

NWL Environmental Technologies

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**ESP Power Optimizer™  
Digital Voltage Controller  
User's Guide**





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This manual is supplied for the convenience of DVC operators and the system engineers who will set up the DVC's for their use. We have tried to make it as comprehensive and error-free as possible, but we assume no responsibility or liability for any errors or inaccuracies that may appear in it. We also reserve the right to improve it or otherwise change its contents without notice.

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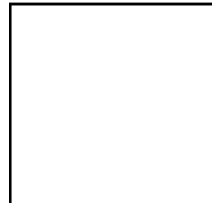
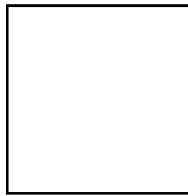
## **WARNING! High Voltage!**

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

- Do not attempt to install the Digital Voltage Controller unit 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 Digital Voltage Controller circuit boards.
- Take precautions against shock or electrocution.
- **Ground any electrical storage devices such as capacitors before touching electrical connections.**
- **Do not stand in water or on damp surfaces while working on a T/R set.**
- **NWL will not be liable for death, injury, or damages resulting from the unsafe installation or operation of this device.**

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## The DVC: Simple, Economical Day-To-Day Monitoring and Limited Control for Your T/R Sets

The Digital Voltage Controller (DVC) for NWL's ESP Power Optimizer offers an economical way to access the NWL Environmental Technologies Precipitator Systems Architecture. It is a good choice for companies that do not need multiple ESP Power Optimizer Graphic Voltage Controllers and do not have NWL's PC-based Precipitator Control and Monitoring System (PCAMS).

A DVC can be mounted on each EPS Power Optimizer-equipped Transformer/Rectifier set (T/R) in your system. Its backlit display provides the day-to-day T/R operator with vital information for his record and logs. It allows him limited control over two parameters selected by the systems engineer.

The DVC units must be set up by the systems engineer using an ESP Power Optimizer Graphic Voltage Controller (GVC). You will need at least one GVC.

The DVC is protected by a rugged NEMA 4 rated enclosure and is similar in appearance to the GVC. It has a fluorescent display with auto-off backlighting that provides a typical display life of 30 years. Eight simple, positive-pressure membrane type keys and three LED status indicators allow simple manipulation of the DVC and control of T/R parameters.

The following information displays are always on:

- Spark/ARC
- Primary Voltage (VAC)
- Primary Current (AAC)
- Secondary Voltage (KVDC)
- Secondary Current (mADC)

A systems engineer can also select any two of the following parameters for automatic display:

- Power
- Conduction Angle

- Spark Rate
- Arc Rate
- Modes of Operation

Parameters not designated for automatic display during setup can be called up by operating the keypad as described on page 6 of this document.

## How to Use This Manual

### What's in the User's Guide

This book is divided into two parts. The first part is for you, the day-to-day operator. It tells you how to use the DVC.

- Chapter One: Monitoring a T/R with a DVC
- Chapter Two: Controlling a T/R with its DVC

The second part tells your systems engineer how to program the DVC using an NWL Graphic Voltage Controller unit.

- Chapter Three: Setting Up The Parameters of the DVC

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

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### What and How to Read

Most users will be primarily interested in the first two chapters. These cover the functions and information available to you, the operator, from the DVC.

Chapter Three is addressed to a systems engineer. Its purpose is to tell him how to set up the DVC for use. If you're not involved in configuring DVCs, you can skip some or all of this chapter.

Whatever section of the guide you read, however, read it while you're looking at a DVC display module. Try to operate the unit as you read because *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 booklet, 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 DVC.

- 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: ***Current Limit***
- The names of the keys you use to enter information on the keypad will appear inside angle brackets: <+>, <Enter>.

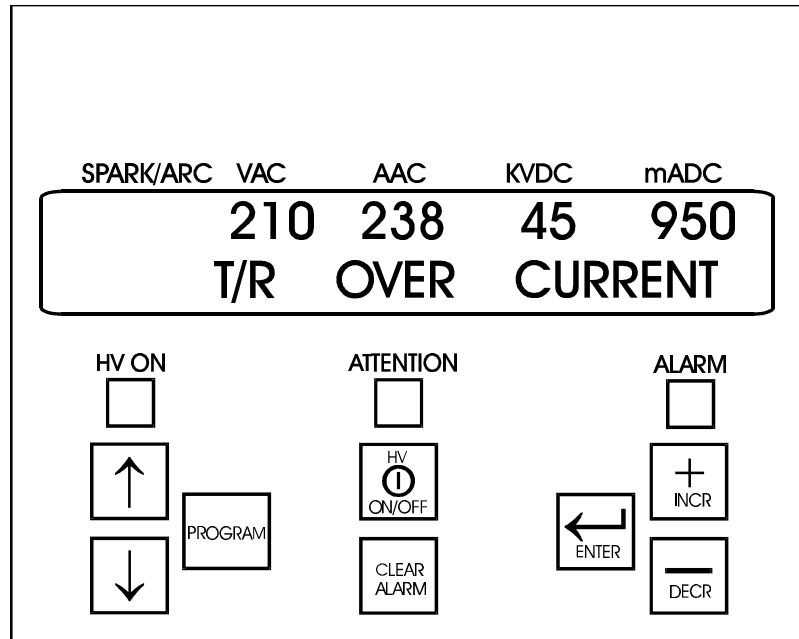
## Side Headings

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 for you 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 DVC has just 8 keys on a membrane keypad plus three LED indicator lights. These simple controls and alerts are all you need to use the unit (fig I-1).

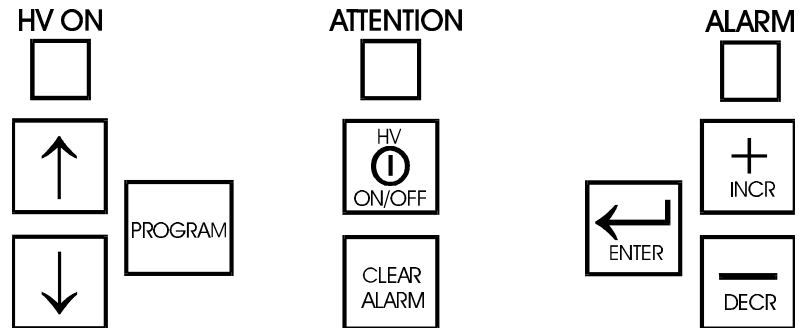


*Figure I-1*

The keys demand positive operation. You must exert some pressure on them before they register. A soft “click” can be heard when a key is pressed sufficiently to activate it. This helps prevent accidental actuation. So, don’t be afraid to press hard — the keypad is remarkably tough.

## Key Arrangement

There are three groups of keys and indicators (fig I-2).



*Fig. I-2*

The leftmost group contains the following:

- A red LED marked HV ON, which glows when the high voltage is on.
- An <arrow UP> key
- An <arrow DOWN> key
- A <Program> key (set slightly to the right of this bank of keys and lights)

The center group has one indicator and two keys:

- A yellow LED marked ATTENTION which glows yellow when an out-of-parameter condition shows on the screen
- An <HV On/Off> button which turns the High Voltage on and off
- A <Clear Alarm> button which allows clearing of any alarm displayed — and turns off the blinking ALARM light ( see below)

The righthand group has:

- A yellow LED marked ALARM which blinks when an alarm condition has occurred
- An <Enter> key (set slightly to the left of this bank of keys and lights)
- A key marked <+ Incr> which will increase the setting of any parameter your systems engineer has enabled you to alter, when it is displayed on the unit.

- A key marked <-Decr> which will decrease the setting of any parameter you have been enabled to alter, when it is displayed on the unit.

These last two keys also serve other functions as set forth in the chapters to come.

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## The Display

The lighted display carries two lines. The top line displays values for the parameters identified by the labels printed on the DVC case:

- Spark/Arc
- VAC (Volts AC)
- AAC (Amps AC)
- KVDC (Kilovolts DC)
- mADC (milliamps DC)

The values displayed on the top of the readout line indicate conditions for each of these parameters in the T/R set, at that moment.

The legends and values which appear on the second line of the display are those which your systems engineer has selected for you to scroll through and review periodically.

ONLY the two which show on the display with brackets - B.C. MODE: [On], for example - can be changed by the operator . The others can only be observed and logged (fig. I-3).

SPARK/ARC	VAC	AAC	KVDC	mADC
	210	238	45	950
B.C.	Mode: [ On ]			

*Figure I-3*

VOLTAGE LIMIT 100%. This is a parameter which contains no brackets and, thus, is one you cannot change (fig. I-4).

SPARK/ARC	VAC	AAC	KVDC	mADC
210	238	45	950	
Voltage Limit: 100%				

*Figure I-4*

### ***Dim or Blank Screen***

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

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

The display will remain 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 DVC display last up to 30 years under normal conditions.

FOR FURTHER INSTRUCTIONS ON USING THE DISPLAY/  
KEYPAD TO ACCESS THE FUNCTIONS AND PARAMETERS  
ON THE DVC, PROCEED TO CHAPTER ONE.

---

# Monitoring the T/R Set with your Digital Voltage Controller

## What this chapter covers

*The Digital Voltage Controller from NWL displays conditions within the EPS Power Optimizer at the time of reading. It shows values for major parameters which can effect the opacity of stack gases and the efficient operation of the T/R unit to which the DVC is attached.*

*You will be able to read and record/log these parameters simply by looking at the lighted display screen on the DV. You can also select certain other parameters for display on that screen by pressing one or more of the buttons on the unit's keypad.*

*There will usually be one Digital Voltage Controller (DVC) mounted on each T/R set in your workplace. Each DVC monitors and controls ONLY the T/R set to which it is fixed.*

*We recommend that you read this section of the Guide while standing in front of the DVC. It will be much clearer if you see the actual monitor screen.*

This chapter assumes that you have already read the “Basics Of Display/Keypad Use” section of this Guide.

The DVC is only one of several modules which work together to monitor and control your T/R sets. There is also an ESP Power Optimizer which manages the actual measurement and control on the basis of the limits set in your DVC.

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## Top Line of Display

The top line of the lighted display on your DVC shows current values for the parameters whose names are printed *on the case above the display screen*. You will be expected to note and perhaps enter these values in a written log.

Generally you'll be expected to note these observations once an hour, but your place of work may have different requirements. Values shown, from left to right, will include:

**SPARK/ARC    VAC    AAC    KVDC    mADC**

- **Spark/Arc** - Displays the word "Spark" when a spark is caused by the controller and "Arc" when an arc is sensed
- **VAC** - indicates primary voltage and shows the amount of power being delivered to the T/R set
- **AAC** - indicates primary current being delivered to the T/R set. It is monitored to ensure that the SCRs in the power supply are not half-waving
- **KVDC** - indicates the amount of secondary voltage being delivered to the T/R set. It is monitored to detect sparks and back-corona — a condition in which the voltage continues to rise without producing a correlated increase in precipitator efficiency (a sort of “spinning the wheels” phenomenon)
- **mADC** - indicates secondary current being delivered to the T/R set. It is monitored to detect sparks or arcs which appear as sudden current peaks

SPARK/ARC	VAC	AAC	KVDC	mADC
	425	150	45	950

*Fig. 1-1*

If any of these parameters go above or below the “high/low” limits preset by your systems engineer, the ATTENTION LED will go on. You can seldom do anything to impact these values. All you can do is log them.

The ATTENTION LED will go out on its own accord when the over-value or under-value involved corrects itself.

## Lower Line of Display

The lower line on the display will name and display two measurements without need for any action on your part. Each will have both a designation and a numerical value. These are parameters *chosen* by your systems engineer and programmed into your DVC to be displayed, read and logged just like the four measurements in the first line of the display. Again, if their high/low limits are exceeded, the ATTENTION LED will go on.

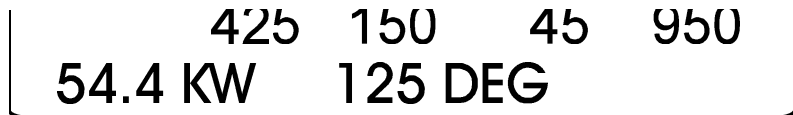


Fig. 1-2

Other parameters and their measurements can also be viewed on this line. You can bring up, and scroll through, these other parameters by pressing either the <arrow UP> button or the <arrow DOWN> button in the left column of buttons.

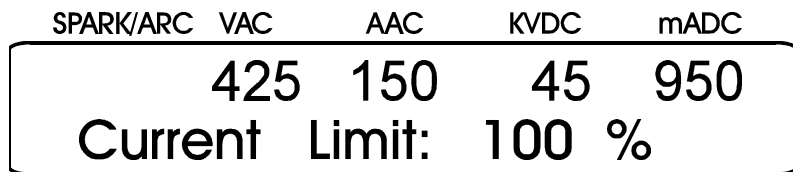


Fig. 1-3

The parameters which will either be displayed automatically on the lower line, or can be brought up by scrolling through the options, are as follows:

- **Power** - indicates total power delivered to the precipitator field
- **Conduction Angle** - indicates how long each SCR in a T/R control cabinet is conducting
- **Spark Rate** - indicates rate of sparking
- **Arc Rate** - indicates rate of arcing
- **Modes Of Operation** - offers the options of **IE/On** or **IE/Off** and **Back Corona (B.C.)/On** or **B.C./Off** and indicates the mode in effect

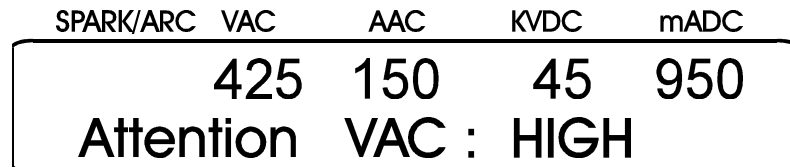
In addition to those shown above, the systems engineer can choose from among the following for additional displays and for parameters

which you can adjust:

- Current Limit
- Voltage Limit
- Conduction Limit
- Manual Mode On/Off
- Manual Conduction Angle (when Manual Mode is On)
- I.E. Mode On/Off
- Back Corona On/Off
- HV Power Up Off/Previous

## ATTENTION display

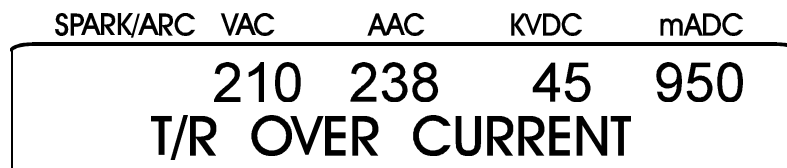
The word ATTENTION will supersede whatever display is on line two of your DVC any time a parameter exceeds its setpoint or preset limit (see Fig. 1-4). It will appear along with the name of the parameter and its present reading, blink, then disappear. At the same moment, the ATTENTION LED will come on and also blink. The ATTENTION item will reappear on the display every 30 seconds until the parameter returns within its set limits.



*Fig 1-4*

## ALARM display

In a similar fashion, the word ALARM will appear on line 2 of your display whenever an alarm situation occurs (Fig.1-5). In this case, however, the word, parameter identification and excess value causing the alarm will remain on screen and will not blink. At the same time, the ALARM light LED will come on and blink until the alarm situation is rectified by either the excessive value coming back within limits — or you pressing the **CLEAR ALARM** button on the DVC.



*Fig. 1-5*

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# Control of the T/R With the DVC

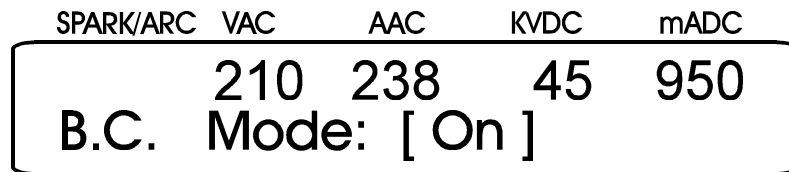
## What This Chapter Covers

*As the day-to-day operator working with one or more T/R sets, you will use the DVC primarily to monitor and record T/R operating conditions. However, the DVC does give you some degree of control over certain parameters of each T/R set. This chapter will explain what actions you may take and how to take them.*

## Changing Set Parameter Values

Your systems engineer can program into your DVC as many as two parameters that you will have the power to change at your discretion. Here's how to tell which ones can be changed

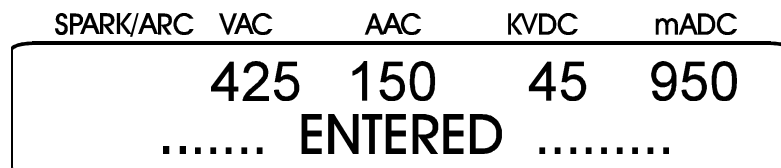
1. Use the <Arrow Up/Down> keys to scroll through the parameters available for display on the second line of your DVC display screen.
2. If your systems engineer has authorized a parameter to be changed by you, brackets will appear around the value as currently set (Fig. 2-1). If no brackets appear, you are not authorized to change this parameter.



*Fig. 2-1*

### To Change Value Of An Authorized Parameter

1. While the parameter you are authorized to change is on display, press the <Program> button.
2. Then alter the value within the brackets by pressing the <+Incr> button to increase the setting or by pressing the <-Decr> button to decrease the value.
3. When the value shown is the value you want, press the <Enter> button to record your change. The word ENTERED will appear on the display's lower line to confirm your selection.



*Fig. 2-2*

## Other Actions You May Take

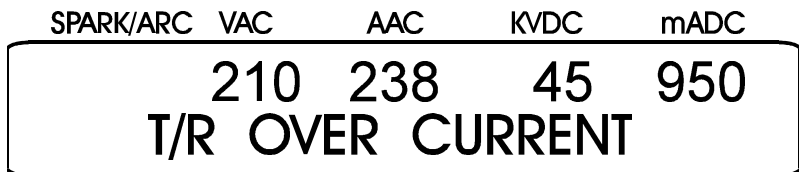
The ALARM LED will blink if any of the following potentially serious internal conditions occur:

- **Undervoltage** - when the T/R operates at or below a set value for a period of time determined by your systems engineer.
- **Overvoltage** - activated instantly if the secondary voltage exceeds its rating by 115%.
- **SCR Unbalance** - trips if an unbalance in primary current feedback lasts longer than 15 seconds.

It will also blink if any of the following exceed their set values:

- OC (Overcurrent Relay)
- T/R Hi Temperature
- SCR Hi Temperature
- Low Oil

In any ALARM instance, the cause of the alarm will be displayed in FULL CAPS on the lower line of the DVC display (see Fig 2-3). This display will take precedence over any other display usually shown on line 2.



*Fig. 2-3*

## Correcting The Alarm Condition

If the alarm cause is one of the parameters you are authorized to change, you can make a change to correct the ALARM condition. (i.e.: raise or lower a value to bring the parameter within bounds). To do this:

1. Bring up and scroll through the parameters displayed on line two of the display by pressing either the <arrow UP> button or the <arrow DOWN> button in the left column of buttons.
2. When you arrive at the parameter matching the alarm condition, change the value *if it is authorized for change*.
3. Turn off the blinking ALARM light by pressing the <Clear Alarm> button in the center group of buttons. If the alarm condition has been satisfied, it will stay off. If it has not, the ALARM LED will come on again.

## Shutting Down the T/R Set

Press the <HV Off/On> button in the center column to turn the high voltage to the T/R set off.

Turning off the T/R set will shut down the electrostatic precipitator it controls.

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# Setting Up The DVC with a GVC

## What This Chapter Covers

*System Engineers can use an NWL ESP Power Optimizer Graphic Voltage Controller (GVC) to set display options and controllable parameters for a DVC on each electrostatic precipitator.*

*This chapter will describe the step-by-step procedure which the systems engineer should use to set up each DVC for use by the day-to-day operator.*

## Connecting the Graphic Voltage Controller

The first step in programming the DVC is to disconnect the DVC from the Local port on the T/R set control module and plug the GVC into the same port. Doing so will automatically power up the GVC. It will not interrupt the operation of the T/R set or its ESP (Power Optimizer): Nor will it change operation parameters stored in the T/R set's Power Optimizer control module.

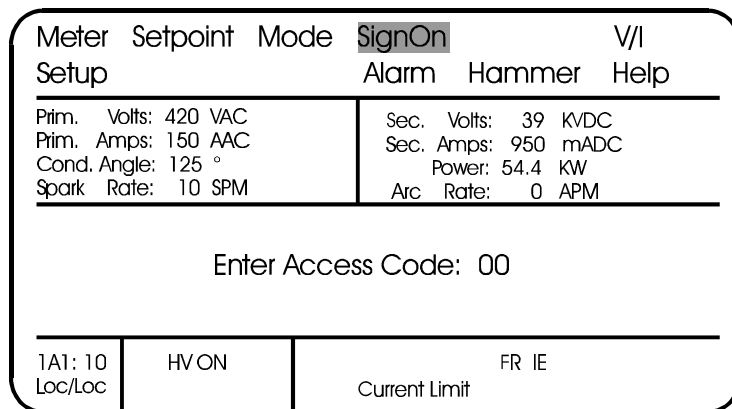
Once the GVC is plugged in, you may begin programming. Though we discuss the setup phase as if you are giving instructions to the DVC, you are, in reality, giving instructions to the Power Optimizer control module of the T/R set.

### Getting Into The DVC Mode

That control module will hold those instructions in memory and display values relative to your instructions on the DVC when it is reconnected.

1. Sign on to the GVC by entering your Entry Code as always. Scroll to the **Sign On** menu bar and 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 to reach the second number and push <Enter> (you will need a Level Three entry code to set all parameters.) .

You are now ready to enter values (See fig. 3-1)



*Fig 3-1*

1. Move to the Menu Bar at the top of the screen on your GVC.
2. Select the **DVC** designation.

3. Scroll through the main menu to the **Setpoint menu item** and press the <Enter> button on the GVC to move to the parameter entry window.

## Setting Upper Line Value Limits for the DVC

Once you have opened the parameter entry window, use the 4-way <arrow> buttons to arrive at each of the parameters to be set (VAC, AAC, KV, mA and KW). See fig. 3-2.

Meter Setup	Setpoint Rate/Cal	Mode DVC	Config Alarm	Count Hammer	V/I Help
Prim. Volts: 0	VAC		Sec. Volts: 0	KVDC	
Prim. Amps: 0.0	AAC		Sec. Amps: 0	mADC	
Cond. Angle: 0 °			Power: 0.0	KW	
Spark Rate: 0	SPM		Arc Rate: 0	APM	
VAC Low: 120	HI: 480		SPM: 50		
AAC Low: 100	HI: 300		APM: 25		
KV Low: 35	HI: 50		Line 2 VAL 1: Power		
mA Low: 500	HI: 1100		Line 2 VAL 2: Cond. Average		
Kw Low: 18	HI: 51		PERMISSIVES		
1A1 : 10 Loc/Loc	HV OFF		FR	ALARM	
			READINGS AT ALARM		

*Fig 3-2*

1. Set high and low setpoints for VAC, AAC, KV, mA and KW in turn.
2. Use the <+ Incr> and <- Decr> buttons on the GVC to adjust the upper and lower limits for each.
3. When you reach the acceptable value in each case, press the <Enter> button to record that value.
4. Follow the same procedure to set high limits for the (Spark Rate) and (Arc Rate) values.

These value limits will display on the upper line of the DVC when it is reconnected.

## Setting Lower Line Parameter Display on the DVC

You can use the GVC to change the two parameters that appear automatically on the lower line of the DVC display.

1. Go to the Line 2 options, using the same 4-way <arrow> keys as you used to get to the items in line 1.
2. Then, use the <+ Incr> and <- Decr> buttons to scroll through the options.
3. Press <Enter> when you have arrived at the selection you wish to make.

Note that the operator will see the parameters you select by default, unless he or she uses the <Arrow> keys to call up different readouts.

## Selecting Parameters that the Operator Can Change

The GVC allows you to designate two parameters whose values an operator can alter using a DVC.

Meter Setup	Setpoint Rate/Cal	Mode DVC	Config Alarm	Count Hammer	V/I Help
Prim. Volts: 0 VAC	Prim. Amps: 0.0 AAC	Cond. Angle: 0 °	Spark Rate: 0 SPM	Sec. Volts: 0 KVDC	Sec. Amps: 0 mA DC
CUR LIMIT: YES VOLT LIMIT: YES MANUAL COND: NO MANUAL MODE: NO IE MODE: NO			BC MODE: NO HV PWR UP: YES  RET TO DVC		
1A1 : 10 Loc/Loc	HV OFF		FR IE		

*Fig 3-3*

- Use the four-way <Arrow> buttons to arrive at the correct section of the screen. You may select “permissible” parameters from the entire list as follows:
  - Current Limit
  - Voltage Limit
  - Conduction Limit
  - Manual Mode On/Off
  - Manual Conduction Angle (when Manual Mode is On)
  - LE Mode On/Off
  - Back Corona On/Off
  - HV Power Up Off/Previous
  - (Comm Status Local/Remote will always be programmable)
- Scroll through the list using the appropriate <Arrow> buttons.
- Designate each item in turn as operator modifiable or non-modifiable by pressing the <+ Incr> button for “permissible” or the <-Decr> button for “not permitted”.
- In each instance, use the <Enter> button to record your choice after pressing the <+> or <-> button.

## Restoring the DVC

Once you have completed programming, follow these steps to disconnect the GVC and reconnect the DVC for normal T/R set operation.

1. Sign off — return to the Main Menu.
2. Use the <Enter> key to move to the parameter entry window.
3. Scroll to SIGN OFF and press the <Enter> key.

Disconnect the GVC from the Local port and reconnect the DVC attached to this T/R set to that same port.

Remember that you must program each DVC...one to a T/R set. The program parameters you have just inputted are not transferable to another T/R set because they are contained in the controller unit in the T/R set — not in the GVC.

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