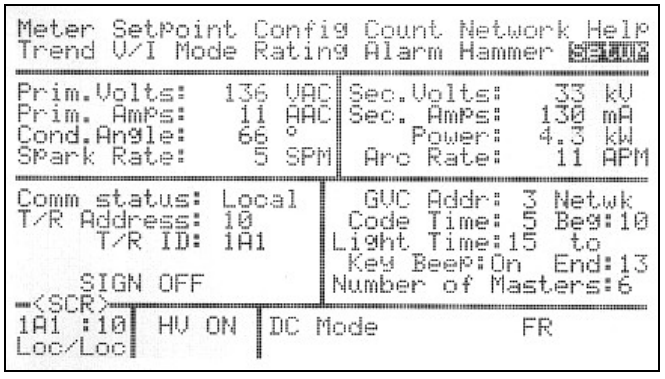


Figure 4-2

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 I (view only) when they are finished with the Optimizer. 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

Two fields in **Setup** (fig. 4-3), ***Light Time,*** and ***Key Beep*** help adapt the Optimizer to its users.

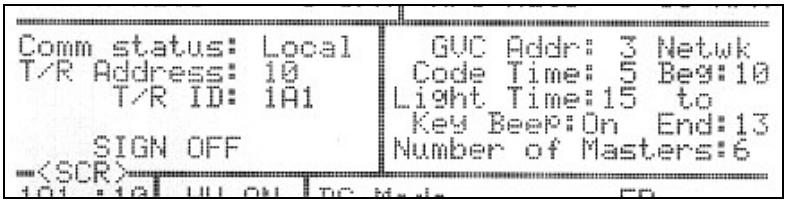


Figure 4-3

They are designed to keep conveniences from becoming annoyances.

Backlight Timeout

The ***Light Time*** field determines how long the backlight will continue to illuminate the display/keypad 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

Key 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 Optimizer.

Networking

The ESP Power Optimizer is equipped to work on a computer network. In fact, the "Network" jack on the Optimizer's controller module is actually an isolated RS-485 serial port for such a network.

This port is commonly used for two purposes:

- to permit any display/keypad 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 display/keypad is connected to any Network port, it can access, monitor, and control any other Optimizer-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 display/keypad into the local jack
2. scroll to **Setup** and press <Enter>
3. at *the **Address*** field (fig. 4-4), use the <+Incr> and <-Decr> keys to assign a port number between 10 and 99
4 press <Enter> to register your choice.

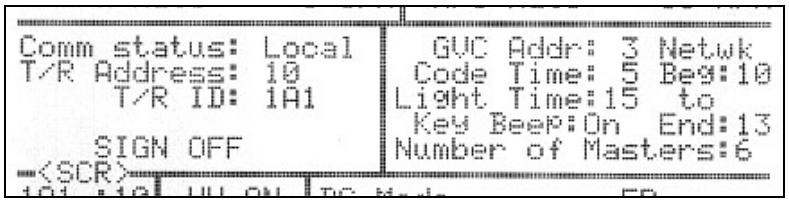


Figure 4-4

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 Optimizer'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 display/keypad into the local jack
2. scroll to **Setup** and press <Enter>
3. at the ***T/R 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.

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 Optimizer 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.***

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

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 Optimizer 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 Optimizer. Follow the instructions in Appendix A, below. These are repeated from the ESP Power Optimizer ***Installation and Startup Guide,*** *Chapters Five and Six.*

Operating at Default Settings

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.

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.

Your T/R set will be ready to operate, though not at peak efficiency.

Important: do not press the <HV 0n/0ff> key until you have checked the system ratings for correct settings.

Calibrating and Configuring

Once the system is back to default settings you must reset the system ratings as necessary.

Scroll through the following screens and check their entries

against your records to make sure they are correct:

Config: ***KVl Feedback*** and ***KV2 Feedback***
Rating: all settings
Cal Setup subscreen in **Rating**: all settings
Setup: ***Address*** (Optional)

If the settings are not correct for the T/R set, carefully follow the instructions in Chapters Five and Six of the **Installation and Startup Guide** on determining the proper values and entering them into the system.

You will now be able to power up the system for default operation.

Resetting Parameters

Once the system is up and running again, reset the alarm, spark/arc, electrical, and network parameters as described in this **User's Guide** and set them for optimum performance.

This process will be much less tedious if you have a written record of all settings to which you can refer.

PCAMS: Automatic Resetting

If the system is running under PCAMS control, the software may have all your settings in a file on the computer. The only exceptions are the addresses and ID codes for the T/R controllers and display/keypads, and the settings under the **Rating** and **Cal Setup** menu items.

With those exceptions, you can simply download your settings to the Optimizer for instant, automatic reconfiguration of operating parameters, as long as you enter the correct addresses as described above and set the controllers to remote mode.

In fact, PCAMS maintains multiple setups. It lets you easily switch among them to adapt to different situations.

For more information on PCAMS software, contact NWL at the number listed in the front of this guide.

Appendix A

Calibration and Configuration

What this Appendix covers

This information is provided so that users of the ESP Power Optimizer who did not retrofit the unit to their T/R set can completely reconfigure it.

You should only need to recalibrate and reconfigure the Optimizer if it loses memory or for some other reason returns to default values, or when replacing software in the control module or replacing the entire control module.

The information included is the same as that in Chapters 5 and 6 of the Optimizer ***Installation and Startup Guide,*** *with one exception. The instructions for configuring alarms are omitted, because they can be found in Chapter Two of this* ***User's Guide.***

Configuration

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

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

Configuration is necessary to match the T/R set with the controller. Failure to configure the Optimizer could result in damage to the T/R set or the precipitator.

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

You will use the display/keypad to set parameters.

Preparing for Configuration

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

Power up the T/R controller by moving the power handle on the control cabinet to the "ON" position. If you receive a Loss of Memory alarm when you first power up, this is not necessarily a cause for concern. *Do not push the <HV 0n/0ff> button on the display/keypad until configuration is complete!*

1. The display will activate. 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.)

Configuring the System

You will be entering parameters in four display screens:

- c onfiguration (**Config**)
- **Rating**
- **Cal Setup**
- **Setup**

The Config Screen

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

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

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

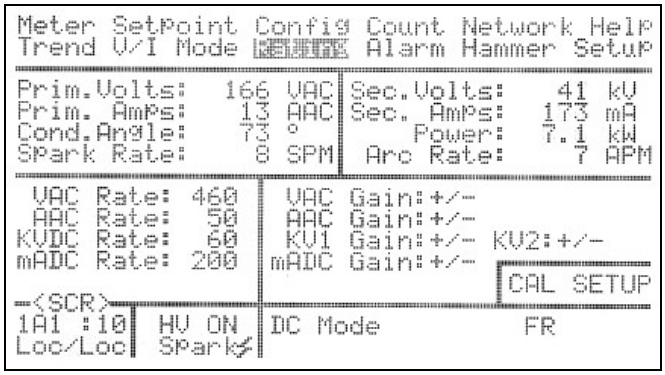
If your T/R set is a double-half wave unit, or has no provision for KV feedback, you will have to change the settings to match those in the chart as follows:

1. press <Enter> again. The cursor will move to Max. Cur.
2. use the <Arrow> keys to scroll to KV1 Feedback and KV2 Feedback in turn
3. press the <+ 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 Optimizer will calculate the secondary voltage based on the primary voltage reading.

The Rating Screen

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



1. Scroll to Rating on the main menu and select it with the <Enter> key.

2. Move among the categories with the <Arrow> keys. 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 Rating*** •***Pri Amps Rating***
   - ***Sec Volt Rating*** •***Sec Amps Rating***

Scroll to ***Menu*** and press <Enter> to return to the main menu.

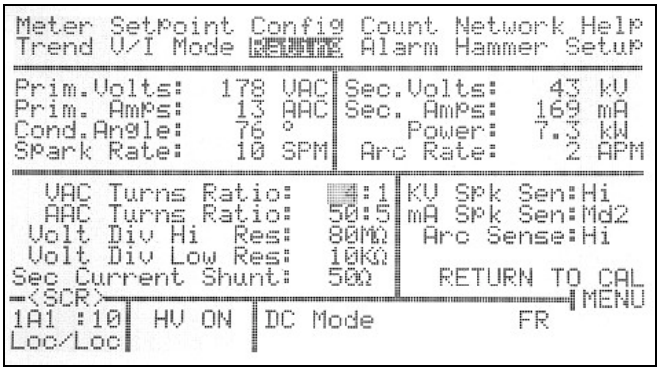
The Cal Setup Screen

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. First scroll to **Rating** on the main menu and press <Enter>.

2. Scr oll to ***Cal Setup*** in the middle window and press <Enter>.

3. On the screen that appears, review the default values. If any of them do not match the values in your system, scroll to them and enter the proper figures as described below.



VAC Turns Ratio

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 10KΩ).

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 -50Ω). The chart below shows typical values.

Typical mADC Rating	Suggested Sense Resistance	Suggested Resistor Wattage
250	50Ω	50
500	25Ω	50
1,000	10Ω	50
1,500	7.5Ω	50
2,000	6Ω	100

Contact NWL Technical support if you have any questions.

Sensitivify 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.

Alarm Configuration

At this time you should configure the alarms in your system. For full instructions, see the section "Alarm Configuration" in Chapter Two: Alarm Functions.

System Energization and Checkout

To ensure proper operation, we will now test the Optimizer 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 display/keypad module. Be sure to watch the analog meters on the T/R set control cabinet carefully where required.

Follow these instructions precisely, in exactly the order given.

.

Start by putting the system in manual mode:

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

2. scroll to ***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. Scr oll to ***Manual Power Level.***

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

3. While observing the control cabinet meters and comparing them to the digital readouts *hold down the <+ 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. T he ***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 f ield

   - the Optimizer will reach the T/R set's current or v oltage limit

   - the Optimizer will reach full conduction limit.

Final Calibration

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

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

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

Digital Readout and Control Calibration

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

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

1. St art with ***Primary Volt Gain*** and adjust it with the <+Incr > and <-Decr > keys until *PRIM. VOLTS* in the electrical readings window matches the VAC reference meter.

2. Adj ust ***Primary Amps Gain*** until *PRIM. AMPS* matches the AC Amps reference.

3. Adj ust ***KV1 Gain*** and *KV2 Gain* to match the *SEC. VOLTS* reading to the Kilovolt DC reference.

4. A djust the ***Sec. Current Shunt*** value to match the *SEC. AMPS* reading to its Milliamp DC reference.

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

Spark Sensing Calibration

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

If the Optimizer 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 ESP Power Optimizer 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 Optimizer automatically controlling your T/R set, protecting it from a potentially dangerous condition, controlling sparking, and saving energy.

Entering Operating Values

You may now enter the typical operating values for your T/R set. See Chapter Two: Alarm Functions for additional information.