
DSP Graphic Voltage Controller (GVC) User's Guide



Dwg. A132249

Revisions

Rev.	Date	Author	Description
0	11/19/10	FGS	Original
A	1/20/12	FGS	Included SD card, Rapper Board changes
B	12/28/12	FGS	Updated features current for DSP firmware V5.18 and Display firmware V5.13
C	1/19/15	FGS	Updated for use with new GDU



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

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WARNING! High Voltage!

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

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



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The Graphic Voltage Controller (GVC)

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

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

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

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

The Global Display Unit (GDU) is a 7" color touch screen display that makes programming and adjustments easier than ever. The GDU can be used as either a local display where it is monitoring only one unit, or as a network display where it can monitor multiple controls.

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

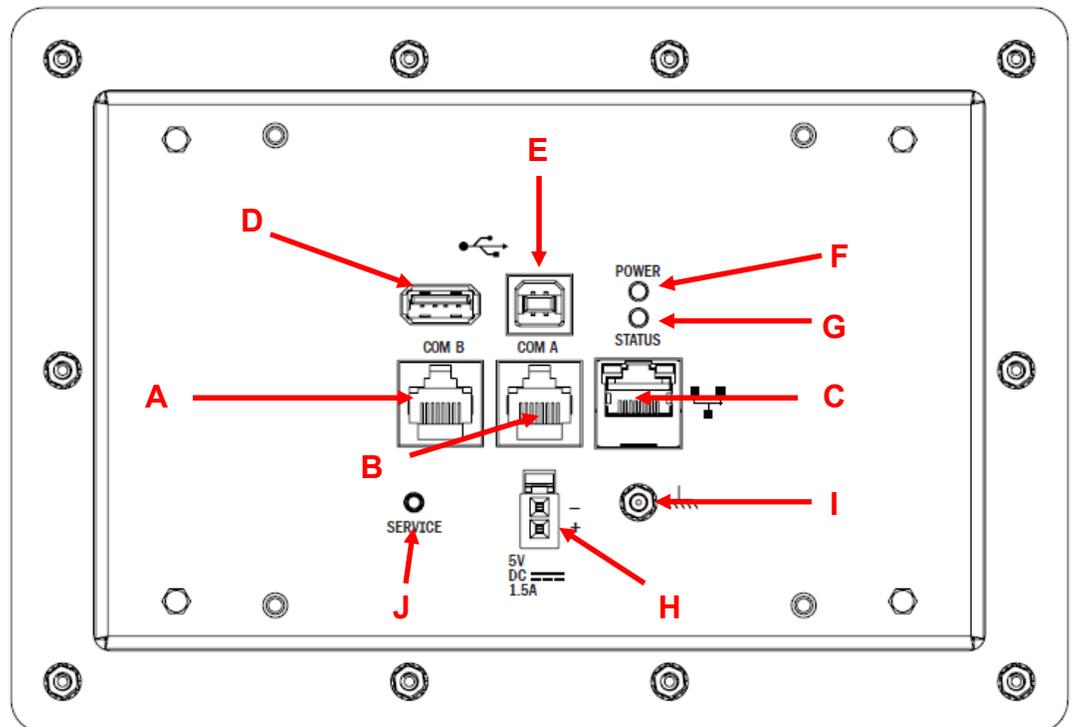
- spark and arc detection
- back corona detection and response
- comprehensive alarm provisions, including four user defined auxiliary alarms
- optional tumbling hammer control
- 24-hour trend plots
- 30-minute trend plots
- detailed 30-second trend plots
- high-voltage control

- setback offset
- current and voltage limiting
- automatic ramp rate adjustment for non-sparking conditions
- optional onboard fieldbus converter for communications with other host computers or your DCS.
- This latest version of the NWL GVC utilizes a digital signal processor (DSP) for faster waveform analysis and computational ability.
- Onboard SD card for storage of operating programs, system configuration, VI curves, and alarm logs.

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

Basics of Global Display Unit (GDU)

The main customer interface is the NWL Global Display Unit (GDU). The GDU is a stand-alone processor unit that operates the Windows CE operating system. It also incorporates a rugged 7" color TFT LCD and resistive touchscreen. There are two USB ports, two RS-485 serial ports (RJ45 connector), and a Ethernet port on the back of the unit. Below is a drawing of the back of the unit with all of the components and connections identified.



A - Com A: RS-485 port to be used for communicating with the GVC control. Display is powered by the 5 VDC within this cable.

B – Com B: RS-485 port for future use.

C – Ethernet port for future use

D – USB A 2.0 port for firmware upgrades and for exporting files via a USB flash drive.

E – USB B 2.0 port for NWL use only.

F – Power On LED

G – Status LED

H – External power connection (5 VDC, 1.5 amp)

I – Ground connection

J – Service pushbutton for NWL use only.

The Display

A glance at the GDU screen shows that it is divided into distinct sections.



- Across the top, the *Menu* bar lists display modes and functions that can be accessed by simply touching one of the boxes. The chosen box will have its name highlighted in red.
- Just beneath the menu bar is the specific window for the selected menu box.
- The bottom section of the screen displays the status of the unit being monitored. It shows the serial address, local/remote status, which port the display is connected to (local or network), the type of control board being monitored, the Unit identifier, and the control mode. It will show icons when the HV is on, the ESP



sparks or arcs, when a Limit condition occurs, or if an alarm occurs. It also contains buttons for the Help section, Sign ON, setting operating parameters, and HV Start and Stop.

Dim or Blank Screen

If the screen appears to be blank, the GDU may have turned off its illumination to extend screen life. To restore the display to full brightness, simply touch the screen. The display will stay at full brightness for a adjustable period of time after any key touch. Then it will go dark again.

Before Using the GVC

System Startup

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

If you are installing and starting up a complete control enclosure manufactured by NWL, the T/R ratings and calibration information have already been entered. The final calibration just needs to be verified.

If you retrofitted the GVC into an existing T/R control enclosure, you must enter the T/R ratings, calibration information, and perform the final calibration as outlined in Chapter 2 of this manual.

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

It is strongly recommended that the users familiarize themselves with the operation of the GVC by reviewing this manual prior to start-up and operation.

If there are any questions, please call NWL Technical Support at 1-800-PICKNWL.

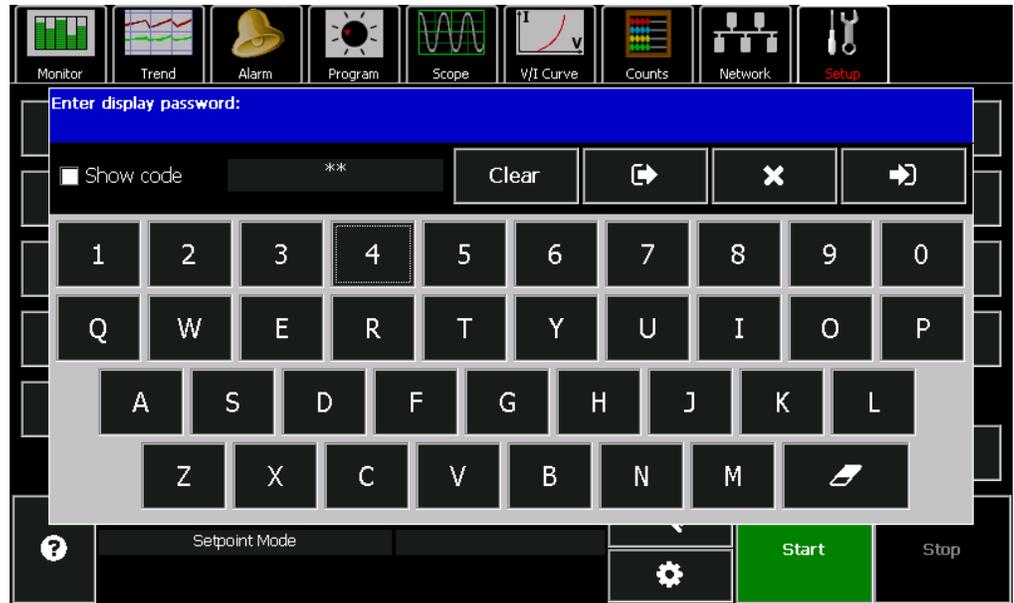
Configuring the GVC

Signing On

There are three levels of access for the user.

- Level 1 gives you the ability to monitor the operation of the GVC and view the process parameters, the process configuration parameters, and the mode parameters. You cannot make any changes to this parameters. You cannot view the GVC configuration (ratings, calibration/gains, etc.) in this level. This is the default level of access and no password is required for it.
- Level 2 gives you the ability to view everything that you could in Level 1 as well as the ability to change process parameters and mode parameters. Any of the configuration parameters cannot be changed. The default password for Level 2 is 11.
- Level 3 gives access to and complete control over all. The default password for Level 3 is 51. Passwords can be changed with Level 3 access.

To sign onto the GDU, press the key button  on the bottom section of the screen. The entry window on the screen that appears allows you to enter your access code.



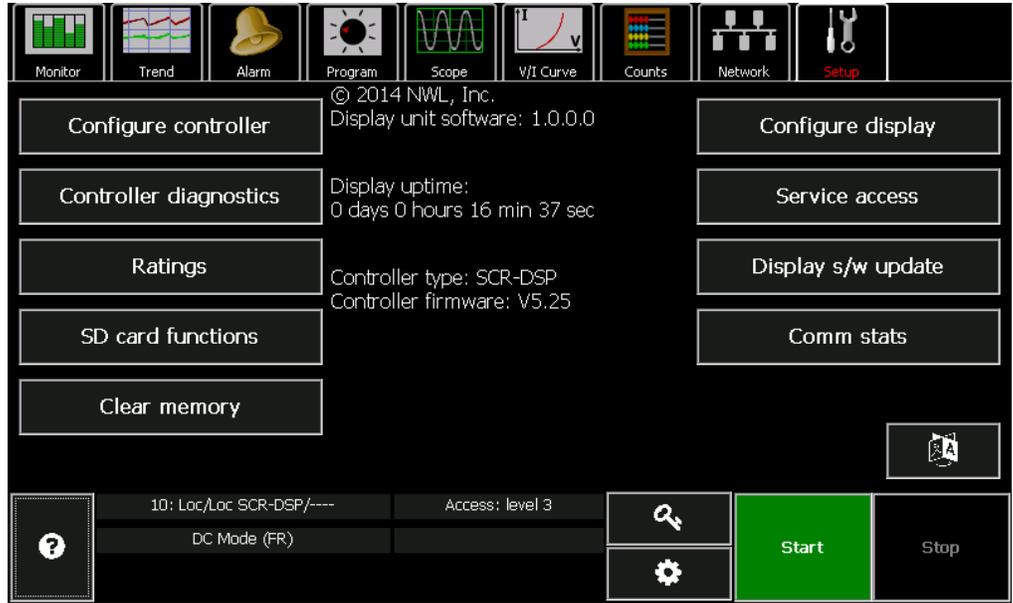
Type the password for the desired level of access. Press the  button to enter the password. You are now signed on to that level of access.

If in typing your password you make a mistake and need to erase a character, press the  button.

Language

The GDU is capable of displaying in several different languages.

To select a language, press the Setup  button on the top menu bar.



Next press the Language button



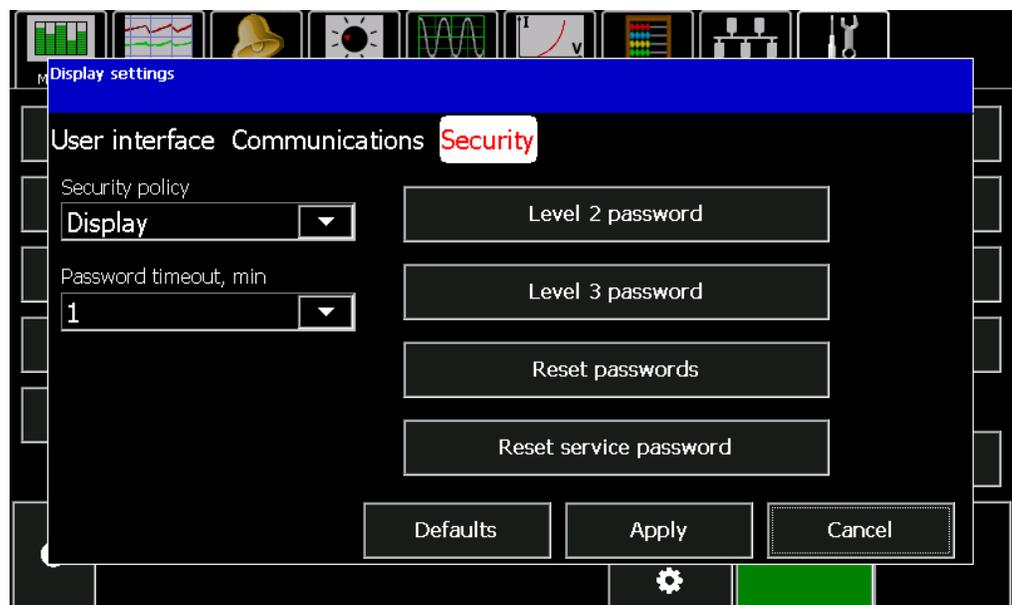
A roller display will appear. Pressing the country selection above or below the center highlighted area will cause the roller to go up or down one country at a time. Continue until the desired country is highlighted in the center of the roller. Press the **Close** button and the GDU will re-configure itself for that language. The re-configuration process involves a re-boot of the display will take a minute or so.

Security Policy

There are three different security policies within the GDU and the GVC. The system must be configured for one security policy.

To configure the security policy, press the Setup  button on the top menu bar.

Next press the **Configure display** button. On the next screen press the **Security** button.



The pulldown window on the **Security policy** parameter shows the following choices:

- Display:* In this mode the GDU uses passwords that are stored in the GDU. If the GDU is being used as a network display, only one sign on is required to access all the controllers on the network.
- Device:* In this mode the GDU uses passwords that are stored in the actual SCR controller. This selection is a little more secure and allows different passwords for different controllers. If the GDU is being used as a network display, you will have to sign on every time you try to access a controller with a different password.
- None:* In this mode no passwords are used. No sign on is necessary to view data or parameters or to make changes.

Password Timeout

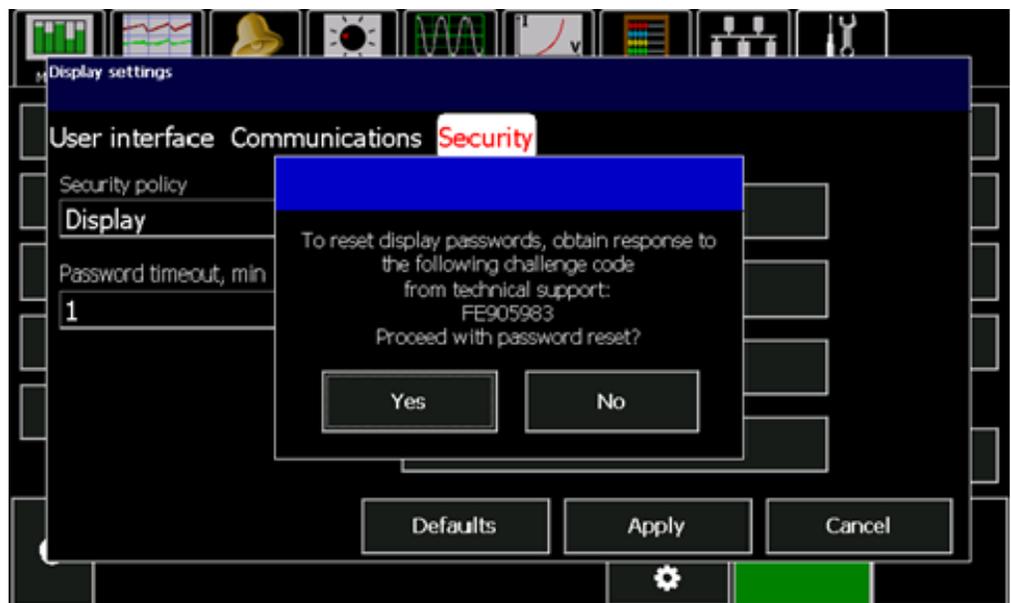
To protect against unauthorized tampering with ESP operation, the GDU will revert to Level 1 (view only) a defined time period after there is no keyboard activity. The default length of time is 5 minutes, but can be adjusted from 1 to 30 minutes using the **Password timeout** parameter in the **Security** tab of the **Configure display** section under **Setup**.

Assigning Passwords

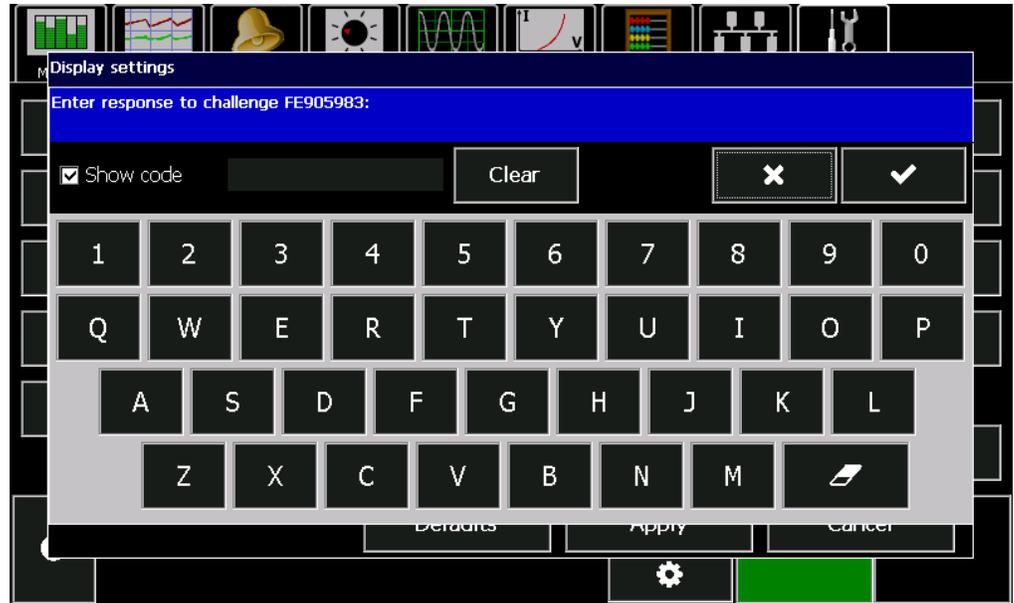
The method for assigning passwords will vary depending upon which security policy is selected.

If the *Display* option is chosen, the passwords are set using the *Level 2 password* and *Level 3 password* parameters in the **Security** tab of the **Configure display** section under **Setup**.

If you forget the passwords that are stored in the GDU and need to reset them to the default values, press the *Reset passwords* button in the **Security** tab of the **Configure display** section under **Setup**. A password is not required to access this button. A new window will be displayed that tells you to obtain a response to a given challenge code.

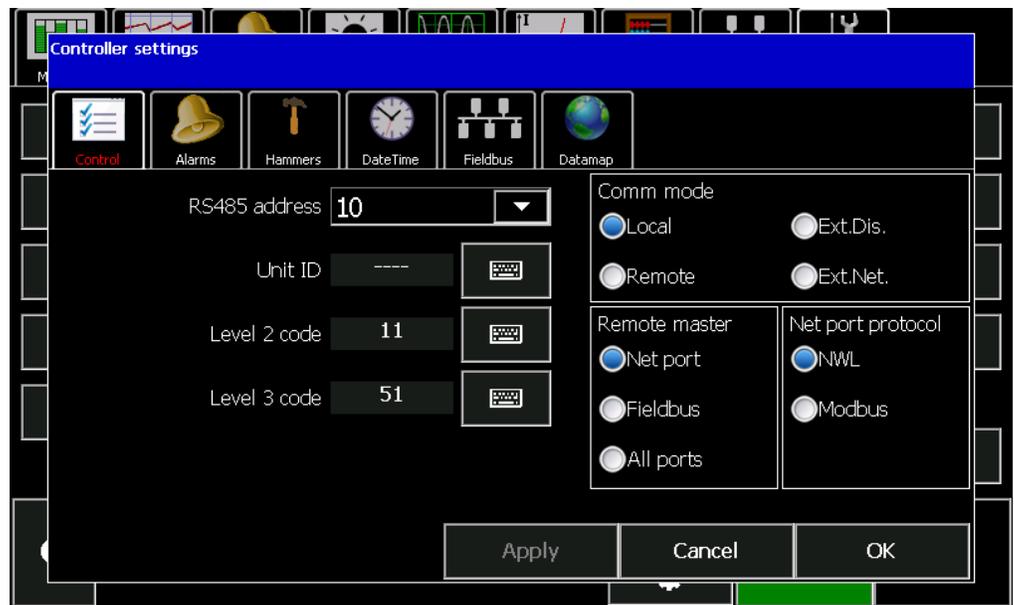


You must notify NWL with that specific challenge code and in return will be given the appropriate response. This response is then entered into the GDU and the passwords are reset to the default values.



If the *Device* option is selected, the passwords are set using the **Level 2 code** and **Level 3 code** parameters in the **Control** tab of the **Configure controller** section of the **Setup** menu bar.

Press the keyboard icon  and enter the desired password.



Signing Off

It is recommended that Level 2 and Level 3 users return the system to Level 1 (view only) when finished with any programming. Otherwise, an unauthorized user could make changes on the Display Module before the software "time out" function shuts the module down, thus changes could be made to crucial operating parameters.

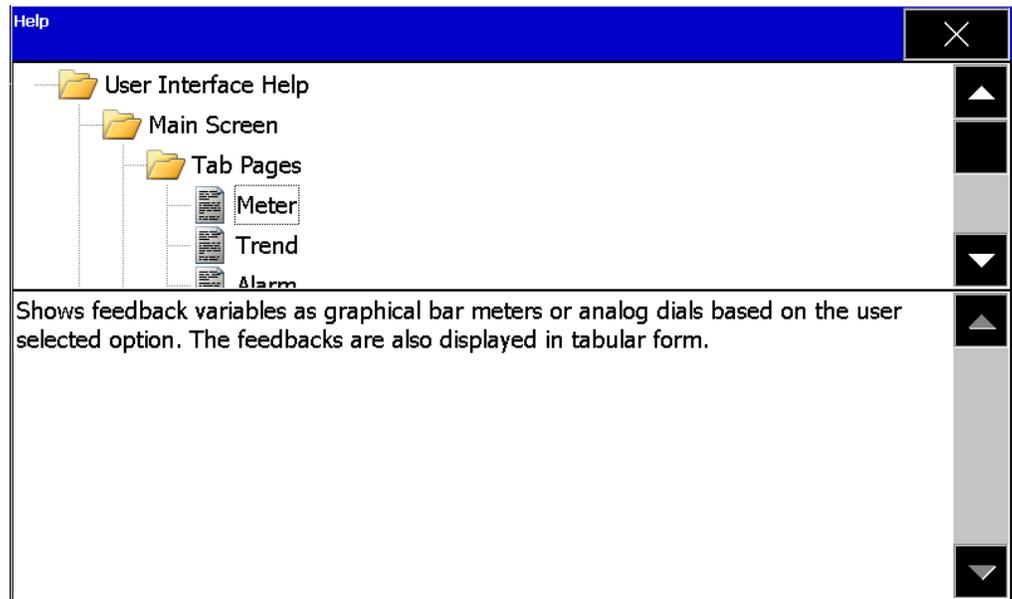
To sign off, press the  button to access the sign on screen.

Then press the  button to sign off.

Getting Help

The GDU has an on-screen help system that can answer many of your questions about accessing features and using the GDU efficiently.

To reach the help facility press the  button on the bottom section of the screen. The following Help menu will be displayed.



The top portion of the screen displays the Help directory. Double clicking on a directory will expand or collapse it. Touching a Help topic will display the Help text in the bottom portion of the screen.

Press the  button in the upper right corner of the screen to exit the Help menu.

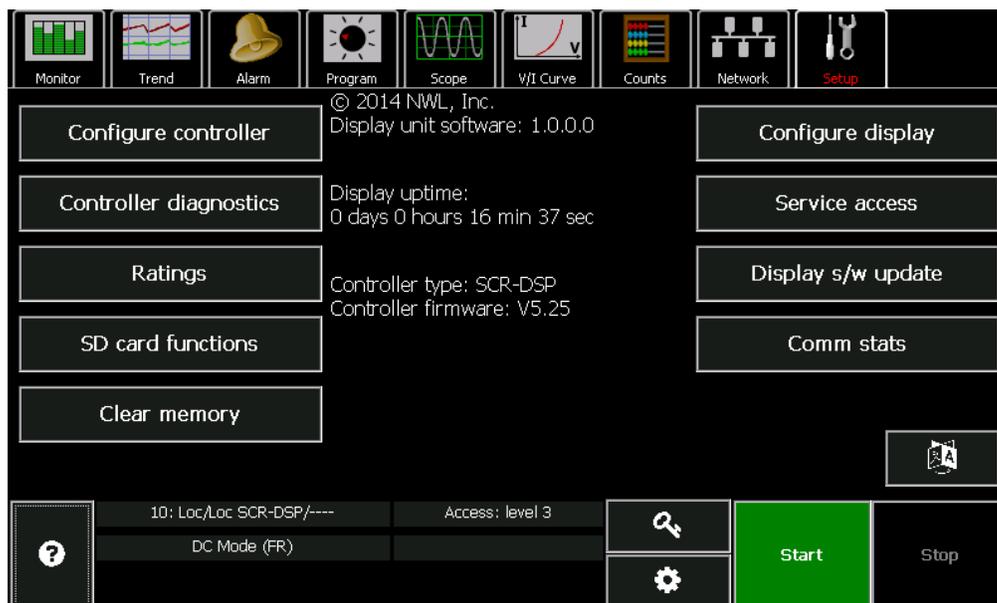
Local and Remote Functions

The display can monitor and control a single controller or a network of up to 90 units. Network operation offers more flexibility than single-unit use. On a network you can access any unit. The controller can also be configured to be used with an external Local/Remote switch for more flexibility in remote control options.

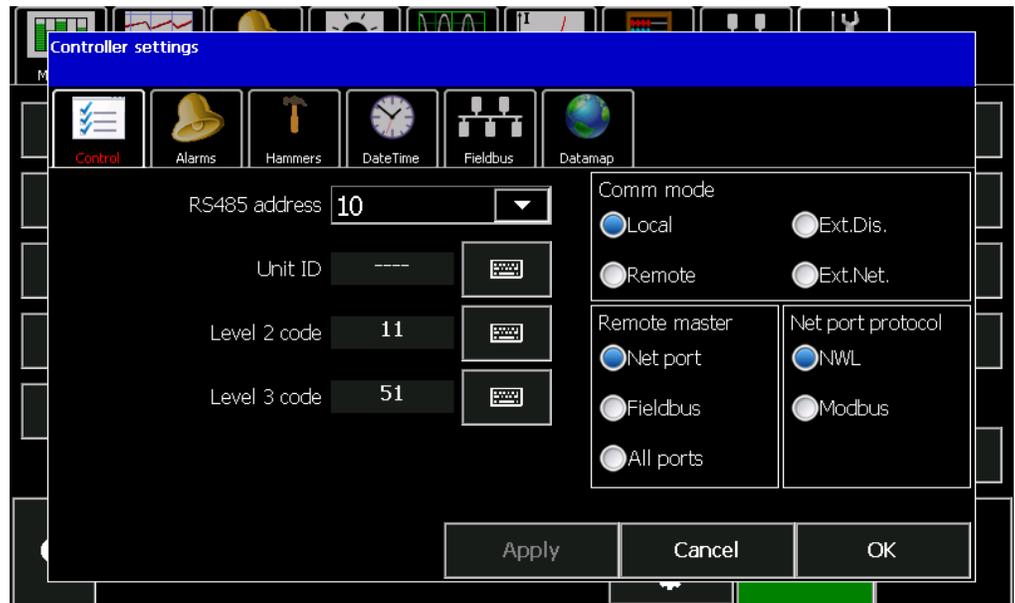
Local Operation

To use the GDU for monitoring and control of a single unit, make sure the display is connected to the local port. Sign On to the system and access Level 3.

Press the **Setup** Button  on the top Menu bar. The following screen will be displayed.



Next press the **Configure controller** button.



For Local operation, press the *Local* button in the **Comm mode** box of the **Control** tab

Other displays 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 to *Remote*.

For easy identification of the individual T/R controller units, a unique identifier of up to four characters can be entered in the **Unit ID**

parameter field by pressing keyboard icon  and entering the desired ID.

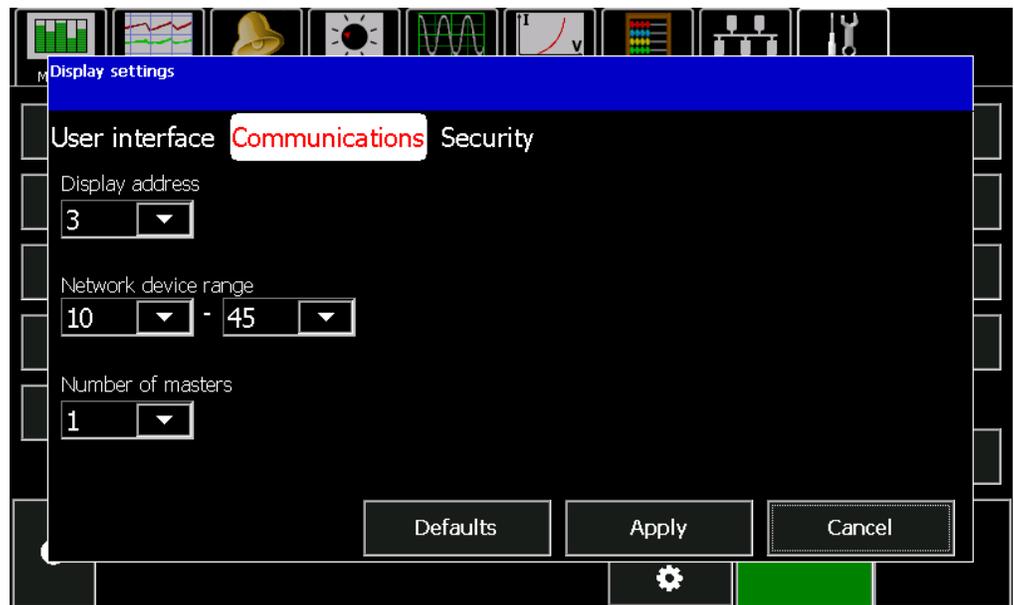
Make sure to press the *Apply* button for the controller to apply the changes and stay on the screen or the *OK* button to apply the changes and exit the screen.

Networking

The GVC controller is also capable of communicating on a NWL network. The “Network” port on the control module is an isolated RS-485 serial port. If a GDU is connected to any network port, it can access, monitor, and control any other controller on the network that has a valid network address.

Each controller and GDU on the network must have a unique RS485 address. The addresses are set in the same controller setting screen shown above. Use the **RS485 address** parameter to select a unique GVC address from 10 through 99. Addresses 3 through 9 are reserved for the network GDU.

The GDU address is set by pressing the **Configure display** button on the main setup screen, then pressing the **Communications** button on the Display settings screen.



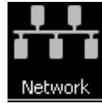
Choose an address between 3 and 9. The default is 3. If there will be multiple GDUs on the network, each one must have a unique address. You will only need to do this once for a given GDU. A maximum of four GDU's can be connected to the network port.

The controller addresses that are to be displayed on the network display screen must also be defined. The display range is set in the **Network device range** parameter. By entering the starting and ending addresses for your specific network, the GDU will only poll those units when on the **Network** screen.

If numerous master devices are present on the network, 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. A master device is defined as a network display, a PCAMS computer system, or a DCSi.

Make sure to press the **Apply** button for the controller to apply the changes and exit the screen.

Once the addresses have been setup, you can proceed to the Network screen to monitor all of the units on the network. To get to the Network screen, simply press the **Network**



button **Network** on the top menu bar. The following screen will be displayed.

ID	Device	kVDC	mADC	kW	Duty	SPM	APM	HV	Alarm
10	PPlus-DSP/TR10	0	0	0.0	0.00	0	0	Off	
11	PPlus-DSP/TR11	0	0	0.0	0.00	0	0	Off	
12	PPlus-DSP/TR12	0	0	0.0	0.00	0	0	Off	
13	SCR-DSP/TR13	0	0	0.0	0	0	0	Off	
14	SCR-DSP/TR14	0	0	0.0	0	0	0	Off	
15	SCR-DSP/TR15	0	0	0.0	0	0	0	Off	
16									
17									
18									
19									
20									
21									
22									
23									
24									

The first column will display the serial addresses of the units as defined in the previously entered Network Device Range parameter.

The next column displays the type of device associated with that address and the unit identifier. The possible types are:

- SCR-DSP: The current version of the conventional SCR controller with DSP technology.
- SCR: The older version of the conventional SCR controller prior to the use of a DSP.
- PPlus-DSP: The current version of the PowerPlus units with DSP technology.
- PPlus: The older version of the PowerPlus units prior to the use of a DSP.

The remaining columns display the kVDC, mADC, kW, Duty (or Conduction Angle), Sparks/min. (SPM), Arcs/min. (APM), HV and Alarm status. Units that are not on the network link or that are not communicating due to loss of line feed or other problems will only

display the address of the unit. The other columns will remain blank.

To select a specific unit to monitor in greater depth or to change operating parameters, press the row containing that unit so that it is highlighted. You can now press any of the other buttons on the menu bar to access the data/parameters for that specific unit..

Remote Operation

It's easy to monitor and control any unit on the network. Simply connect to the network port. The GDU will automatically display the **Network** screen. Simply press the row that contains the unit that you wish to monitor or control.

As long as the **Comm mode** (in the **Control** display of the **Configure controller** section of the **Setup** menu bar) is set to *Remote*, you can now change its parameters just as if the display was plugged into its local jack. Note that **Comm mode** (local or remote) can only be set from the local port.



When you set the **Comm mode** for a GVC to local or remote in the **Setup** you will not have full access to all GVC functions. Some are compatible with both local and remote control, but others are exclusive to one or the other. The table below shows the breakdown by mode.

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

ExtDis (External Discrete) Operation

This option should be selected if an external Local – Remote switch is to be used with an external discrete On signal. The PCAMS, DCSi, or a network GDU cannot turn the controller On or Off in this mode. However, other parameters can still be modified by the PCAMS or DCSi. Go to the **Control** screen. In the **Comm mode** box, press the *ExtDis* button. With this option the terminals functions are as follows:

Terminal 51 : 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 to change parameters is from the keypad/ display module in the local port. The network port or the external discrete turn on devices connected to Terminal 48 (Remote On) will not initiate any changes. If the unit is in Remote, the only way to energize the unit is by the external discrete devices connected to Terminal 48. The On/Off button on the keypad in the local port as well as the On/Off command from any other network device will not function. The other network devices will still be able to make changes to other control parameters. The Remote Enable function of Terminal 29 will still function as an electrical permissive in either Local or Remote.

Terminal 48 : This terminal will be used as the Remote On input. It is only functional when voltage is also applied to terminal 51, thereby placing the unit in Remote. When a sustained 120 VAC is applied, the controller will turn on. Removal of this maintained 120 VAC will turn the HV off. The unit will not turn on if 120 VAC is applied at terminal 48 (in Ext. Dis. Mode) and 120 VAC is not present at Terminal 51 (thereby putting the unit in Local).

Terminal 29: This terminal is used as the Remote Enable. 120 VAC must be applied to this terminal in order for the unit to operate, regardless of whether it is in Local or Remote. Removal of the 120 VAC from terminal 29 will turn the unit off. Re-applying the voltage will not turn the unit on again. If the user does not wish to use the ENABLE function, then it can be enabled all the time by connecting a jumper from terminal 28 to terminal 29.

If the unit is switched from Remote to Local, it will continue in the same state of energization. Meaning if the unit is Off in Remote, then switched to Local, it will stay off. If it is On in Remote, then switched to Local, it will stay on. However, if the unit is switched from Local to Remote, then the unit will follow the state of energization defined by the voltage on Terminal 48. If there is no



120 VAC applied, the unit will turn off. If there is 120 VAC applied, the unit will turn on.

ExtNet (External Network) Operation

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. Go to the **Control** screen. In the **Comm mode** box, press the *ExtNet* button. With this option the terminals functions are as follows:

Terminal 51 : 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 to change parameters is from the keypad/ display module in the local port. The network port or the external discrete turn on devices connected to Terminal 48 (Remote On) will not initiate any changes. If the unit is in Remote, the only way to energize the unit is by the network devices connected to the network port. The On/Off button on the keypad in the local port as well as the external discrete devices connected to Terminal 48 will not function. The Remote Enable function of Terminal 29 will still function as an electrical permissive (safety interlock) in either Local or Remote.

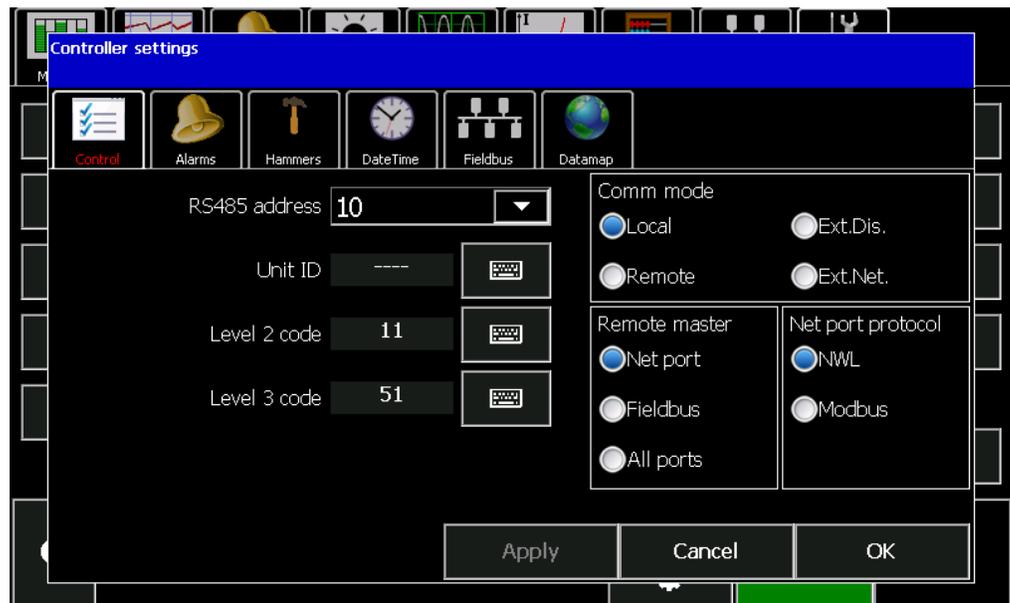
Terminal 48 : This terminal is not functional when in Ext.Net.

Terminal 29: This terminal is used as the Remote Enable. 120 VAC must be applied to this terminal in order for the unit to operate, regardless of whether it is in Local or Remote. Removal of the 120 VAC will turn the unit off. Re-applying the voltage will not turn the unit on again.

If the unit is switched from Remote to Local, it will continue in the same state of energization. Meaning if the unit is Off in Remote, then switched to Local, it will stay off. If it is On in Remote, then switched to Local, will stay on. If the unit is Off in Local, then switched to Remote, it will stay off. If it is On in Local, then switched to Remote, it will stay on.

Open Architecture Communications Using the Network Port

The network port is capable of being configured as Modbus RTU protocol. The **Net port protocol** parameter in the **Control** display of the **Configure controller** section of the **Setup** menu bar lets the customer choose which protocol will be used for the RS485 network port.



If *NWL* is selected, the network port will utilize the *NWL* proprietary protocol.

If *Modbus* is selected, the GVC converts the network port from the *NWL* proprietary protocol to a Modbus RTU protocol. In this case the control will not be able to communicate with other *NWL* network devices such as any network GDU, PCAMS, or DCSi. The Net Port parameter must be set to *NWL* for these devices to operate properly.

Optional Fieldbus Converter

If the controller has an optional field bus converter installed on the DSP board, the specific field bus will be designated in the **Fieldbus** display of the **Configure controller** section of the **Setup** menu bar. The type of module is automatically read and cannot be changed by the operator without changing the module.



There are other specific protocol parameters that also have to be configured.

Enter the appropriate data for each parameter by pressing the keyboard icon . Consult with your network administrator for the proper parameter values to be entered.

Press the *Apply* button for the controller to apply the changes and stay on the screen or the *OK* button to apply the changes and exit the screen.

The Fieldbus Configuration Screens will vary slightly depending upon the specific Fieldbus being used. The GVC is capable of supporting Ethernet IP, Modbus TCP, Modbus RTU, Profibus DPV1, Profinet, ControlNet, and DeviceNet protocols.

The optional Fieldbus converter is in reality a second network port. There is a parameter for defining which of these network ports will be the master port. The master port is designated as the port which accepts commands and parameter changes via a remote host. The **Remote master** parameter in the **Control** display of the **Configure controller** section of the **Setup** menu bar lets the customer choose which port will be the master.



The parameter choices are:

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

Fieldbus: When the **Comm Mode** is set to *Remote*, the fieldbus port will be able to read or write data to the controller. Any network device on the NWL network port will only be able to read data from the controller. It will not be able to write data.

All ports: When the **Comm Mode** is set to *Remote*, both the NWL network port and the fieldbus port will be able to read and write data to the controller. Note: This mode may lead to contentions on the network and in some cases may lead to parameter/mode settings being continually toggled back and forth as both ports attempt to gain control.

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

Go to the **Datamap** display of the **Configure controller** section of the **Setup** menu bar.

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

This screen allows you to define which parameters will be capable of being written to by the fieldbus device. Press the individual parameters to select or un-select your choice.



Installing the Optional Fieldbus Converter

If the T/R control enclosure was ordered with the optional fieldbus converter, it will be installed at the factory. However, if it was ordered as a retrofit kit the converter will be shipped loose and must be installed. If you need to replace the control module, the converter must be moved from the old control to the new control. To remove the old converter:

1. Remove the field wiring connector that plugs into the converter.
2. Turn the two screws on the front plate of the converter counter-clockwise to release the converter from the DSP board. A torx screwdriver is required.
3. Grab the sides of the converter and gently slide it out from the multi-pin jack.
4. Once removed follow the steps below to install it on the new board.

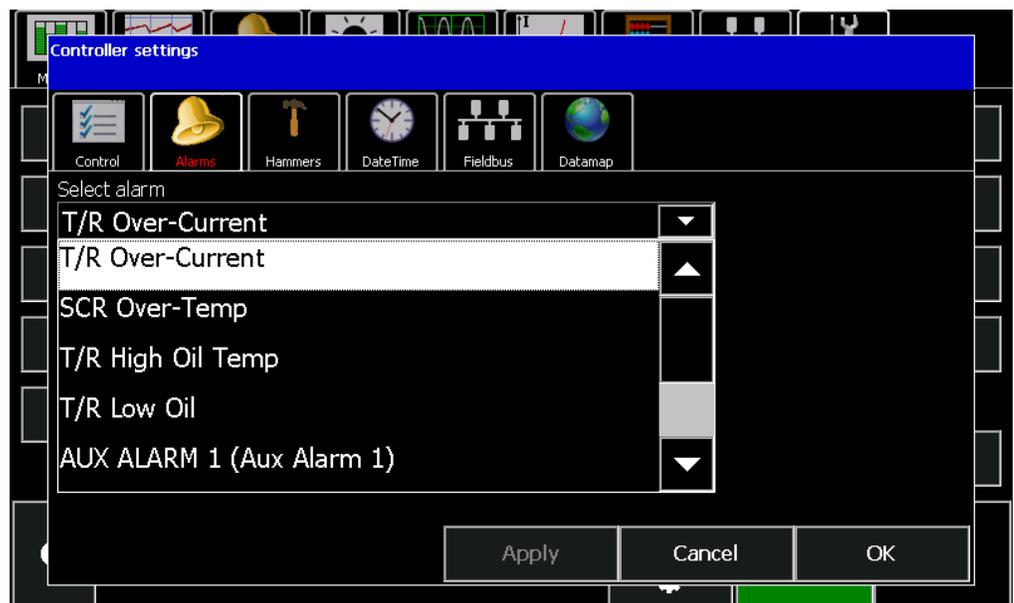
5. Make sure that the mounting feet on the module are fully retracted by turning the two screws on the front plate counterclockwise.
6. Carefully line up the module with the mounting rails of the jack. Slowly and carefully start to slide the module into the jack. **As the module approaches the pins in the back of the jack, stop and visually verify that all of the pins in the jack are properly aligned and entering the sockets in the module. If the pins are not properly aligned damage will occur to the jack on the DSP board.** If the pins are all aligned, continue to slowly push the module into the jack until it is fully seated.
7. Turn the two screws on the front plate of the module clockwise to secure the module to the DSP board.
8. The users wiring will then connect directly to the connector on the field bus module.

Alarm Configuration

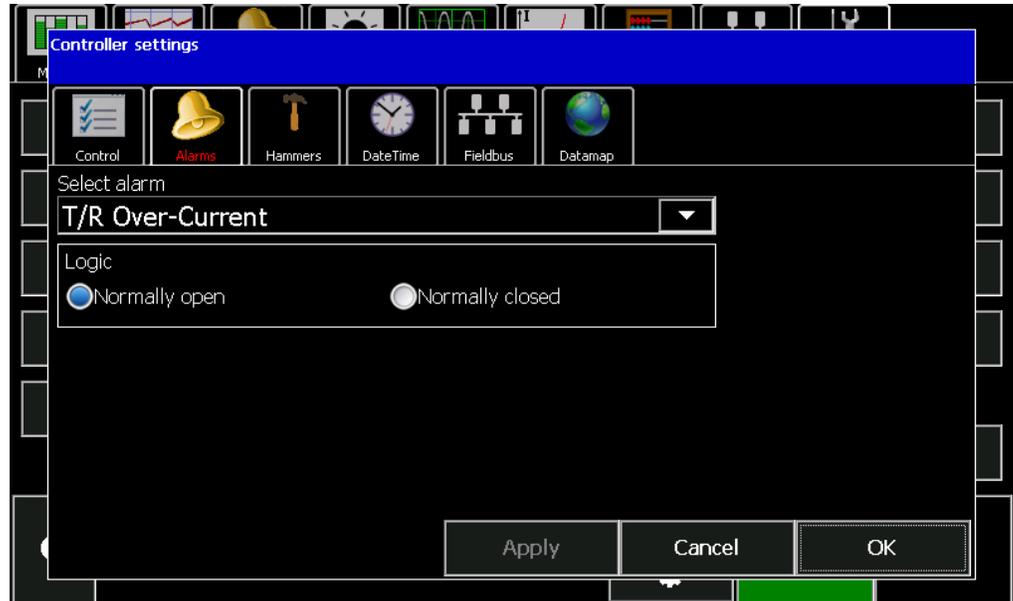
The standard alarms appear on the **Alarm** display screen under the **Configure controller** option of the **Setup** screen. They are:

T/R Over-Current	SCR Over-Temp
T/R High Oil Temp	T/R Low Oil

The alarms are configured by selecting the appropriate alarm from the *Select alarm* pull down option.



The alarms warn you of serious threats to precipitator operation, including potential damage to the T/R set. They are discrete alarms from external devices that are wired into the appropriate alarm input. The logic for each alarm must be configured.



Logic can be set to

- ◆ *Normally open*: A contact closure (or presence of 120 VAC on the alarm input terminals) will activate the alarm.
- ◆ *Normally closed*: A contact opening (or removal of 120 VAC from the alarm input terminals) will activate the alarm.

Type can be set to

- ◆ *Disabled*: ignores any signal at this input.
- ◆ *Display*: shows alarm but does not trip the contactor or a relay
- ◆ *Disp/Relay*: takes the preventive measure of tripping a relay in addition to indicating results
- ◆ *Disp/Relay/Contactor*: adds the capability of de-energizing the power supply by opening the contactor under the specified condition as well as tripping a relay and displaying an alarm

Auxiliary Alarm Configuration

You can add up to four auxiliary alarms to suit your system and procedures. Auxiliary alarms are completely user-definable and configurable.



To advance through the auxiliary alarm configuration pages select the appropriate one from the pulldown list. 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 but specific ID (i.e. : Fan Failure, Penthouse Temp., etc.), press the keyboard icon , and type in the desired name on the keyboard that appears. Press the submit button when done.

Then set up each parameter as described below.

Logic can be set to

- ◆ *Normally open*: A contact closure (or presence of 120 VAC on the alarm input terminals) will activate the alarm.
- ◆ *Normally closed*: A contact opening (or removal of 120 VAC from the alarm input terminals) will activate the alarm.

Type can be set to

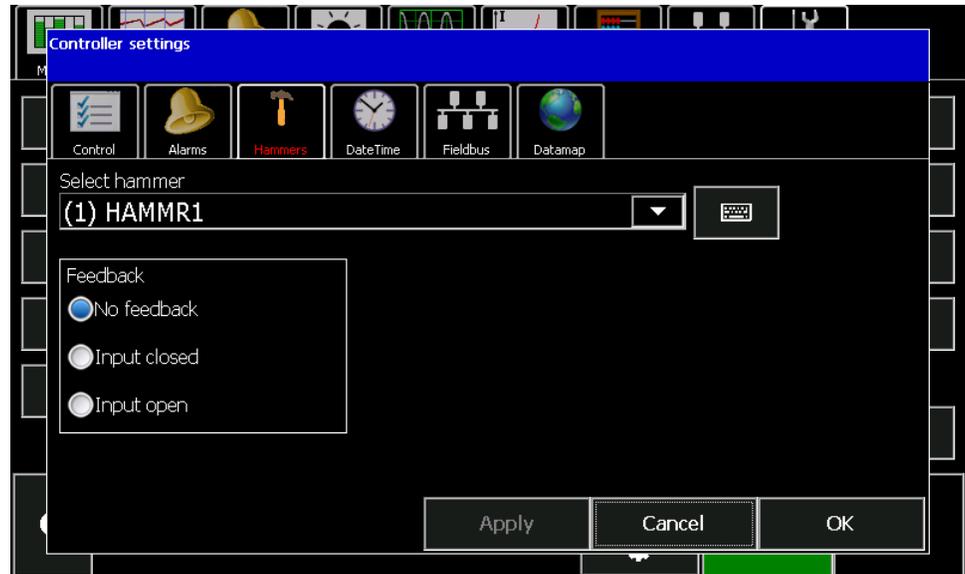
- ◆ *Disabled*: ignores any signal at this input.
- ◆ *Display*: shows alarm but does not trip the contactor or a relay
- ◆ *Disp/Relay*: takes the preventive measure of tripping a relay in addition to indicating results
- ◆ *Disp/Relay/Contactor*: adds the capability of de-energizing the power supply by opening the contactor under the specified condition as well as tripping a relay and displaying an alarm
- ◆ *Reduced kVDC*: When the input contact is closed (or opened, depending on the configuration) the output kVDC will be reduced to a 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.

When this option is selected an additional control panel will appear to set the Reduced kVDC level that you wish to reduce to when the input contact is closed (or opened, depending on the configuration). Range is 0 – 99%.

- ◆ *Clear alarm input*: When the input contact is closed (or opened, depending on the configuration) the active alarm will be cleared.

Rotating Hammer Rapper Configuration

The GVC can also be configured to operate up to four rotating hammer style rappers with the optional hammer control board. The optional board provides four outputs rated at 120/240 VAC @ 3 A. These outputs are configured by going to the **Hammers** display.



Start by selecting the appropriate hammer output from the **Select hammer** pulldown list. To give each hammer output a unique but specific ID, press the keyboard icon , and type in the desired name on the keyboard that appears. Press the submit button when done.

Next select the **Feedback** logic to be used.

No feedback - The Display Module will not monitor the rotating hammer feedback input.

Input closed - The Display Module will verify the rotating hammer input closes during hammer energization and opens during hammer de-energization. If this condition is not satisfied, the Display Module will indicate a hammer feedback alarm. The high voltage contactor is not affected.

Input open - The Display Module will verify the rotating hammer input opens during hammer energization and closes during hammer de-energization. If this condition is not satisfied, the Display Module will indicate a hammer feedback alarm. The high voltage contactor is not affected.

Date/Time

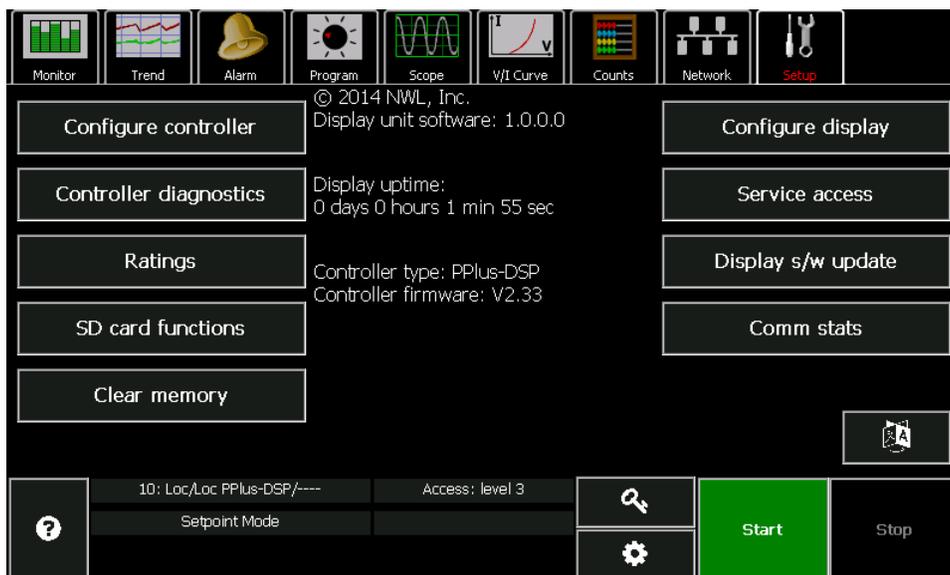
The Date and Time are used when logging events to the SD card. They can be viewed by pressing the **DateTime** button.



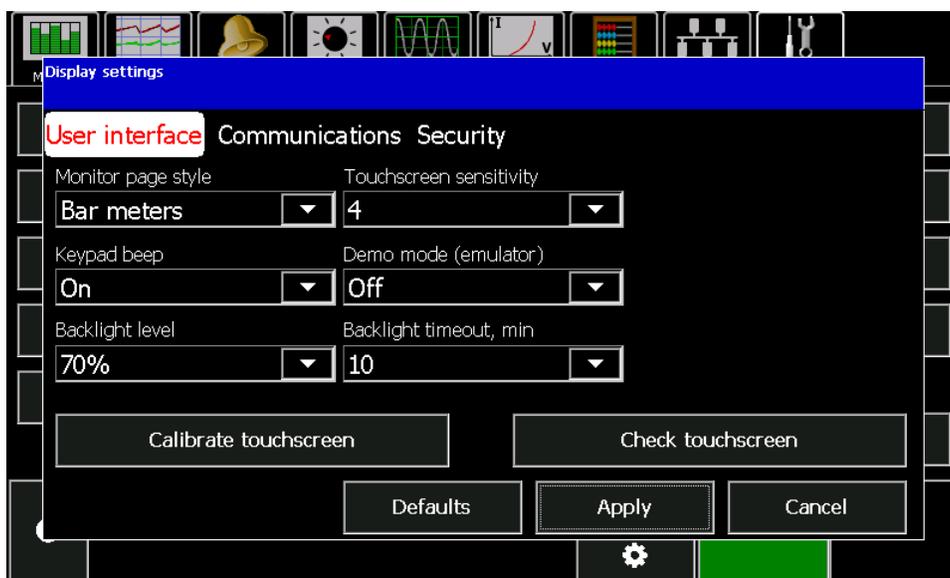
To edit the date or time, press the *Change* button then use the raise or lower arrows to enter the proper values. Press the *Apply* button when complete.

Display Settings

The Display Settings can be accessed by pressing the **Setup** button on the main menu bar.



Next press the **Configure display** button.



Make sure that the **User interface** button is highlighted by pressing it.

The parameters are:

Monitor page style:

Bar meters – Will display the metering values in a bar graph format on the **Monitor** screen.

Circular meters – Will display the metering values in a circular (analog) meter format on the **Monitor** screen.

Keypad beep: Lets you select whether the keyboard/display will sound a signal each time you touch the screen.

Backlight level: Lets you adjust the backlight intensity of the screen. It adjustable in 25% increments up to 100%.

Touchscreen sensitivity: Lets you adjust the how sensitive the screen is to touch. It is adjustable from 1 (min) to 5 (max).

Demo mode: Lets you configure the display in a demo mode for training purposes. If in the demo mode, the display will not communicate with the GVC and any displayed values or parameters are emulated. **The demo mode must be turned off for proper operation of the GVC.**

Backlight Timeout: This field determines how long the Display Module will continue to illuminate after keyboard activity stops. When the time is up, the screen "blanks", the back-light goes out and you can no longer read the display. This feature is will extend the service life of the display. The adjustment is from 1- 30 minutes.

Calibrate touchscreen: This feature performs a calibration of the touchscreen by having you press and hold a stylus on a crosshair target as it moves around the screen. It is recommended that some sort of stylus be used instead of a fingertip as it will provide a more accurate contact point.

Check touchscreen: This feature allows you to check the calibration of the touchscreen. As you press the stylus on various areas of the screen, a red dot will appear under the stylus at the point of contact. As the stylus is moved a line will appear. The line should track the point of contact of the stylus. If it does not, the touchscreen should be re-calibrated.

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System Checkout and Energization

Ratings Verification

Press the **Ratings** button on the **Setup** display on the menu bar. The following screen will be displayed.



This screen shows the electrical ratings for the unit. These ratings must be correct to allow the control to maintain operation within safe values.

V AC: This is the primary voltage rating of the T/R set.

A AC: This is the primary current rating of the T/R set.

kVDC: This is the kVDC rating of the T/R set.

mADC: This is the mADC rating of the T/R set.

Verify that the ratings agree with the T/R nameplate. If they are not correct, press the parameter to be adjusted and then use the +/- 1, 10, or 50 buttons in the bottom left of the screen to change the value by that amount.

The gain adjustments are used to calibrate the meter readings. The A system calibration should be performed only the T/R and controller are installed and energized. A complete procedure is given in a later section of this manual.

There are two other pages that contain other settings required for the system calibration. Press the number **2** button at the top of the screen.



VAC Turns Ratio: This is the ratio of the primary metering transformer being used to measure the primary voltage at the T/R set. This transformer is usually located in the control enclosure.

AAC Turns Ratio: This is the turns ratio of the current transformer being used to measure the primary current of the T/R set. This CT is usually located in the control enclosure.

Volt Div High Res: This is the value of the high voltage divider resistor being used to measure the KVDC. This resistor is usually located in the T/R tank.

Volt Div Low Res: This is the value of the low voltage KVDC feedback resistor that is in series with the above referenced high voltage divider. It can be located in either the T/R junction box or in the control enclosure.

Press the parameter to be adjusted and then use the +/- 1, 2, or 3 buttons in the bottom left of the screen to change the value by that amount.

When complete press the number **3** button at the top of the screen.



Sec Current Shunt: This is the value of the mADC feedback resistor that is used to measure the T/R output current. It can be located in either the T/R junction box or in the control enclosure.

kV Spark Sensit: This is the spark sensitivity adjustment based on the kVDC feedback. It should initially be set for *High*.

mA Spark Sensit: This is the spark sensitivity adjustment based on the mADC feedback. It should initially be set for *High*.

Arc Sensitivity: This is the arc sensitivity adjustment based on the mADC feedback. It should initially be set for *High*.

Once all of the parameters have been confirmed and/or adjusted press the **OK** button to return to the **Setup** screen.

RS485 Address (optional)

Use this parameter only if the controller will be connected to a central computer using the NWL PCAMS software, a network Display Module, or a DCSI on the network port.

Go to the **Control** screen in the **Configure controller** section of the **Setup display** on the menu bar.



Use the *RS485 address* parameter to select a unique address from 10 through 99. Start with the *Comm mode* set to Local. Press OK.

Start-up

The system is now ready to be energized. The following procedure should be followed to insure that there are no problems with the ESP or the connections to it.

1. Start by temporarily disabling the Undervoltage (U.V.) trip by setting the U.V. Trip setpoint to 0 kV.

Press the Operating Parameter Settings button  located below the Sign On button and next to the HV On button on the bottom section of any of the menu bar screens.

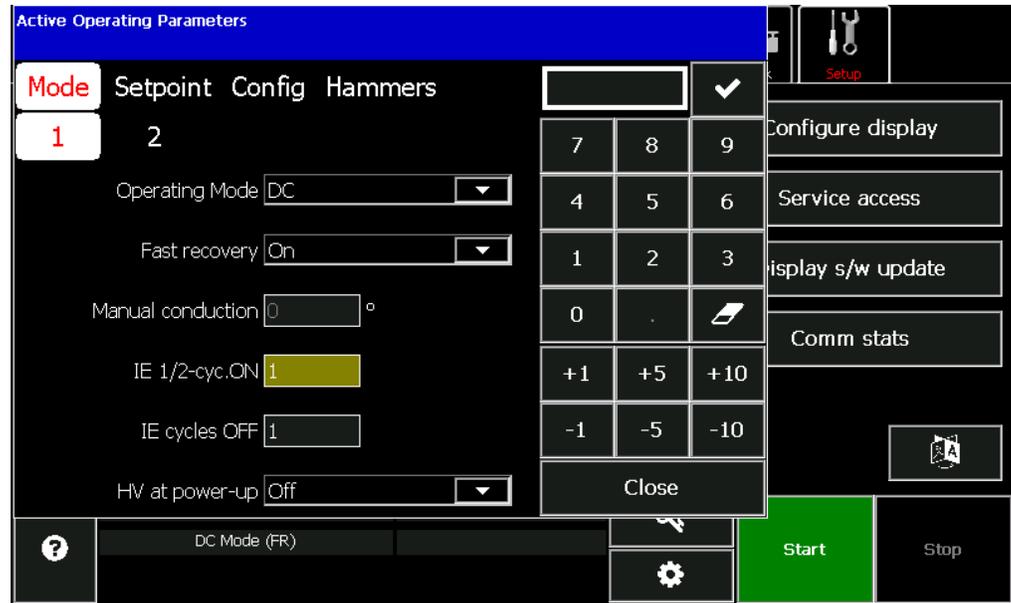
On the next screen press the **Setpoint** button. Go to page two by pressing the **2** button.



Highlight the U.V.Trip parameter value by touching it. Using the keypad on the right side of the screen press 0 and then press the  button to enter the value. Close the window.

2. Next put the system in manual mode. Press the Operating Parameter Settings  button located below the Sign On button and next to the HV On button on the bottom section of any of the menu bar screens.

On the next screen press the **Mode** button.



Using the pull down button next to the **Operating Mode** parameter, select *Manual* mode. Press the **Close** button.

The status section at the bottom of the menu bar screens should now display *Manual Mode*.

3. The system is now ready to be energized. The output will be increased manually to verify that no problems exist within the ESP and to limit the output levels until the metering calibration can be verified.
4. Next go to the **Monitor** screen on the menu bar.
5. Press the Green *Start* Button. The main contactor will energize and the HV On icon  will be displayed at the bottom of the screen. The *Start* button will also change color from green to black and the *Stop* button will change color from black to red indicating that the unit is on. Since the controller is in the manual mode awaiting the increase command, all of the meter readings should be zero.
6. Then return to the **Mode** screen shown above. The meter readings table should be visible to the right of the **Mode** screen. This table will be used to monitor the operation of the T/R set while in the Manual mode.
7. Press the **Manual conduction** parameter box to highlight it.
5. Press the  button on the keypad several times to increase the conduction angle while monitoring the meter readings. The

meters should all start to increase. If the current meters increase very quickly, but the voltage meters don't, there may be a short in the load. If the voltage meters increase quickly, but the current meters don't, there may be an open in the load. Turn the HV OFF and correct the problem.

6. If all of the meters increase properly and the system has been calibrated, return the **Operating Mode** to the *DC Mode* (Automatic).

Calibration

Calibration is best performed while there is no sparking activity in the precipitator. If the display indicates sparking is taking place, place the controller in the Manual mode and lower the **Conduction angle** until the sparking stops. You can now fine-tune the digital readings to take into account resistor tolerances, wiring runs, and other factors in your T/R set. This will yield much more accurate readings and T/R set control.

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

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

Press the **Ratings** button on the **Setup** display on the menu bar. The following screen will be displayed.



This screen shows the electrical ratings for the unit. These ratings must be correct to allow the control to maintain operation within safe values.

Make sure that the ratings and other calibration factors are correct per the Ratings verification section of this manual.

Watch the digital readouts in the Act. (Actual) column on the display. These are the real time readings that the GDU will display based on the current feedback levels. Compare them to reference meters (external meters such as a calibrated multimeter or ammeter) as you adjust settings on this screen. By adjusting the values of the Gain parameters you are adjusting the digital readings on the display. The default gain is 50. A gain of 0-49 is a negative gain. A gain of 51-99 is a positive gain. Raising the gain will increase the displayed meter value.

1. Start with **V AC Gain** and adjust it with the  and  buttons until VAC value in the Act column matches the VAC reference meter. This reference meter is usually an external RMS voltmeter placed across the T/R primary.
2. Adjust **A AC Gain** until the AAC value in the Act column matches the AAC reference meter. This reference meter is usually an RMS clamp-on ammeter on one of the main 480 VAC current carrying lines in the controller.
3. Adjust **kV DC Gain** until the kVDC value in the Act column matches the kVDC reference meter. This reference meter is usually a VDC meter placed across the low end resistor of the voltage divider network. The proper scaling factor must be applied to this reading to obtain the measured kVDC. The scaling factor is the ratio of the Voltage Divider High Resistor/Voltage Divider Lo Resistor. Example: If you read 5 VDC across a 10K low resistor used with an 80 meg high resistor, the GDU should display $5 \times (80/10) = 40$ kVDC.
4. Adjust the **mA DC Gain** until the mADC value in the Act column matches the mADC reference meter. The reference meter is usually a VDC meter placed across the mADC shunt resistor. The proper scaling factor must be applied to obtain the measured mADC. The scaling factor is the VDC measured across the mA shunt resistor divided by the resistance of the mA shunt. Example: If you read 5VDC across a 10 ohm mA shunt resistor, the GDU should display $5\text{VDC}/10 \text{ ohm} = .5$ amps or 500 mADC.

The GVC is now calibrated for the most precise display and safest control of your T/R set's power output. The above configuration should be saved to the SD card for future reference. If the control

electronics module is replaced, or if the memory is cleared, these gain settings will be re-loaded to return the system to calibration. The procedure for saving the configuration is explained in the SD card section of this manual.

Starting Automatic Control

The GVC is now fully checked out and calibrated. To start automatic operation:

1. Press the Operating Parameter Settings  button located below the Sign On button and next to the HV On button on the bottom section of any of the menu bar screens.

On the next screen press the  button.

2. Using the pull down button next to the **Operating Mode** parameter, select *Setpoint* mode. Press the **Close** button.
3. The status section at the bottom of the menu bar screens should now display *Setpoint Mode*.

The output of the GVC will now automatically increase until one of the following occurs:

- A Spark indication  appears at the bottom of the display.
- The T/R reaches its secondary current limit .
- The T/R reaches its secondary voltage limit .
- The Controller reaches maximum Conduction Angle limit .

The display will now show the GVC operating automatically.

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Monitoring the System

Metering Display

Monitoring begins with the **Monitor** screen on the menu bar. This display contains a bar chart with accompanying numeric readouts.



1. V AC displays the primary voltage of the T/R set.
2. A AC displays the primary current of the T/R set.

3. *Conduction °* displays the conduction angle in degrees of the SCR's in the controller.
4. *KW* displays the output power in kilowatts.
5. *mA DC* displays the load current going to the precipitator section.
6. *kV DC* displays output voltage level to the precipitator section.

The red line on the bar meters designates the rating (or maximum value) of the T/R set. If the reading goes above rating, that portion of the bar graph will be displayed in red. The kVDC bar graph also has a lower line that indicates the setting of the UV (Undervoltage) trip parameter. If the kVDC reading goes below this line the bar graph will be displayed in orange.

The table to the right of the bar graphs also displays some additional metering values.

SPM displays the sparks per minute that are occurring in the precipitator section.

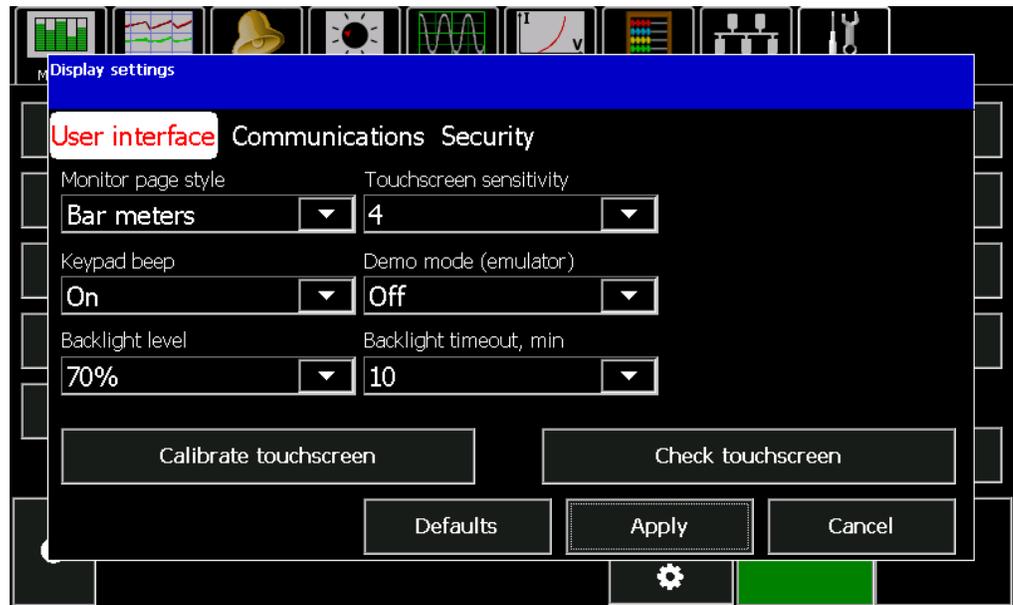
APM displays the arcs per minute that are occurring in the precipitator section.

kV peak displays the peak value of the kV waveform.

kV prod display the kV product which is the kVDC x kVpeak and is an indication of ESP performance.

Circular Meter Display

There is an option to display the metering values as a circular or analog style meter instead of a bar meter. To exercise this option, press the **Configure display** button on the **Setup** screen on the menu bar.



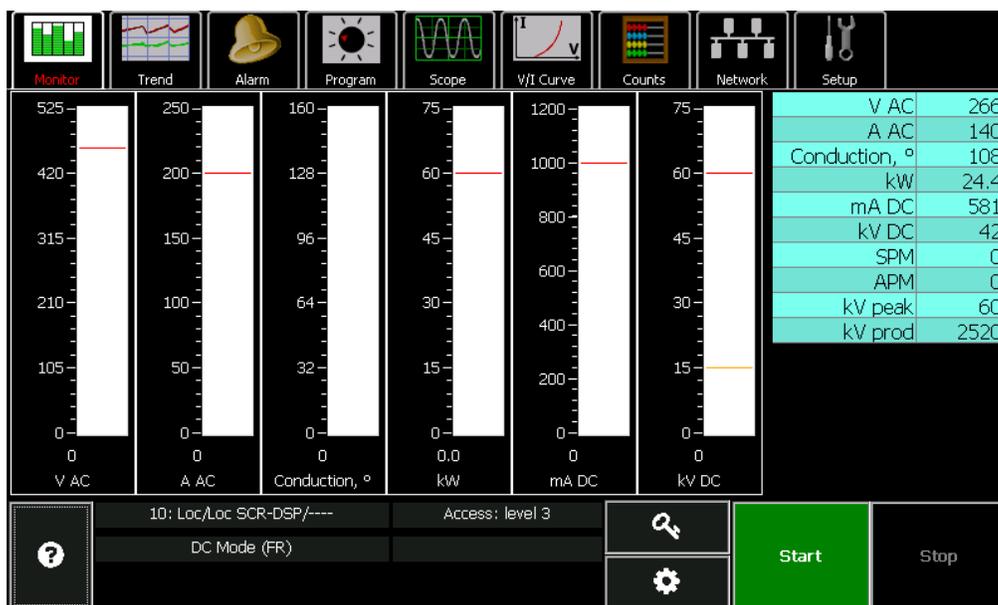
Select *Circular meters* from the pulldown options for the *Monitor page style* parameter. Press the **Apply** button and wait for the display to reboot. Then return to the **Monitor** screen from the menu bar.



The red portion of the meters indicate operation at values that are exceeding the rating of the unit. The orange portion of the kVDC meter indicates operation below the UV trip point.

Capturing the Meter Display

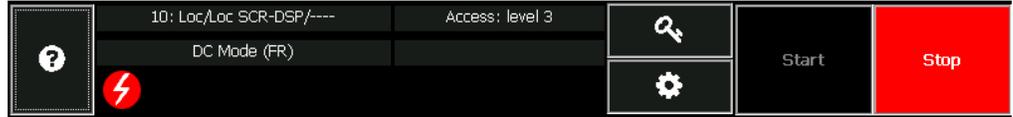
Since the GVC is often responding to and recovering from a spark and/or arc within the precipitator, the metering values are usually fluctuating. This makes the recording of these values a little challenging. The meter readings contained in the table can be captured at any point in time by pressing the table to the right of the meters.



Once captured, the bar graphs or analog meters will continue to show the real time values. Pressing the table again will return it to the real time monitoring mode.

Status Section

The area just under the meter displays is used to show the status of the system.



The top portion indicates the address of the unit being monitored, whether the unit is in Local (*Loc*) or Remote (*Rem*) mode / whether the display is connected to the Local (*Loc*) or Network (*Net*) port, and the unit ID. The active access level is also shown as well as the mode of operation.

The bottom portion shows icons that give a graphical indication of the events occurring. They icons are:



HV On



A Spark has been sensed



An Arc has been sensed



An Alarm has occurred



The unit is in Current limit and the output current is being held to a preset value.



The unit is in Voltage Limit and the output voltage is being held to a preset value.



The unit is at maximum conduction angle and the duty cycle is being held to a present value.



The unit is in the process of generating a V/I curve and the output may be reduced.



The unit is in the process of performing a Back Corona check and the output may be reduced.



The unit has determined that Back Corona exists and is holding the operating levels to the knee of the V/I Curve.



The rotating hammer rapper output #1 is energized. Similar icons for rotating hammer rapper outputs #2, #3, & #4 also exist.

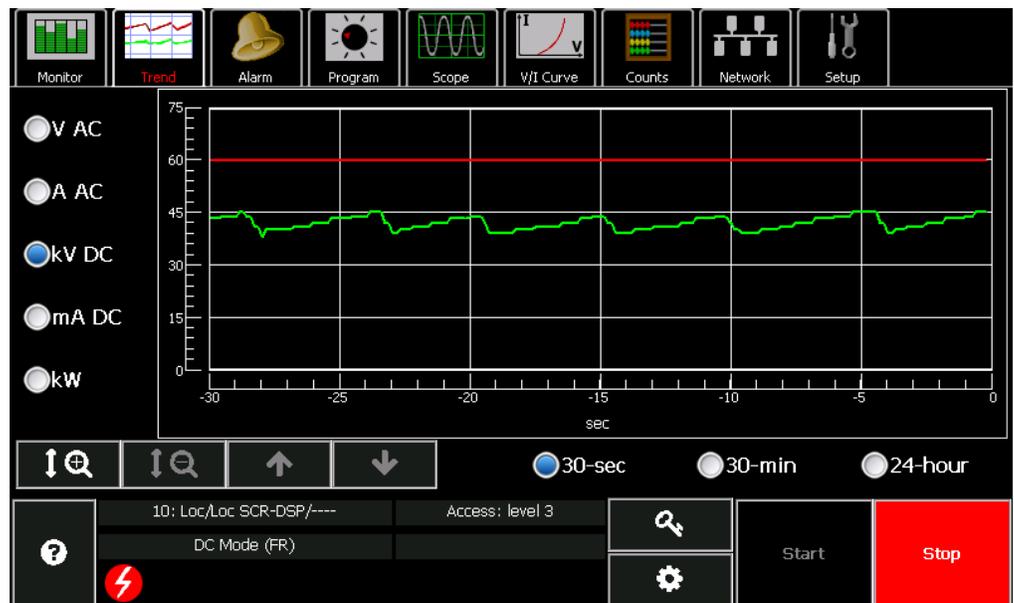


The display is not communicating with the GVC.

Trending

The GVC can track trends in precipitator performance automatically. This provides the ability to manage ESP performance better by identifying the conditions that cause performance changes.

To access the trends, press the **Trend** button on the main menu bar.



Select one of the following trends by pressing the desired button on the left side of the screen.

- **VAC**, to trend primary voltage
- **AAC**, to trend primary current
- **KVDC**, to trend output voltage
- **MADC**, to trend output current
- **KW**, to trend secondary output power.

The time view can be selected by pressing the desired button for *30 sec.*, *30 Min.*, or *24 Hrs.* located under the trend graph.

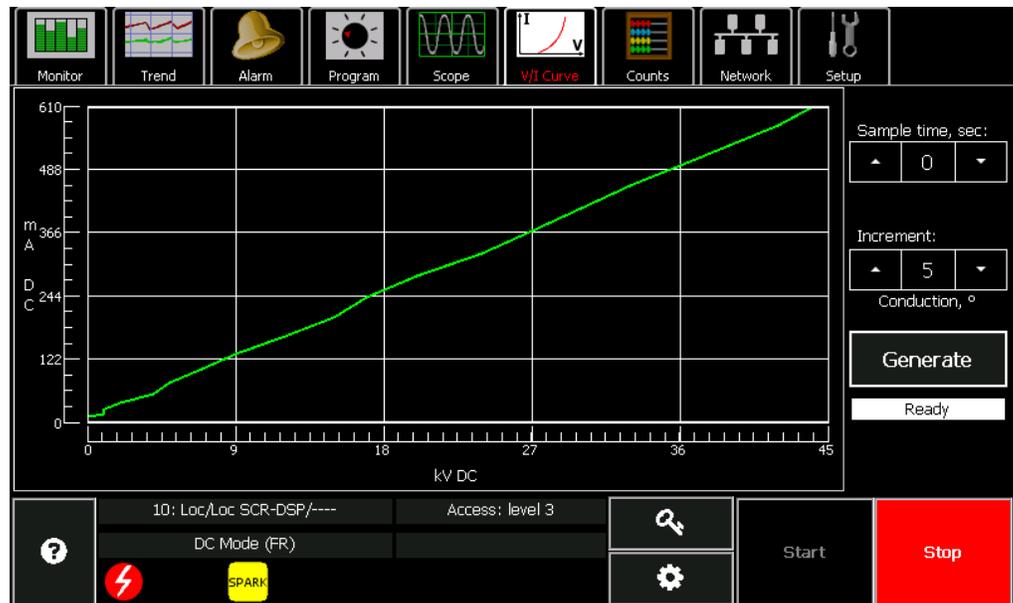
The red line across the trend indicates the rating of the T/R set.

The operator can also zoom and pan the meter value axis of the trend by using the navigation buttons at the lower left portion of the screen.



V/I Curve

The GVC will generate a V/I Curve, allowing comparison of voltage versus current on an easy-to-read graph. To access the screen, press the **V/I Curve** button on the main menu bar.



The operator can set certain criteria for each curve.

Sample Time: Choose a value from 1 to 10 seconds to select dwell time for each point on the curve.

Increment: Select a Conduction Angle change value from 1 to 10 to vary how large the incremental steps will be in generating the curve.

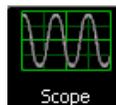
Press the **Generate** button to generate the curve. The GVC will back the Conduction Angle to zero, then increase incrementally until a limit is reached or the ESP sparks or arcs.

This curve will be stored for display until you create a new one

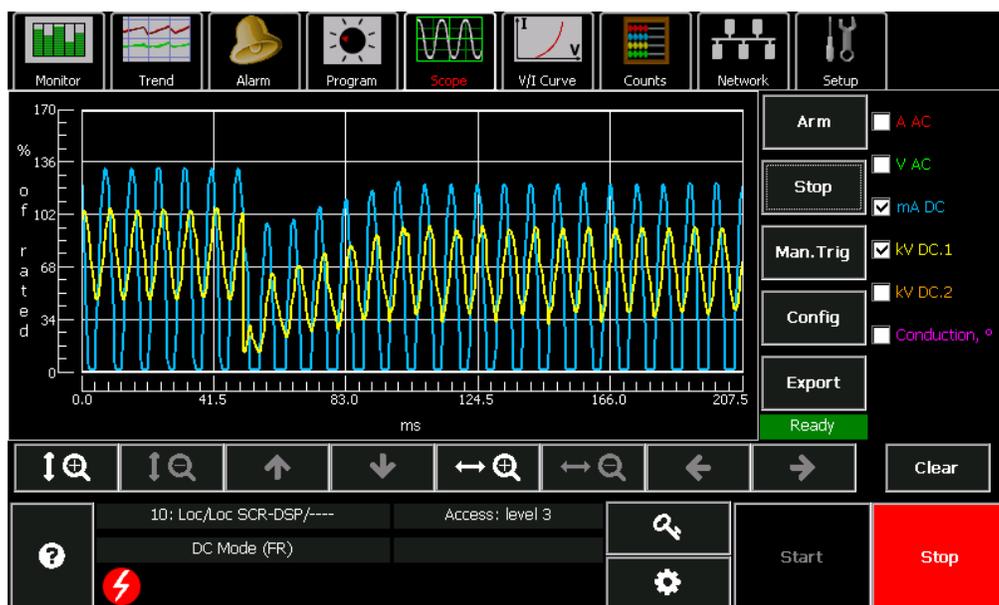
The **V/I** curve data points are also saved to a comma separated values (.CSV) file on the SD card located on the DSP board. This file is appended every time a curve is generated. The SD card can be removed and read by any computer with a spreadsheet program capable of importing CSV files. The **V/I**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

Scope Display

The GDU is also capable of providing oscilloscope waveforms of the kV and mA feedbacks, as well as the line current, the DC bus voltage and the duty cycle.



Press the **Scope** button on the main menu bar.



Select the desired feedback from the list on the right side of the display. More than one waveform can be shown at a time.

Press the **Config** button on the right side of the screen.



The following parameters can be set.

- *Sampling interval, μs :* This parameter defines how often a data point is taken; 65, 130, 260, or 520 μs intervals.
- *Data points:* This parameter defines how many data points will be collected; 100, 200, or 400. The total time span of scope capture will be the sampling interval time times the number of data points.
- *Trigger source:* The scope capture can be trigger by either a *Spark* or an *Arc* or both.
- *Trigger position:* This parameter defines the relative horizontal position of the triggering point on the scope waveform; 0%, 25%, 50%, 75%, or 100%. It will allow for variation of the pre-trigger and post trigger waveform that can be seen.

Once configured press the **Arm** button. The next event will trigger the scope waveform. Pressing the **Stop** button will un-arm the trigger. Pressing the **Man.Trig** will manually trigger the scope.

Once the waveform is displayed, the operator can zoom and pan each axis by using the navigation toolbar under the waveform.



Count Display

Pressing the **Counts** button on the main menu bar will show the number of times the unit has experienced certain events since last checked and reset.

Event name	Counts
Overvoltage	0
Line Overcurrent	0
Spark Rate Over 60 SPM	0
T/R High Temperature	0
SCR Unbalance	0
On/Off Starts	30
Undervoltage	5
SCR High Temperature	0
Cold Resets	6
Warm Resets	1
AUX ALARM 1	0
AUX ALARM 2	0
AUX ALARM 3	0
AUX ALARM 4	0
Loss of Line Sync	0

10: Loc/Loc SCR-DSP/---- Access: level 3

DC Mode (FR)

Start Stop

Counters can be reset to zero by pressing the *Clear selected* or *Clear all* buttons.

Event Log

The GVC also logs operational events to a comma separated values (.CSV) file on the SD card. These events include the time and date of each time that the HV is turned On and/or Off. It also logs whenever a limit routine is activate. The SD card can be removed and read by any computer with a spreadsheet program capable of importing CSV files. The event log file name on the SD card is NWLLOG.CSV.

Alarm Functions

Available Alarms

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

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

Internal Alarms

These are alarms that are derived from the metering feedback or internal signals from the GVC control module. When an internal alarm is activated, the controller trips the contactor to remove high voltage from the T/R set and displays an alarm message. The internal alarms are:

- **Undervoltage:** occurs when the T/R set operates at or below a set value for a user-determined period of time, indicating a short circuit or high spark rates in the precipitator.
- **Overvoltage:** activated instantly if the primary or secondary

voltage exceeds its rating by 10%.

- **Overcurrent:** activated instantly if the primary current exceeds its rating by 20%.
- **SCR Unbalance:** trips if one SCR is at a different conduction angle than the other. This will cause an unbalance in primary current that may cause the T/R transformer to saturate due to the DC component present.
- **Blown Fuse:** activates if contactor coil fuse or the alarm relay coil fuse, located on the I/O board, fails.
- **Voltage Reference:** activates when a 1.5 VDC internal voltage reference drops below 1.35 VDC or exceeds 1.65 VDC. This is an indication of an internal board problem.
- **Low Battery:** activates when the battery in the controller's non-volatile RAM chip drops below an acceptable level.
- **Loss of Memory:** alerts you that the battery-backed RAM chip has failed to retain programmed parameters, and has reset to default values.
- **Loss of Line Sync:** indicates that the microprocessor is not receiving a line synchronization pulse from the system hardware.

Standard Alarms

The standard alarms are alarms that are derived from discrete inputs into dedicated alarm input channels. The alarm inputs are looking for the presence or the absence of 120 VAC. Each alarm can be configured as previously described in Chapter One: Configuring the GVC. The standard alarms are:

- T/R Over-Current – For monitoring the status of external overcurrent devices.
- SCR Over-Temp – For monitoring the status of thermal switches located on the SCR assembly heatsink.
- T/R High Oil Temp – For monitoring the status of the oil temperature switch in the T/R tank.
- T/R Low Oil – For monitoring the status of the oil level switch in the T/R tank.

Auxiliary Alarms

You can add up to four auxiliary alarms to suit your system and procedures. Auxiliary alarms are completely user-definable and configurable as previously described in Chapter One: Configuring the GVC. The auxiliary alarms must be dry contacts. The drive voltage is supplied by the internal circuits of the GVC.

Alarm Information

If an alarm is tripped during precipitator operation, the GVC responds with:

- an alarm message on screen, regardless of the display you're currently viewing
- a contactor trip
- a signal for an auxiliary annunciator wired into the common alarm relay

The GDU immediately changes to the **Alarm** screen.

The screenshot shows the Alarm screen interface. At the top, there is a navigation bar with icons for Monitor, Trend, Alarm, Program, Scope, V/I Curve, Counts, Network, and Setup. The main area is divided into several sections:

- Active alarms:** A red header section containing a list of active alarms. The first alarm listed is "Under-Voltage".
- Readings at active alarm:** A table showing various feedback readings and their values.
- Troubleshooting info:** A section for additional diagnostic information.
- Clear Alarm:** A prominent yellow button to clear the active alarm.
- Status Bar:** At the bottom, it displays system information such as "10: Loc/Loc SCR-DSP/---", "Access: level 3", "DC Mode (FR)", and a yellow warning triangle icon. There are also buttons for "Start" and "Stop".

Feedback	Value
V AC	27
A AC	20
Conduction, °	37
kW	0.2
mA DC	62
kV DC	4
SPM	0
APM	0

The alarm(s) that caused the trip is listed under the *Active alarms* section of the screen. The readings at the time of the alarm are also shown in the table to the right of the active alarms list. These will continue to be displayed until the alarm is cleared.



A flashing icon  is also shown on the status bar. This flashing icon will continue to be visible from any of the other screens on the menu bar until the alarm is cleared.

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

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

The high voltage cannot be turned on if an alarm is active.

Responding to an Alarm

To get more information on troubleshooting the alarm, highlight the alarm name in the *Active alarms* list by pressing on it. Then press the *Troubleshooting info* button just under the list. A new page will be shown that gives a brief description of the alarm, possible causes, and possible solutions. The up and down navigation arrows can be used scroll the text.



Press the  button in the upper right corner to return to the **Alarm** screen.

To clear an alarm, first make sure the active alarm is highlighted in the *Active alarms* list. Then press the yellow *Clear Alarm* bar.

- If the condition that triggered the alarm has been removed, the alarm will also clear and the GVC will operate normally.
- If the situation has not changed, the alarm will reappear and the flashing alarm icon will return to the status bar. Correct the problem as described below and the alarm will clear.

Alarms can also be remotely cleared by configuring one of the auxiliary alarms for the Clear Alarm Input function. Refer to the Auxiliary Alarm Configuration section in Chapter One of this manual for more information on this feature. They can also be cleared through a network connection.

Alarm Guidelines

For *internal alarms*, follow these guidelines.

- **Undervoltage:** Occurs when the kVDC is at or below a set value for a user-determined period of time, indicating a short circuit or high spark rates in the precipitator. The undervoltage trip level is adjustable.

Cause: Short circuit or close clearances in the precipitator causing it to spark at low kV levels.
Solution: Perform an open circuit test to verify if problem is in ESP. Correct problem in the field.

Cause: Incorrect settings for undervoltage, spark rate, setback, fast recovery, and spark level.
Solution: Change settings to correct values as described in Chapter Five: Changing Operating Parameters.

Cause: Readout not calibrated properly.
Solution: Recalibrate following instructions in Chapter Two: System Checkout and Energization.
- **Overvoltage:** Activated instantly if the kVDC exceeds its rating by 10%. This is a fixed setpoint. This usually indicates an open circuit condition.

Cause: HV connection from the T/R set to the ESP section is not tight or secure.
Solution: Perform a short circuit test to verify that the T/R can produce rated mADC. If it does, the open is in the connection to the ESP. Find the loose or open connection and tighten it.

Cause: Incorrect T/R rating entered for unit.
Solution: Change rating to correct value.

Cause: Readout not calibrated properly.
Solution: Recalibrate following instructions in Chapter Two: System Checkout and Energization.
- **Overcurrent:** Alarms signal either the primary current is exceeding it's rating by 20% or an external overcurrent relay has actuated.

Cause: Shorted SCR
Solution: Test SCR and replace if shorted.

Cause: Excessive primary current

Solution: Make sure that the current limit is properly set and that the controller is properly calibrated.

Cause: Arcing in ESP not being sensed.

Solution: Set Arc Sensitivity Parameter to High. Verify feedback network is correct.

Cause: If Alarm display states that the trip was caused by an external overcurrent, it means that alarm was triggered by the contact opening from an external overcurrent relay circuit.

Solution: Verify that the external relay circuit is set for the proper trip point. Verify that the 120 VAC is present on the overcurrent relay discrete input on the I/O board. Verify that the OC Relay logic is properly set on the Alarm screen.

- **SCR Unbalance:** Indicates an unbalance in the output current feedback. One SCR is turning on more than the other.

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

Solution: Use an oscilloscope to determine which component is faulty. Replace faulty hardware component.

Cause: SCR unbalance parameter is set too low.

Solution: Change SCR unbalance setting as described in Chapter Five: Changing Operating Parameters.

Cause: Problem with HV rectifier bridge. One leg may be open.

Solution: Megger each leg of the HV full wave bridge. Replace if necessary.

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

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

Solution: Remove the electrical noise from the incoming voltage.

- **Liquid Overtemperature:** Indicates that the temperature of the dielectric fluid in the T/R tank has exceeded 85 C and has actuated the thermal switch in the temperature gauge.

Cause: T/R is operating at levels higher than nameplate ratings

Solution: Verify that the current and voltage limit parameters are properly set and that the metering circuits are properly calibrated.

Cause: High ambient temperature

Solution: Verify the ambient temperature is not exceeding the nameplate rating for the T/R set. If it is reduce T/R output to lower the T/R losses and thus the dielectric fluid temperature.

Cause: Thermal switch faulty or bad connection to I/O board.

Solution: Verify temperature of fluid is greater than 85C. If temperature gauge is faulty replace. Verify wiring for 120 VAC input to alarm terminal on I/O board.

- **SCR Overtemperature:** Indicates that the thermal switch on the SCR heatsink has activated.

Cause: Bad SCR cooling fan (if applicable)

Solution: Verify that cooling fan is operating properly. Replace if necessary.

Cause: High ambient in control enclosure

Solution: Verify internal temperature and operation of any enclosure cooling devices. Replace faulty devices or reduce T/R output to lower SCR operating temperature.

Cause: Thermal switch faulty or bad connection to I/O board.

Solution: Verify heatsink temperature is greater than 180 F using external temperature device. If thermal switch is faulty replace. Verify wiring for 120 VAC input to alarm terminal on I/O board.

- **Liquid Level Low:** Indicates that the level of the dielectric fluid in the T/R tank has dropped below the minimum level for safe operation.

Cause: T/R tank has developed a leak.

Solution: Inspect tank and HV bushing for any signs of a leak. Repair as necessary.

Cause: Level gauge/switch is faulty or bad connection to I/O board.

Solution: Verify the level of the fluid in the T/R tank. If the level is correct replace the liquid level gauge. Verify wiring for 120 VAC input to alarm terminal on I/O board.

- **Auxiliary Alarm:** Activated instantly if any of the customer supplied auxiliary alarm circuit are activated.

Cause: One of the customer supplied auxiliary alarm circuits was activated.

Solution: Check the specific auxiliary alarm circuit and correct the condition.

Cause: Incorrect input to alarm circuit.

Solution: Check the wiring to the auxiliary input and verify that the proper signal is being applied to the input. Correct if necessary.

- **Hammer Feedback Alarm:** Activated instantly if any of the customer supplied rotating hammer feedback alarms are activated.

Cause: One of the rotating hammer motor starters is not energizing.

Solution: Check the specific rotating hammer motor starter and correct the condition.

Cause: Incorrect input to alarm circuit.

Solution: Check the wiring to the hammer feedback alarm input and verify that the proper signal is being applied to the input. Correct if necessary.

- **Invalid Vref:** Signals that an internal voltage reference is outside of the allowable voltage range. This is an indication of a failed control board.

Cause: Problem with control board.

Solution: Replace complete control module.

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

Cause: Short in the contactor or alarm relay coil or wiring from the I/O board to the coil.

Solution: Find the short circuit and correct it.

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

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

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

Cause: Failure of battery backup or RAM.

Solution: Replace battery or RAM; then reload the configuration from the SD card.

Cause: Line surge or other electrical anomaly scrambles memory.

Solution: Reload the configuration from the SD card.

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

Cause: Problem with replaceable lithium battery on RAM chip

Solution: Replace battery on RAM chip, then reload the configuration from the SD card.

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

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Changing Operating Parameters

Mode Parameters

The operating parameters can be accessed by pressing the  button next to the On button.

The first screen option is the **Mode** settings.



The **Operating Mode** parameter provides access to several control modes (features) of the GVC:

- **DC** operation is automatic operation using the spark and arc parameters set by the user.
- **Manual** operation allows the user to manually increase or decrease the conduction angle of the SCR's. This will allow the output to be manually set. For protective purposes all limit circuits and spark/arc sensing circuits are still operational. This mode is usually used for initial start-up and for troubleshooting purposes.
- **IE** mode allows intermittent energization of the SCR's. The SCR's are turned ON for an adjustable number of half cycles, then turned Off for an adjustable number of cycles. This mode can be used for a power savings if collection can be maintained or for improved collection with high resistivity loads. A more complete description is given later in this chapter.
- **Back Corona/DC Hold** mode whereby the control optimizes operation in the DC mode when back corona conditions are detected. Back Corona is explained later in this section.
- **Back Corona/DC->IE**. mode whereby the control will automaticity switch to the IE mode if Back Corona is detected.

The **Fast recovery** mode decreases 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.

The **Manual conduction** is used to input the desired conduction angle when operating in the manual mode. This is the parameter for increasing or decreasing the output manually.

Back Corona can cause poor precipitator performance. When Back Corona occurs, applying more power to the ESP produces no corresponding increase in the secondary voltage and sometimes the voltage actually drops. Page 2 of the **Mode** screen lets you enter settings for a special feature that detects Back Corona and corrects for it by temporarily reducing power.

Intermittent Energization (IE), is an operating mode that may be used to save power by gating the SCR's in an On/Off pattern. It may also provide a beneficial enhancement to the collection efficiency when used with certain types of high resistivity loads and if back corona is present. You must experiment with each precipitator to find the optimum IE ratio that will produce reduced energy consumption or a decrease in the operating opacity.



The mode works by programming separate "on" times and "off" times for the GVC.

1. **IE 1/2 Cyc. ON** is used to set the number of half-cycles the SCRs are to be On (range: 1 to 20).
2. **IE Cycles OFF** is used 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 spark control is still in effect during IE operation.

IE operation is useful to improve precipitator collection during Back-Corona (B.C.) conditions. Back Corona can cause poor precipitator performance. When Back Corona occurs, applying more power to the T/R set produces no corresponding increase in the secondary voltage; sometimes the voltage actually drops.

HV at power-up 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 controller's 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.

Back Corona can cause poor precipitator performance. When Back Corona occurs, applying more power to the ESP produces no corresponding increase in the secondary voltage and sometimes the voltage actually drops. Page 2 of the **Mode** screen lets you enter settings for a special feature that detects Back Corona and corrects for it by temporarily reducing power.



The detection function works as follows.

- The Back Corona Mode is initiated by setting the **Operating Mode** parameter (on page 1) to **Back Corona/DC Hold** or **Back Corona/DC-> IE**.
- The mode 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 reducing the conduction angle by the amount shown in **Inc/Dec** (increment/decrement).
- After the time shown in **Delay**, it takes a secondary voltage reading.
- The GVC then increases the conduction angle 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.

If the mode is set to **Back Corona/DC Hold** the GVC will display a message indicating as such and will attempt to correct the problem.

1. First the controller reduces the conduction angle 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 the conduction angle until back corona is detected.
3. If back corona is present it reduces the conduction angle by 1.5 times the percentage shown in **Inc/Dec** plus that shown in **Phaseback**. 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 DSP will continue to increase the conduction angle until it occurs again.

Back Corona Hold mode ends when the conduction angle reaches the original pre-Hold level.

If the mode is set to **Back Corona/DC->IE**, the GVC follows the same detection procedure as previously described in the **Back Corona / 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. ON** and **OFF** parameters are used as the timing parameters. These parameters are set by the user. 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.

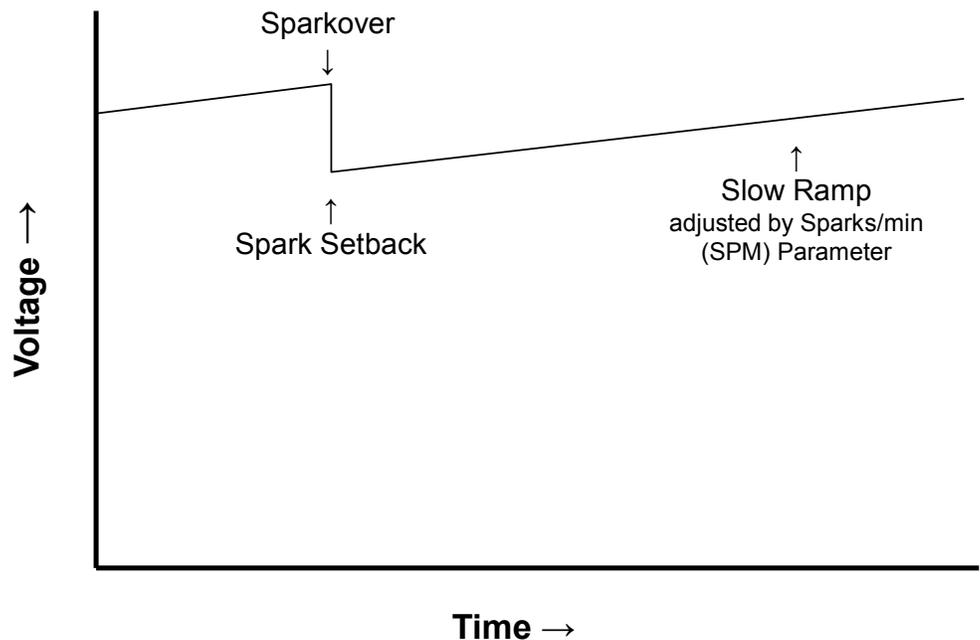
You can adjust back corona detection with these **Mode** screen settings.

- **Inc/Dec** determines how far power is phased back and up in normal detection, and combines with **Phaseback** 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 GVC 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.
- **Phaseback** indicates the additional amount of phaseback applied in addition to the **Inc/Dec** amount during Back Corona Hold. Limits are 0% to 20%.

Spark/Arc Control

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

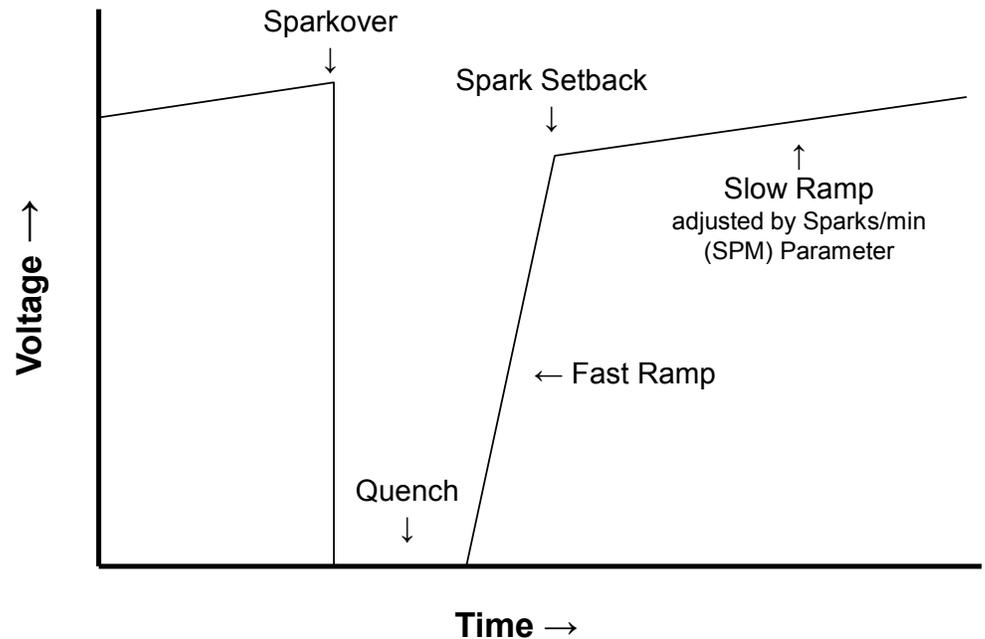
Once it senses a spark, the GVC controls it by setting back the SCR's conduction angle slightly in the next half-cycle, thus reducing the voltage to a level lower to stop the occurrence of another spark (**Spark Setback** level). It then performs a *slow ramp* back to the pre-spark level.



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

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

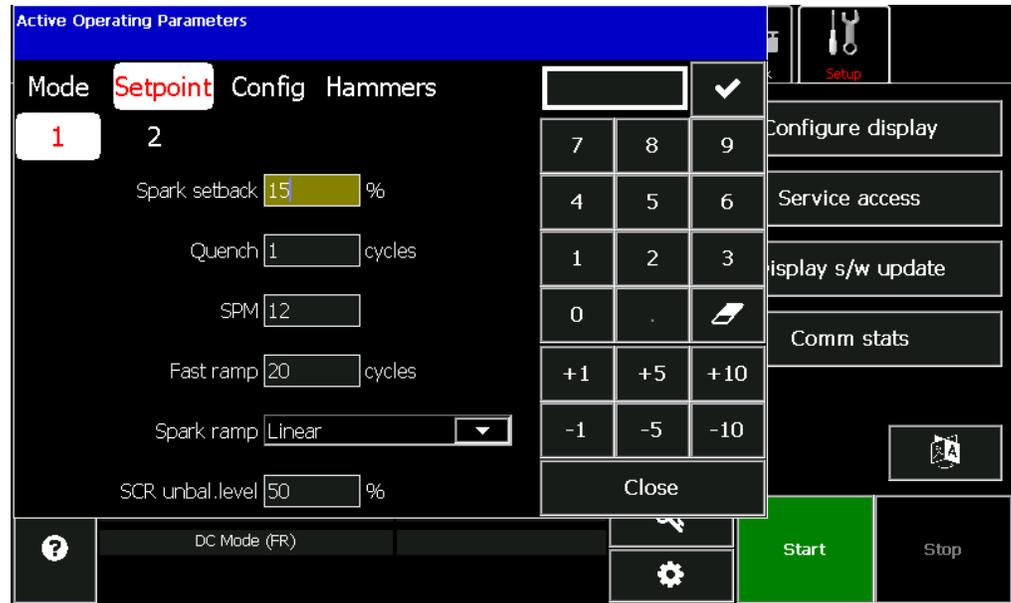
power until either it reaches current limit, voltage limit, or a spark, as described above under "Spark Control."



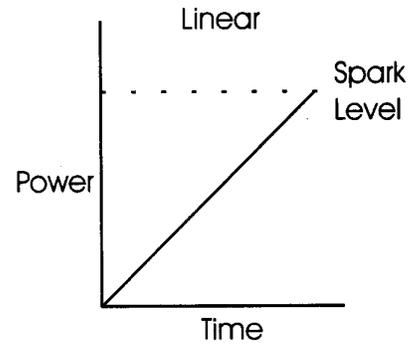
After the quench period expires, if the controller senses that secondary current has not dropped to near zero, it will repeat the quench cycle. This will continue until the condition corrects itself or until the controller signals an undervoltage alarm and trips the contactor.

Setpoint Parameters

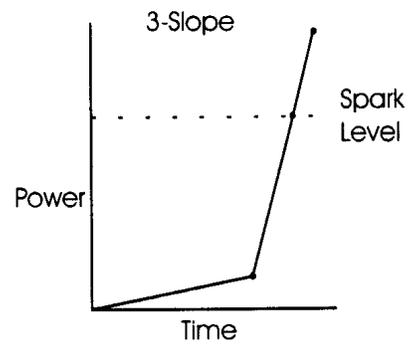
Settings that affect spark/arc control appear in the **Setpoint** section of the Operating Parameters Setting screen. They can be accessed by pressing the  button next to the On button. Then press the screen option for **Setpoint** and then the page  button.



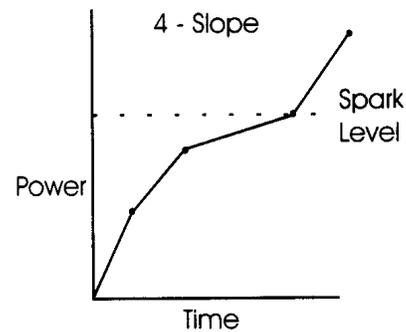
- **Spark setback (%)** determines how far power will be set back in response to sparks and arcs. Highlight the parameter and use the keypad to program it for any setting between 1% and 30% (default is 10%).
- **Quench** shows the amount of time that the SCR's are turned off (conduction angle = 0) to allow an arc to extinguish. Highlight the parameter and use the keypad to program it for any setting between 1 and 10 line cycles (default is 1).
- **SPM** (Sparks Per Minute) shows the desired operating condition. The "slow ramp" back to pre-spark levels is calculated on this basis. Highlight the parameter and use the keypad to program it for any setting between 1 and 120 (default is 12).
- **Fast ramp** sets the number of cycles it takes to raise SCR conduction to the setback level. Fast ramp can be programmed from 2 to 20 cyc. (default is 5).
- **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.



- ◆ *3 Slope*: steps through three different rates from setback to pre-spark levels for a recovery slope similar to that shown below. This method permits a longer time at lower output to allow any disturbance to pass through the ESP section.



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



- **SCR Unbalance** sets the level of unbalance that the GVC deems detrimental to the T/R set and initiates an alarm. An unbalance occurs when one SCR is conducting more than the other. The range is 1% to 99%. (default is 50%).

Setting the **SCR Unbalance** parameter to 99% disables it. *This is dangerous and should be done only for diagnostic purposes.*

Page 2 of the **Setpoint** screen contains additional parameters.



- **Current limit** allows automatic limiting to a pre-set output current limit value. It is expressed as a percentage of the T/R output current (mADC) rating (set in the **Rating** display). The safe range is from 10% to 110% of the T/R's rating (default is 100%).
- **Voltage limit** works similarly to **Current Limit**, but sets the output voltage limit as a percentage of the T/R output voltage (kVDC) rating. The control range is 10% to 102% (default is 100%).
- **U.V. trip** is the level at which the GVC registers an undervoltage condition in the output, indicating a short circuit or excessive sparking. It will shut off power under these conditions. The control range is 0 to 35 KVDC (default is 10 KVDC).

Setting **U.V. trip** to 0 KV disables it. *This may be hazardous and therefore should be done only for diagnostic purposes by certified personnel.*

- **U.V. delay** dictates how many seconds the GVC will tolerate an undervoltage condition before powering down. The range is 5 to 45 seconds (default is 30 sec.)

Configuration Parameters

The **Config** screen contains some additional parameters for setting up the GVC.



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

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

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

Four parameters on the **Config** display let you set the conduction limits for the T/R set, using the normal keypad controls.

- **Max. voltage 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. current limit** holds the primary and secondary current at or below its value no matter what PCAMS, a user, or a timeout algorithm request. The value can be set between 110% (the default) and 30%.
- **Max. current 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. select** switches between voltage (*Volt*) and current (*Curr*) conduction angle control.

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° .

The **Setbk offset mode** feature adds an extra setback function after a spark occurs.

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 **Setbk offset mode** parameter to select *Auto* or *Manual* mode.

- *Auto* uses an internal algorithm to determine the optimum setback offset:
- *Manual* allows you to enter your own value for the offset setback to be used.

Use the **Setback Offset %** parameter to enter the value for manual offset. The range is from 10 to 100% with the default at 15%.

Page 2 of the **Config** screen contains two additional parameters.



If the T/R set being controlled is a double-half wave unit, or has no provision for KV feedback, you will have to select the settings that accurately describe the configuration.

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

Rotating Hammer Rappers

The GVC can also be configured to operate up to four rotating hammer style rappers with the optional hammer control board. The optional board provides four outputs rated at 120/240 VAC @ 3 A. The rapper program timing for these outputs are set by going to the **Hammer** display.



There are four screens, one for each rotating hammer output. Below is a definition list of the parameters.

- Modes:** Off - The rotating hammer output will not energize.
Program run - When selected, the rotating hammer output will energize using the following time parameters; initial wait, duration, and wait time.
Program Run with Clean - Identical to Program Run mode except when the high voltage is removed from the T/R, the rotating hammer output will energize for the amount of time defined in clean time.
Continuous - The rotating hammer output will remain energized regardless of the high voltage status and the operating time parameters.
- Initial Wait:** Amount of time after the high voltage is applied to the T/R before energizing the rotating hammer output. This value is programmable from 00:00:00 to 23:59:59.
- Duration:** Amount of time the rotating hammer output remains energized. This value is programmable from 00:00 to 59:59.
- Wait:** Amount of time after the rotating hammer duration period before re-energizing the output. This value is programmable from 00:00:00 to 23:59:59.
- Clean:** Amount of time the rotating hammer output is energized after the high voltage to the T/R is removed when the "Program Run with Clean" mode is selected. This value is programmable from 00:00:00 to 23:59:59.

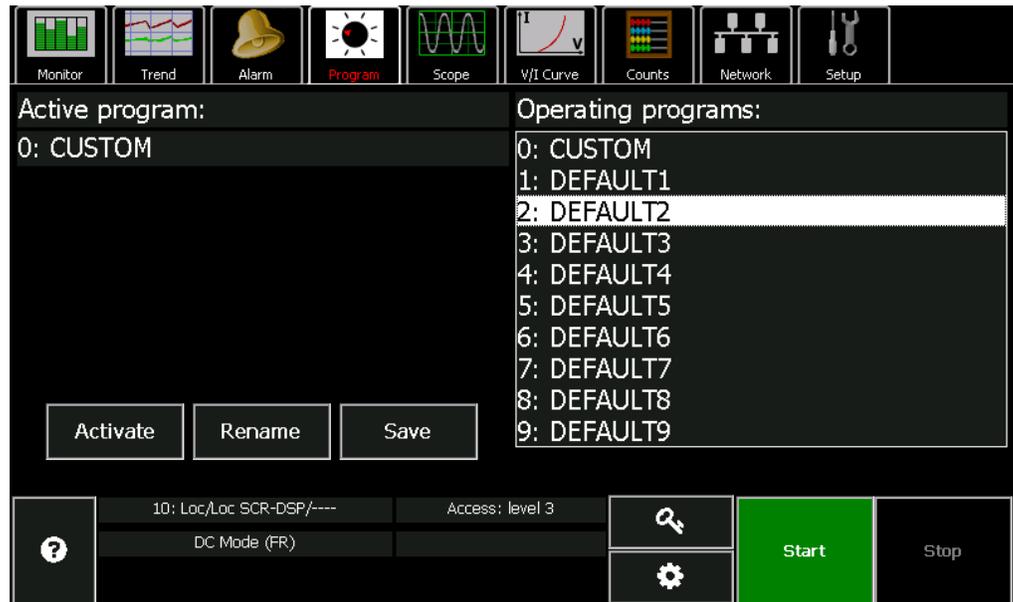


Whenever a hammer rapper output is energized an icon  will be displayed in the status section of the display.

Saving Operating Programs

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

To save the active program, press the Program button on the Main menu.



Press the program number (1-9) where the active program will be saved. If you wish to assign a preprogram name, press the **Rename** button the use the pop-up keyboard to enter the desired name. When finished press **Submit**.

Once programs have been saved in memory, they can be recalled by pressing the desired program number and then pressing the **Activate** button. The operating program will be identified in the

status section of the display screen. If any changes are made to a parameter of an operating stored program, the controller will accept the change, but will classify the operating program as Program 0 Custom, since the program has now changed. The stored program is not changed.

SD Card

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

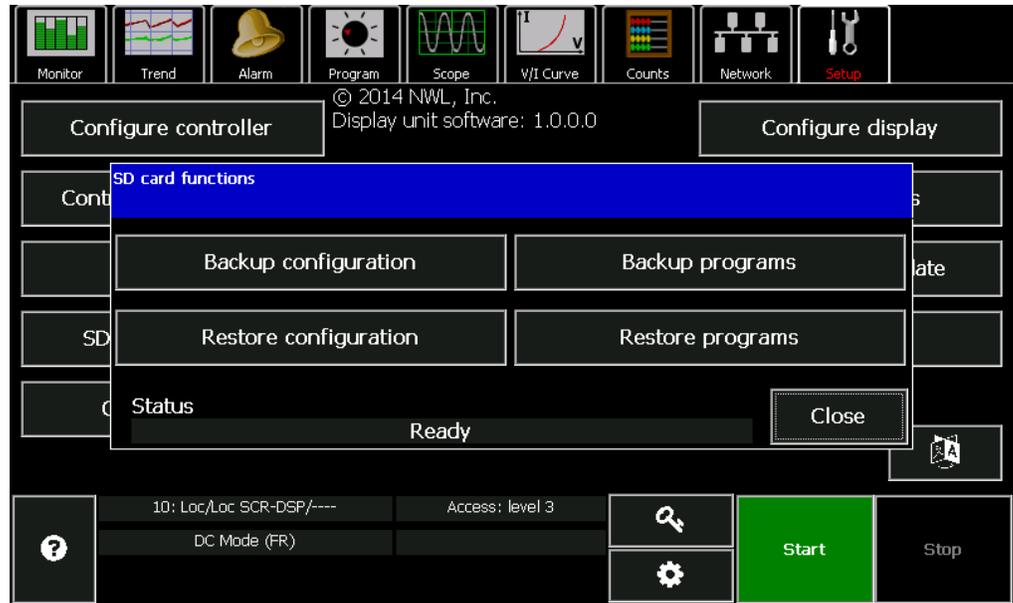


The SD card holds the following files:

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

The Alarm log, the V-I curve data file, and the Event log are automatically saved when new data is generated. A Configuration file containing all of the user set operating parameters, unit ratings, and calibration information is automatically saved whenever power is applied to the GVC and every hour thereafter. A firmware version check is also performed whenever the power is applied to the GVC. If the controller senses that a firmware upgrade has taken place, the Configuration file is automatically loaded back into the controller.

The Operating program file and the Configuration file can also be manually saved and retrieved. This is done by pressing the **SD card functions** button on the **Setup** screen.



Press the appropriate button to backup or restore the configuration or programs.

The SD card is also used to hold the new firmware to be uploaded to the controller. Complete instructions on uploading the new firmware can be found in the next chapter of this manual.

Clearing the Memory

A loss of memory or any other situation that erases the configuration from your GVC automatically resets the system to the operating defaults. This can also be done manually to totally reconfigure the unit. Prior to performing this, the Configuration and the User programs should be saved to the SD card as described in the SD Card section of this manual.

Press the **Clear memory** button on the **Setup** screen.

A window will appear asking for confirmation to reset all settings to the default values. Press **Yes**.

This will clear the microprocessor of whatever it retains from the existing configuration (some of which may be scrambled).

The Configuration and the Operating Programs can now be loaded from the SD card back to the controller as described in the SD section of this manual.

Important: Do not press the <On/Off> key until the system has been re-configured and verified to be correct.

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Updating Firmware

NWL will periodically release firmware updates that either introduce new features or address past problems. The firmware in both the GVC control module and the GDU can be easily updated by the user. The latest firmware releases can be downloaded from a secure NWL FTP site. For instructions and access to the FTP site, contact NWL Technical services at 1-800-PICKNWL.

GVC Control Module Updating

The firmware on the GVC control module is updated through the use of the SD card. The update procedure is as follows:

1. Download the new application firmware hex file from the FTP site and copy it to a 2 or 4 GB SD card.
2. Turn the HV off of the unit by pressing the *Stop* button on the GDU.
3. Press the Reset button on the D25290-01 DSP board. It is labeled RST SW1 and is located as shown below. This will save all of the configuration settings to the SD card.



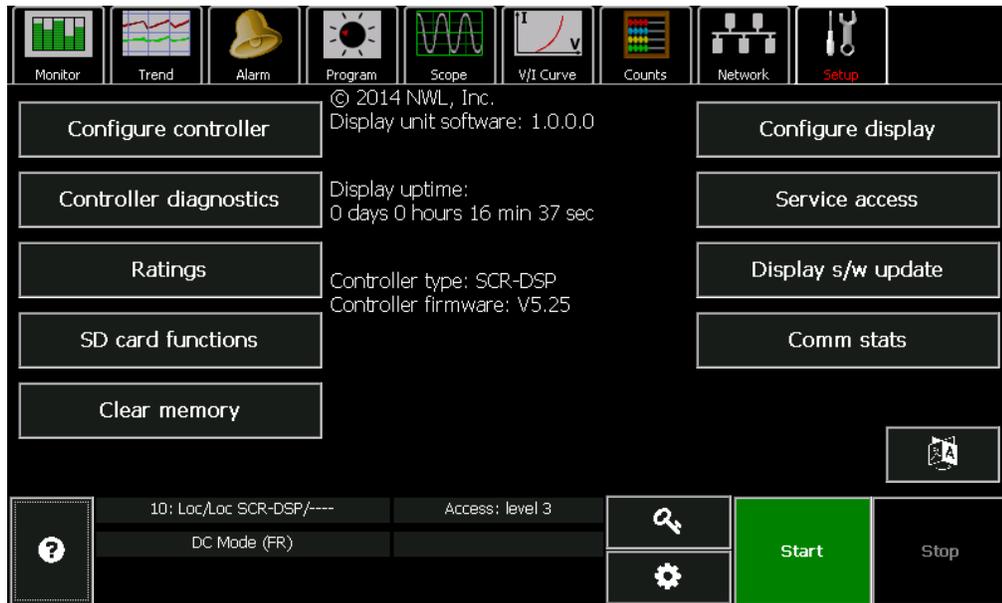
6. Remove the SD card from the DSP board and insert the new SD card with the new application firmware.
7. Power up the GVC by turning the main circuit breaker on. The firmware update will start automatically.
8. When the update is finished, the word “done” will be displayed on the four character LED display on the DSP board.
9. Remove the power from the GVC by turning the main circuit breaker off.
10. Set all of the SW3 switches back to OFF.
11. Remove the SD card with the new application firmware and replace with the original SD card with all of the configuration setting files on it.
12. Power up the GVC by turning the main circuit breaker on.
13. The controller will automatically load the configuration settings back into the controller.
14. Verify that the correct firmware version number is displayed and that the ratings and parameter settings are correct before turning the HV on again

GDU Updating

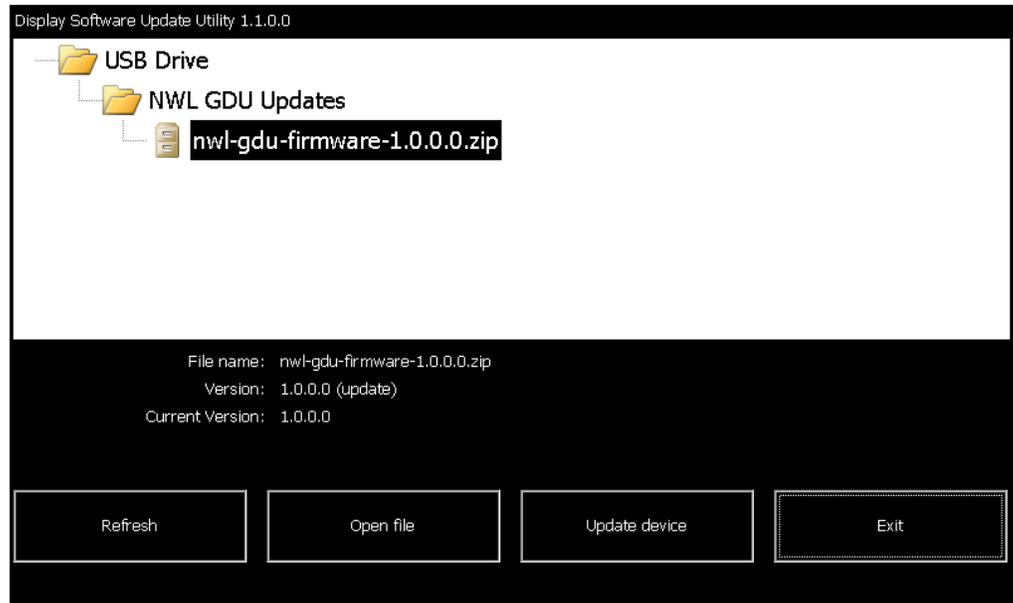
The firmware on the GDU is updated through the use of a USB flash drive. The update procedure is as follows:

1. Download the new application zipped file from the NWL FTP site and copy the complete zipped file to a USB flash drive. Do not extract the files on the drive.
2. Plug the flash drive into the USB port on the back of the GDU.
3. Sign on to the GDU using the Level 3 password.

4. Press the **Display s/w update** button in the **Setup** screen.



5. A window will appear stating that the main application will be closed and the update utility will be started. It will ask if it should continue. Press Yes.
6. The following update utility screen will be displayed.



7. Press the Press icon of the zipped file, then press the **Open file** button. There will be a slight delay while the GDU reads the files. A progress bar is shown.
8. When completed, press the **Update device** button. There will be another delay as the GDU extracts the files and performs the update. A progress bar is shown.
9. Upon completion a window will be displayed asking to reboot the device. Press **OK**.
10. The GDU will now be rebooted with the updated firmware.

Appendix A

DSP Board Four Character Display Messages

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

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

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

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

Table 1: Event Messages

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

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



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

Table 2: Alarm Messages

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

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

Table 3: Operating Mode Messages

Appendix B

Fieldbus Module Additional Information

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

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

Network Status LED

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

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

Module Status LED

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

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

LINK/Activity LED

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

Ethernet Interface

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

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

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

Communication LED

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

Device Status LED

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

Modbus Interface

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

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

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

For DeviceNet Fieldbus Module :

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

Network Status

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

Module Status

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

DeviceNet Connector

This connector provides DeviceNet connectivity.

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

M12 Connectors, Code A

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

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

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