



Graphic Rapper Controller™ (GRC) User's Guide

Rev. 4.0

Revisions

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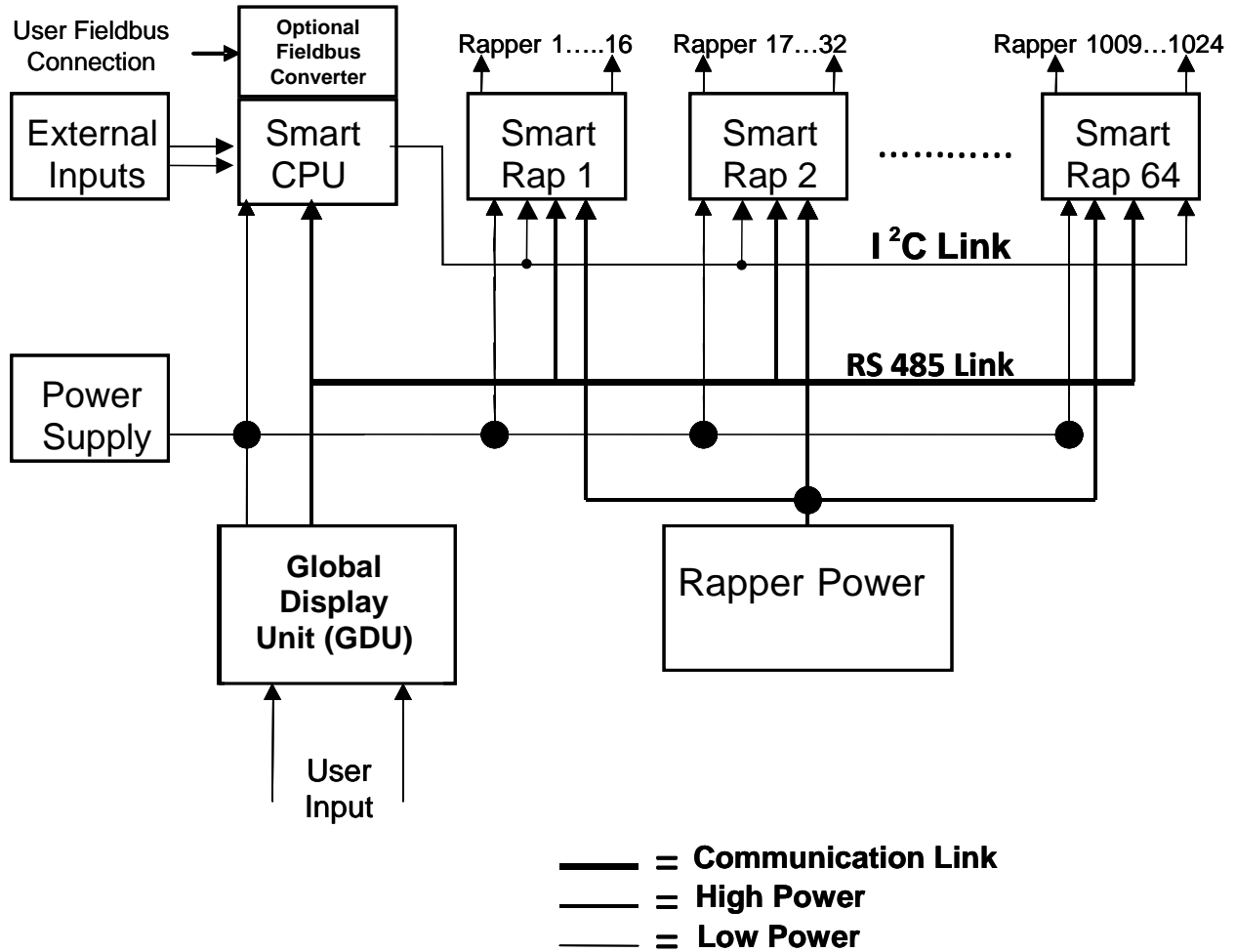
Chapter 1: Introduction

NWL's Graphic Rapper Controller

NWL Transformers' 3rd Generation rapper controller – The Graphic Rapper Controller (GRC). Years of electrostatic precipitator controls experience have resulted in the design of this state-of-the-art rapper controller.

The GRC System consists of three major components (see figure 1), the Smart-CPU (S-CPU), the Smart-Rap (S-RAP), and the Global Display Unit (GDU). The main function of the S-CPU is to store and run complex operating programs. The S-CPU offers many other features such as Power Off Rapping, Trending, Anti-Coincidence Grouping making it the most powerful rapper controller in the industry. The S-RAP module operates in two fashions, “stand-alone” or part of the complex system controlled by the S-CPU. When the S-CPU has control, the S-RAP will energize devices and monitor the current levels for alarm conditions. In stand-alone mode, the S-RAP uses either on-board switch settings or internal memory settings to energize and monitor the devices. Should the S-CPU have trouble at any time, the S-RAP modules will automatically switch to stand-alone and maintain rapper activity. The third major component of the GRC System is the GDU. Through the GDU, the user can create and modify operating programs, monitor rapper activity and alarms, and troubleshoot system faults. Using a graphical color touchscreen, the GDU provides the most information in the industry.

GRC Block Diagram



GRC Block Diagram

Unique “Smart System” Features

R-Scan

The GRC’s R-Scan feature will check and report the operating status of each rapper output within seconds. By applying a small amount of power to each output, the GRC can determine whether a device is within the preset normal operating ranges or whether it requires attention by technicians. R-Scan reduces the time for total system checkout to minutes rather than hours. Today, with plant technicians assuming more responsibility than ever, saving man-hours is not only a convenience, but also a necessity.

Opacity Spike Detection

Creating operating programs without causing “opacity spikes” due to re-entrainment has been the task of many plant engineers. The GRC will monitor and detect opacity spikes caused by specific rappers. This information eliminates the trial and error method of creating the most efficient rapper program.

Support for Over 1000 Devices

The GRC will support up to 1024 devices on a single controller. In the past, precipitators with a large number of rappers required separate “stand-alone” controllers. Separate controllers meant more hardware, more maintenance and more system attention. With the technological advance in today’s microprocessors, the limitations of the past are gone. The GRC brings total control of a precipitator’s rapping responsibility to a single display unit. Increasing demands on the precipitator require more complex rapping schemes. With the GRC, the plant engineer’s tasks become more manageable.

Auto-Lift Calibration

Temperature changes and rapper “wear and tear” cause changes in a device’s performance. Constant attention had to be paid to rappers in order to maintain optimum precipitator performance. With the GRC, you simply select the desired lift in inches, and the system will do the rest. Monitoring current levels and making adjustments on the fly provides “lift regulation” in changing conditions.

System Redundancy

When a rapper controller fails, ash begins to build up on plates and may eventually cause a necessary precipitator shutdown. With the GRC, you have the option for rapping redundancy. The redundancy is accomplished with the S-RAP modules. Each S-RAP will can be configured to automatically begin to fire each output to maintain rapper activity in the event of an S-CPU failure. Using this option provides the plant with a level of redundancy virtually eliminating precipitator downtime due to rapper controller failure.

Automatic Program Selection

Changes in operating loads of a precipitator require different operating programs to maintain efficiency. The GRC will allow automatic program changes based on boiler load ranges, time of day, or remote input signals. Operators no longer have to worry about changes to program settings when the levels of a precipitator change.

Global Display Unit (GDU)

The GDU is a 7” color touch screen in an IP65 package. It runs the Windows CE operating system in the background with proprietary NWL software designed for control of the rapping devices. The touch screen icon and graphics module makes programming and adjustments easy for the operator. The system uses USB drive technology in case the operating software ever needs to be updated.

Opacity and Boiler Load Graphical Trending

Opacity and boiler load signals can be supplied to the GRC for graphical trending and used for automatic system features. The GDU provides a graphical trend of the information giving the operator immediate feedback caused by changes to system settings.

NWL's Last ½ Cycle Variation

Several methods of obtaining precise lift are used in the industry. Applying full ½ cycles of energy gives less control over rapper lift. Phasing back ½ cycles to accomplish more lift variations results in magnetism problems. NWL's GRC uses a combination of the two methods providing precise lift control without causing magnetism. Applying full ½ cycles of power and then phasing back power on only the last ½ cycle gives repeatable lift control to the ½ inch.

NWL's Patented Ramped Intensity Pulsing – “Rip/Rap”

The energy applied to the lower area of precipitator plates is reduced. In order to clean the bottom of the plate, higher rapper lifts are required. This causes problems with re-entrainment. When ash re-enters the gas flow, it's either re-collected by the next field or makes its way to the stack. NWL's “Rip/Rap” (Patent # 4928456), applies several “Rips” with increasing energy levels. Each successive “Rip” will clear an area of the plate eventually reaching the bottom. Before and after opacity strip charts show significant reduction of spikes when Rip/Rap is applied.

How to Use This Manual

The guide is divided into 6 chapters. Each chapter covers a crucial aspect of the GRC operation.

Chapter 1: Introduction

Provides a summary of the GRC's main features, and general information related to this document.

Chapter 2: Quick Start Guide

A simple checklist for initial GRC System configuration.

Chapter 3: User Interface

An explanation of how to use the GDU for monitoring and configuration of the GRC system.

Chapter 4: GRC Configuration

Detailed procedures for configuring the various boards within the GRC system.

Chapter 5: Operating Programs

Detailed description on how to creating operating programs for the GRC.

Chapter 6: Monitoring Operation

An explanation of how to monitor the operations of the GRC.

Chapter 7: Troubleshooting

Detailed procedures for using the GRC's built-in troubleshooting features

Chapter 8: Updating Firmware

A handy guide to updating the firmware in the S-CPU, the S-Rap, and the GDU.

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

Chapter 2: Quick Start Guide

Use the checklist below to ensure proper configuration prior to energizing the GRC System. For a more detailed description of the Smart System board setup, see the Configuration Summary chapter. Both DSP and non-DSP versions of the boards are given.

S-CPU-DSP Configuration - NWL Part #G20650

- Board Address – Rotary Switch 1
- Configure Power Feed Values via GDU
- Create Operating Program via GDU
- Create POR Program via GDU
- Configure Anti-Coincidence Grouping via GDU
- Program all S-CPU associated values (Load Scale, etc.) via GDU
- Optional – Configure the fieldbus converter parameters via the GDU

S-CPU-Non DSP Configuration - NWL Part #D20650-01

- Board Address – DIP Switch 1
- Configure Power Feed Values via GDU
- Create Operating Program via GDU
- Create POR Program via GDU
- Configure Anti-Coincidence Grouping via GDU
- Program all S-CPU associated values (Load Scale, etc.) via GDU

S-Rap-DSP Configuration (each module) - NWL Part #D20659-AC or -DC

- Board Address – Rotary Switch 1 & 2
- Set Module Device type via GDU
- Calibration or Standard Lift Table for DC Impact Devices via GDU

NWL ENVIRONMENTAL TECHNOLOGIES

- Stand Alone On/Off via GDU
- Set Stand Alone Initial Wait, Cycle, and Wait Time via GDU
- Set Stand Alone Device Lift/Frequency/Intensity/Duration via GDU
- Configure Overcurrent/Undercurrent settings via GDU

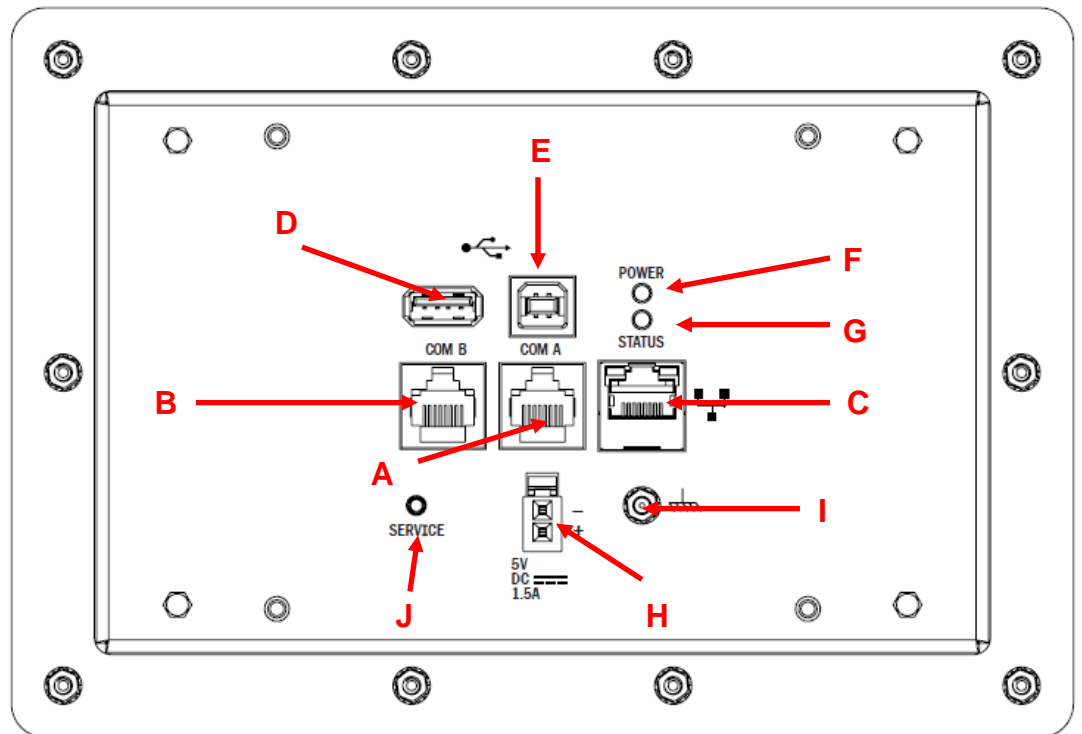
S-Rap-Non DSP Configuration (each module) – NWL Part # D20651-01 or 02

- Board Address – DIP Switch 8 (positions 3 through 8)
Each S-RAP Board Address is associated with assigned device output range.
- Calibration or Standard Lift Table for DC Impact Devices – DIP Switch 8 (position 1)
- Stand Alone On/Off – DIP Switch 1
- Set Module Device type – DIP Switch 7
- Select DIP or Internal Registers “Fire” Settings – DIP Switch 2
- For DIP Settings – set Device Fire Settings – DIP Switch 6
- For Internal Register Settings – set Device Fire Settings via HHP
- Set Initial Wait, Cycle, and Wait Time – DIP Switches 3, 4, & 5
- Select Gain setting – DIP Switch 10
- Configure Overcurrent/Undercurrent settings via HHP

Chapter 3: User Interface

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 GRC 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

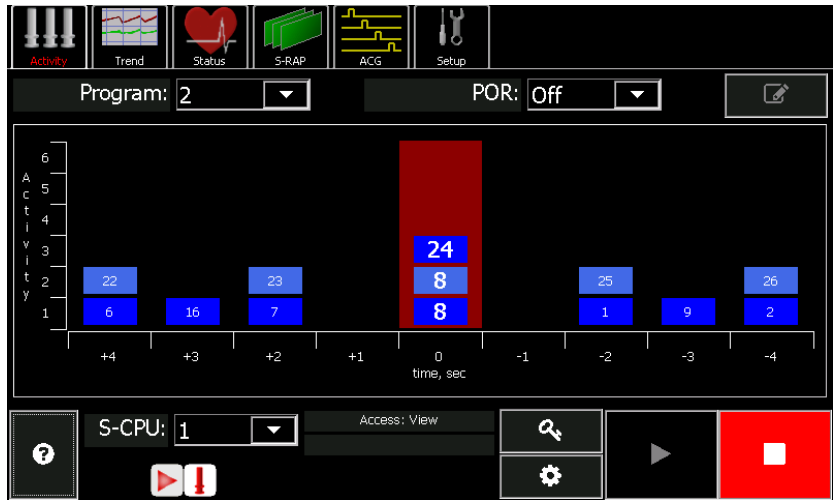
H – External power connection (5 VDC, 1.5 amp)

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 of the S-CPU being monitored. It will show icons when the rapping program is On or if an alarm occurs. It also contains buttons for the Help section, Sign ON, setting operating parameters, and Rapping Start and Stop.


Dim or Blank Screen

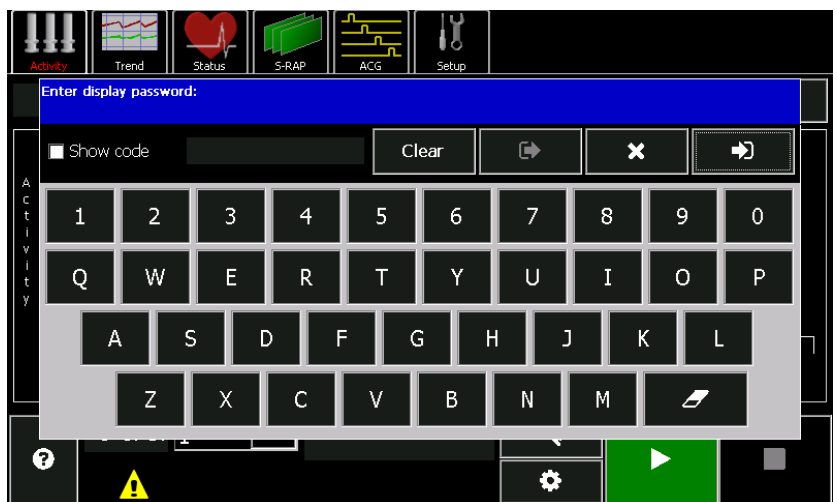
If the screen appears to be blank, the GDU may have turned off its illumination to extend screen life. To restore the display to full brightness, simply touch the screen. The display will stay illuminated for an adjustable period of time after any key touch. Then it will go dark again.

Signing On


The user has the ability to monitor the operation of the GRC and view certain process parameters and configuration parameters without signing on the system. You cannot make any changes to these parameters.

Signing on gives the user complete access and control over all parameters. The default password is 51. Passwords can be changed once you have signed on.

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.




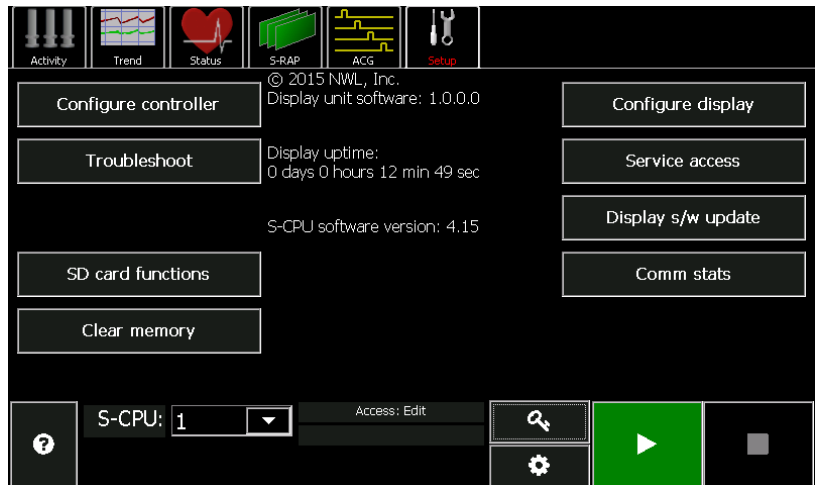
Enter the password. Press the  button. You are now signed on.

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

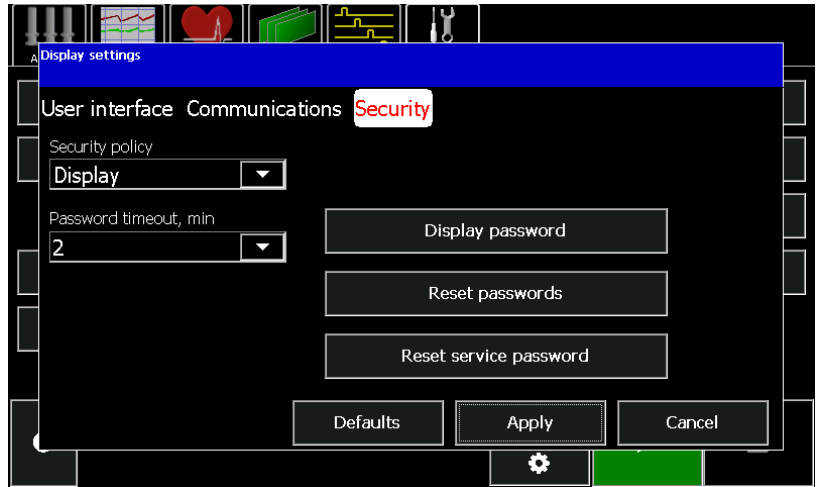
Security Policy

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 a password that is stored in the GDU. If more than one GRC are networked together, only one sign on is required to access all the controllers on the network.

Device: In this mode the GDU uses a password that is stored in the actual SCPU board. This selection is a little more secure and allows different passwords for different controllers. If more than one GRC are networked together, 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

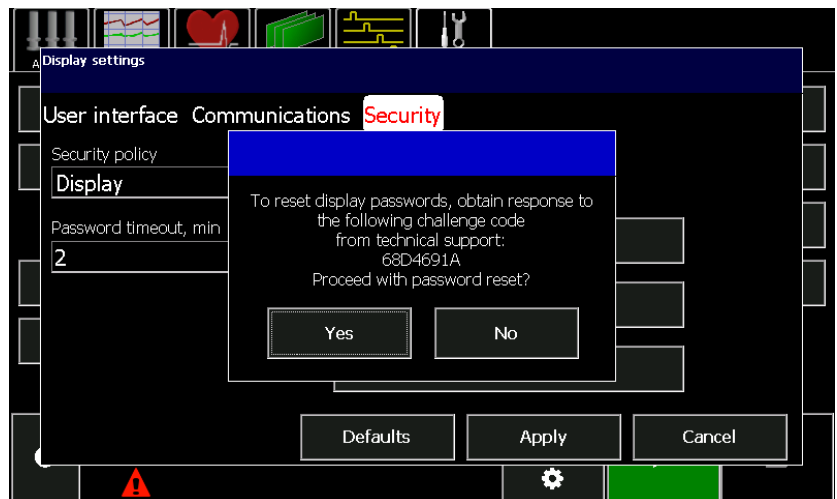
To protect against unauthorized tampering with ESP operation, the password will timeout if there is no keyboard activity after a defined time period. Once the password times out, the user will be signed off. The default length of time is 5 minutes, but can be adjusted from 1 to 30 minutes using the **Password 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 password is set using the **Display password** parameter in the **Security** tab of the **Configure display** section under **Setup**.

If you forget the password that is 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 password is set using the *Device Password* parameter in the **Control** tab of the **Configure controller** section of the **Setup** menu bar.



Signing Off

It is recommended that users sign off the system when finished with any programming. Otherwise, an unauthorized user could make changes on the GDU before the software “time out” function shuts the module down.

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

Then press the  button to sign off.

User Configuration Settings

These parameters are accessed by pressing the **User interface** button within the **Configure display** screen under the **Setup** menu.



The parameters are:

Keypad beep

Let's you select whether the GDU will sound a signal each time you touch the screen.

Backlight level

Let's you adjust the backlight intensity of the screen. It adjustable in 25% increments up to 100%.

Touchscreen sensitivity

Let's you adjust the how sensitive the screen is to touch. It is adjustable from 1 (min) to 5 (max).

Demo mode

The demo mode is not functional for the GRC controller. **The demo mode must be turned off for proper operation of the GRC.**

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.

Active application

This field is used to specify if the GDU will be operating with a GRC or a GVC control board. It should be set for GRC.

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.

Communications Settings

These parameters are accessed by pressing the **Communications** button within the **Configure display** screen under the **Setup** menu.



The parameters are:

Display address

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.

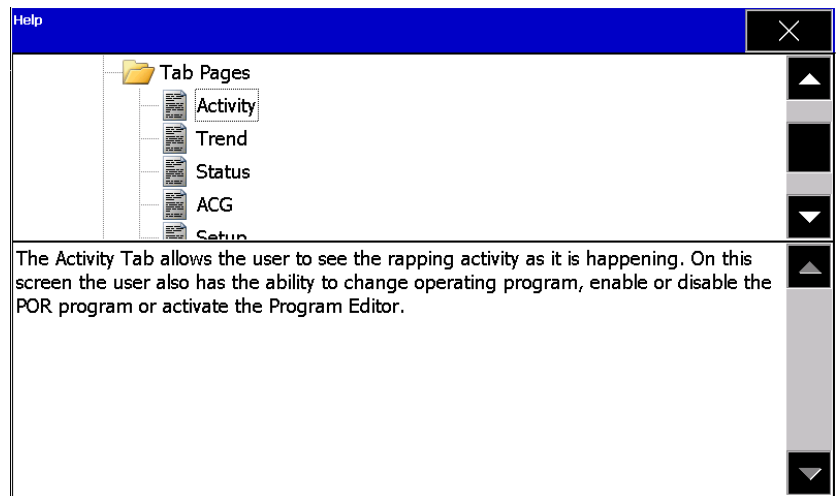
Display baud

This parameter sets the baud rate for the GDU communication port. The possible settings are, *9600, 19200, 38400, 57600, and 115200*. In order for the GDU to communicate on the same serial link as the NWL PCAMS or GRC-DCSi, the baud rate should be set for *19200*.

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.

Chapter 4: GRC Configuration

S-CPU

The S-CPU module requires setup of several parameters for proper system operation. These parameters are accessed through two different GDU screens.

Board Address


Prior to accessing these parameters the serial communications address for the S-CPU must first be set. If a complete rapper controller has been purchased, the S-CPU address has been set at the NWL factory. Otherwise, the user needs to insure that the address has been set. If the newer DSP version of the S-CPU board is being used, set the rotary selector switch that is located on the S-CPU board to the desired address per the table below.

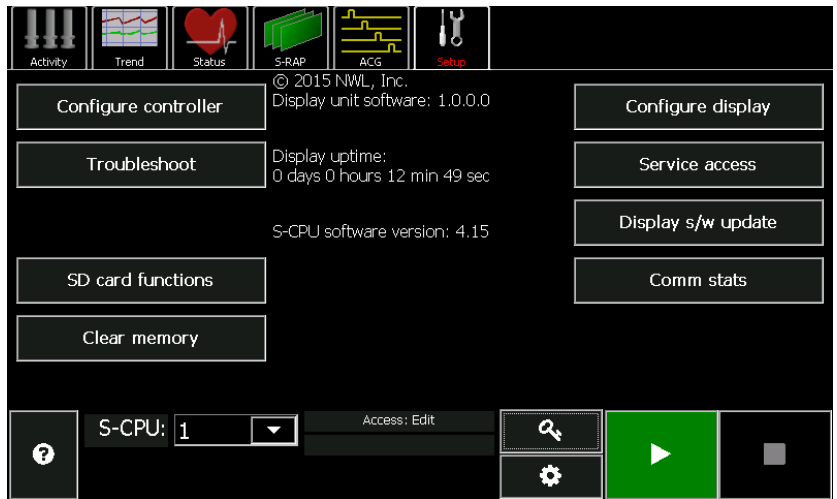
Switch Position	Board Address
0 or 1	1
2	2
3	3
4	4
:	:
F	15

If the older none DSP version of the S-CPU board is being used, set the dip switch 1 for the desired address as follows.

Board Address - Switch Positions 1 - 4

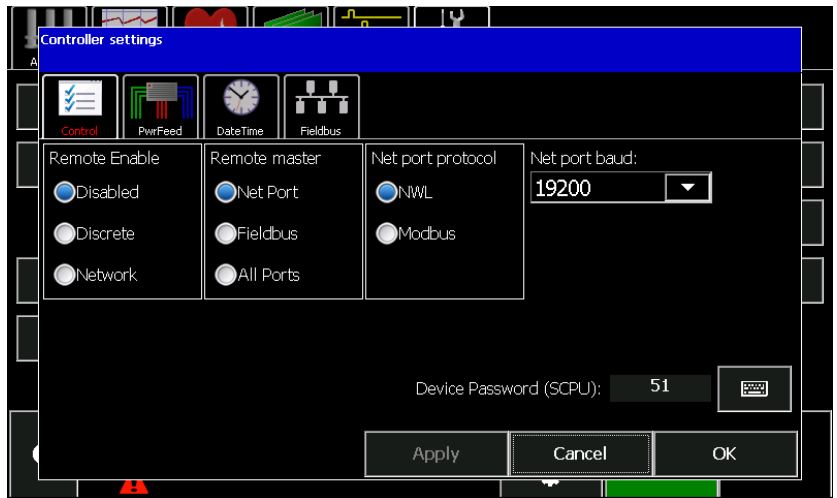
Switch Setting	Board Address
0 0 0 0	1
0 0 0 1	2
0 0 1 0	3
0 0 1 1	4
:	:
1 1 1 1	16

Once the address has been set go to the **Setup** screen  on the GDU.



Make sure that the *S-CPU*: parameter at the bottom of the screen is set to the address of the S-CPU board in the unit.

Press the **Configure controller** button. Next press the **Control** button.



Set the following parameters:

Remote Enable

Note: Please, refer to the GRC System schematics for reference terminal designators.

This is a software switch that will allow the User to operate the GRC in **Local** or **Remote** modes. The switch has 3 settings: **Disabled**, **Discrete**, and **Network**.

a) *Disabled*

This is a default setting. Most of the Users will operate in this mode. They will be able to send write commands to the GRC locally (from GDU) and remotely (PCAMS/NT and DCSi).

b) *Discrete*

In this mode the system software will monitor and respond to **Rem_Prg_On** input (1TB – 22 on the GRC System schematics) as long as the system is configured to **Remote** mode (120VAC is applied to **Loc/Rem Enable** input located on 1TB – 21 on GRC System Schematics).

If system is configured to **Remote** mode **all** write commands from GDU will be rejected. Write commands can be sent via PCAMS/NT or DCSi (**except Program ON/OFF command**).

To turn the Program ON remotely 120VAC must be applied to **Rem_Prg_On** input (1TB – 22 on GRC System schematics). To turn the Program OFF remotely 120VAC must be disconnected from **Rem_Prg_On** input. If 120VAC is not applied to **Loc/Rem Enable** input then the system will be in **Local** mode which means that write commands from GDU only will be accepted.

The common/neutral return for the 120 VAC must be connected to 1TB-9 on the GRC system schematics.

c) *Network*

In this mode the system software will monitor and respond to commands originating from PCAMS/NT or DCSi only as long the system configured to **Remote** mode (120VAC is applied to **Loc/Rem Enable** input located on 1TB – 21 on GRC System schematics). If system is in **Remote** mode **all** write commands from GDU will be rejected, **all** write commands from PCAMS/NT and DCSi will be accepted. If 120VAC is not applied to **Loc/Rem Enable** input (1TB – 21 on GRC System schematics) then the system will be in **Local** mode and accept write commands from GDU only.

Remote master

The DSP S-CPU board (G20650) has provisions for an optional fieldbus converter module. This module provides an additional

port for communicating with other host computers via an assortment of industrial protocols. This parameter is for defining which of these network ports will be the master port if the optional fieldbus converter is used. The master port is designated as the port which accepts commands and parameter changes via a remote host.

The parameter choices are:

a) *Net Port*

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

b) *Fieldbus*

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

c) *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 GRC. 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.

Net port protocol

The protocol for network port is selectable between *NWL* and *Modbus*. In *NWL* mode, our proprietary protocol is used to communicate with other NWL products. In *Modbus* mode, the Modbus RTU protocol is used for communications with a PLC or other host computer.

Net port baud

This parameter sets the baud rate for the Network port. The possible settings are, *9600, 19200, 38400, 57600, and 115200*. In order for the GRC to communicate with the NWL PCAMS the baud rate should be set for *19200*.

Local/Remote Control Table

The table below outlines the functionality of the Local/Remote features across all of the communication ports.

“Remote Enable” Setting	“Local/Remote” Discrete Input State	Local Port (NWL protocol only)	Remote Port (NWL protocol or Modbus-RTU)	Anybus Port	“Program On/Off” Discrete Input	“Program Select” Discrete Inputs
Disabled	Local or Remote	Write access	Write access if “Remote Master” is set to “Net Port” or “All”	Write access if “Remote Master” is set to “Fieldbus” or “All”	Disabled	Enabled
Discrete	Local	Write access	Read-only	Read-only	Disabled	Disabled
	Remote	Read-only	Read-only	Read-only	Enabled	Enabled
Network	Local	Write access	Read-only	Read-only	Disabled	Disabled
	Remote	Read-only	Write access if “Remote Master” is set to “Net Port” or “All”	Write access if “Remote Master” is set to “Fieldbus” or “All”	Disabled	Disabled

Device Password

This is the password that is stored in the S-CPU and to be used when the **Security Policy** parameter is set to *Device*. The password is a 2 digit alphanumeric value. Programmable from 00 – ZZ. The default password is 51.

Power Feeds

Next press the **PwrFeed** button on the **Configure controller** screen.

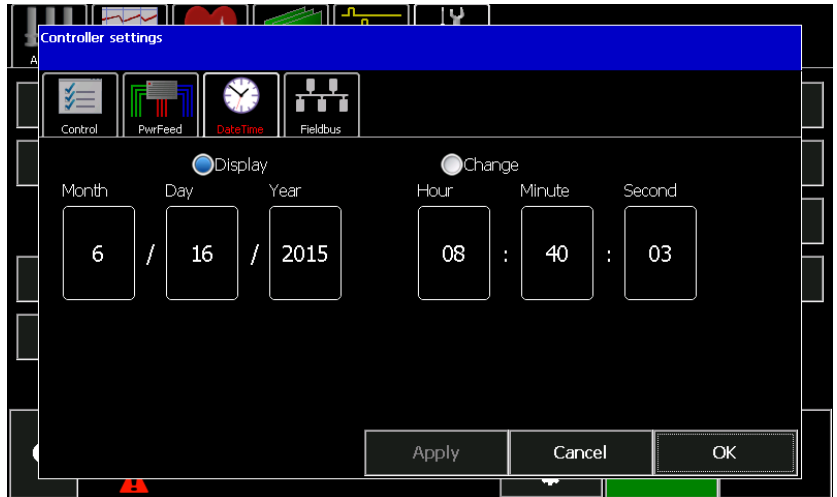


The power feed defines which S-RAP cards are connected each of the GRC power transformers. The S-CPU uses this information to insure that the power transformers are not overloaded during the operation of the rapping program.

The GRC System allows up to 6 separate power feeds. Each power feed is assigned to one or more S-RAP cards. Proper configuration of the power feeds is critical for rapper operation. Take a simple example of a GRC System with three S-RAP modules. S-RAP1 and S-RAP2 modules are responsible for energizing 16 DC-Impact style devices each. S-RAP3 module is responsible for energizing 16 AC Vibrator devices. The power feed assignments for *X1* should be *S-RAP 1 to 2* and *X2* should be assigned *S-RAP 3 to 3*. The GRC System's S-CPU utilizes this information to enable simultaneous rapper operation and to prevent system damage. For safety reasons, if the power feeds are not assigned, the S-CPU will not energize any rappers.

Date/Time

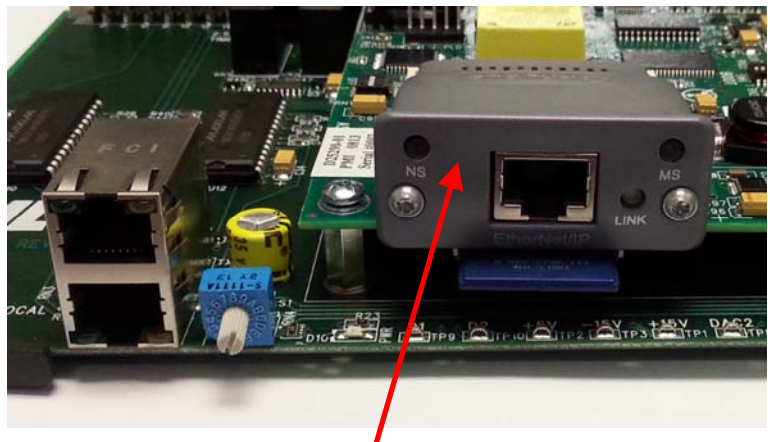
The S-CPU Date and Time are used for the Auto Program Select feature which will be described later in this manual. They can be viewed by pressing the **DateTime** button. This field is automatically synced to all of the S-RAP boards upon power up of the GRC and on an hourly basis thereafter and if the S-CPU date/time is changed.



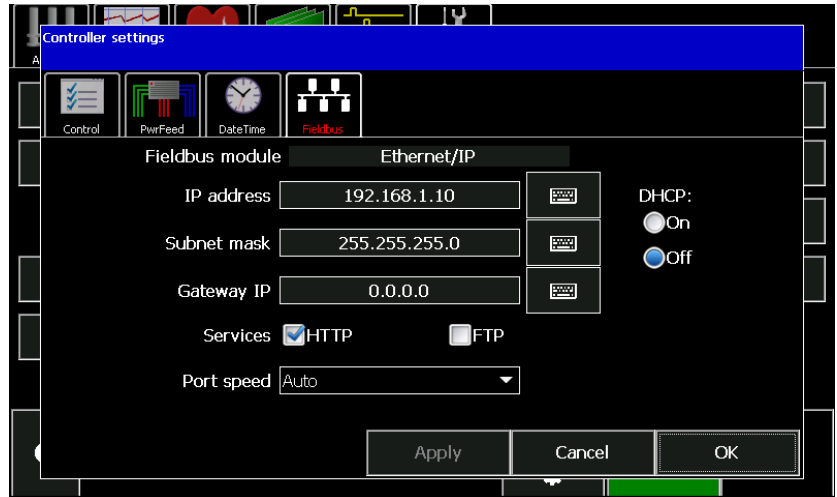
To edit the date or time, press the *Change* button then use the raise or lower arrows to enter the proper values. Press the *Apply* button when complete.

Fieldbus

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.




Optional Fieldbus Module



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 GRC 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.

Installing the Optional Field Bus Converter


If the rapper controller was ordered with the optional fieldbus converter, it will be installed at the factory. However, if you need to replace the SCPU board, the converter must be moved from the old board to the new board. To remove the old converter:

1. Remove the field wiring connector that plugs into the converter.
2. Remove the SCPU board from the card cage and place on a flat surface.
3. Use a Number 9 Torx screwdriver to turn the two screws on the front plate of the converter counter-clockwise to release the converter from the DSP board.
4. Grab the sides of the converter and gently pull it from the multi-pin jack.

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

1. Make sure that the mounting feet on the module are fully retracted by turning the two screws on the front plate counterclockwise.
2. Carefully line up the module with the mounting rails of the jack. Slowly and carefully start to slide the module into the jack. **As the module approaches the pins in the back of the jack, stop and visually verify that all of the pins in the jack are properly aligned and entering the sockets in the module. If the pins are not properly aligned damage will occur to the jack on the DSP board.** If the pins are all aligned, continue to slowly push the module into the jack until it is fully seated. Ensure that the tabs on the module slide under the rails on the connector's side arms and that the front tab slides under the actual printed circuit board. This may require slight downward pressure on the module while inserting the module into the jack.
3. Use a Number 9 Torx screwdriver to turn the two screws on the front plate of the module clockwise to secure the module to the DSP board.

4. Replace the SCPU card in the card cage.
5. The users wiring will then connect directly to the connector on the field bus module.

The remaining S-CPU parameters can be found by pressing the Operating Parameter Settings button  located below the Sign On button and next to the On button on the bottom section of any of the menu bar screens. Next press the **Settings** button and then the **1** button.



Relay Logic

The GRC contains a common alarm relay to notify operators in a control room, sound an alarm horn, or simply light an indicator. The logic of the relay is programmable as *N.O.* (normally open – closes on alarm), or *N.C.* (normally closed – opens on alarm).

Program off

If you would like the GRC to generate an alarm if the rapping program is turned off, set this parameter to *Alarmed*. If you

want to be able to turn the rapping program off without getting an alarm set this parameter to *No Alarm*.

Number of alarms

Being notified of every alarm may eventually become a nuisance. By setting the number of alarms value to something other than 1, the S-CPU will delay activation of the alarm relay until that number of alarms occurs. Programmable from 0 – 99.

Program restart

When the operating program is turned on, the S-CPU will either re-start the program or continue from where it previously left off. Re-starting the operating program causes all timers to be initialized at 0 and the sequence pointer returns to the start of the rapping sequence. Programmable as *Continue* or *Re-start*. Changing to a different operating program will always start at the beginning of that program.

Boiler load scale

If the boiler load 4-20mA signal is connected to the GRC, the scale value represents what value should be displayed at 20mA or full scale. Programmable from 0 – 9999.

The remaining parameters are set by pressing the **2** button under the Settings screen.



Flow delay

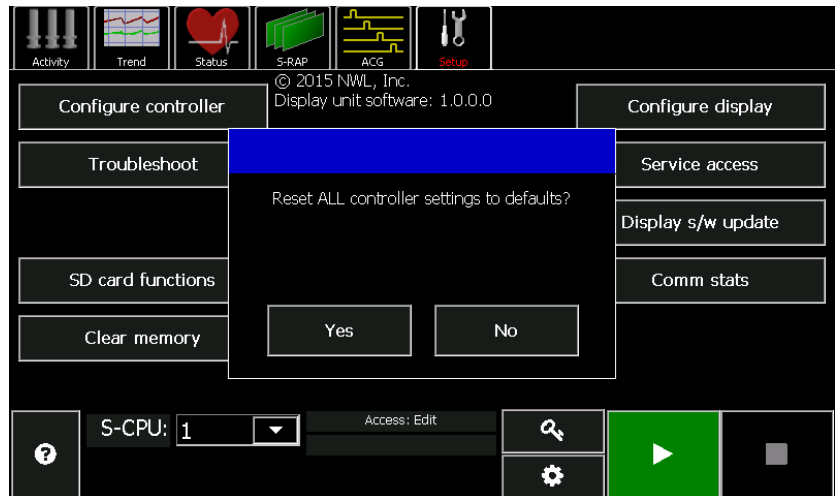
The flow delay is defined as the amount of time it takes for gas to completely travel through the precipitator. This value is used for determining which devices are suspected of causing opacity spikes. Programmable from 0 – 99 seconds.

Opacity spike

The GRC system has a unique feature that identifies which rappers are suspected of causing opacity spikes. This value defines what percentage of an increased in sudden opacity is required to enable a opacity spike scan. Programmable from 0 – 99%.

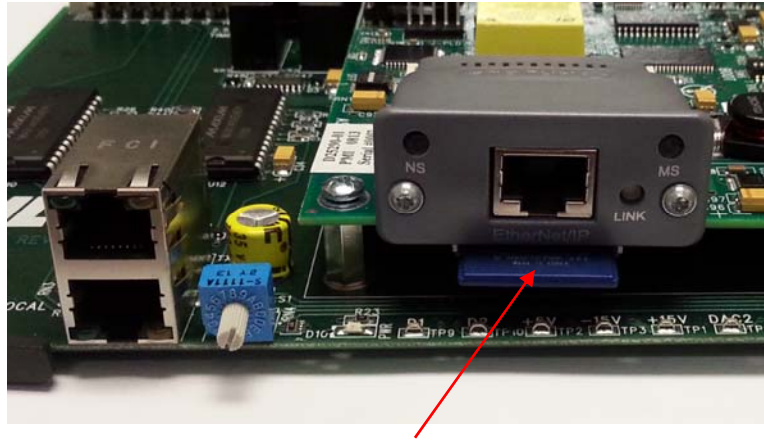
Clearing Memory

All of the S-CPU settings can be restored to the default values by pressing the **Clear Memory** button on the **Setup** page.



S-CPU 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.



SD Card Location

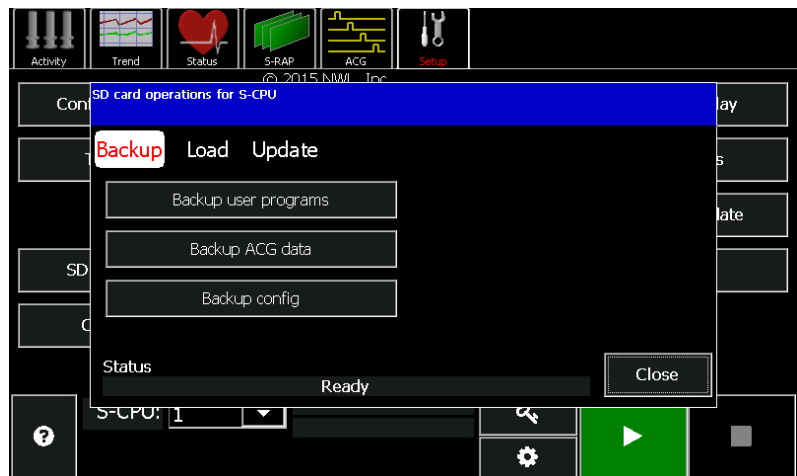
The SD card holds the following files:

- User Rapping Programs (SCPU_PGM.DAT)
- User ACG Data (SCPU_ACG.DAT)
- User Saved Configuration files (SCPU_UCF.CSV)
- Auto Saved Configuration files (SCPU_ACF.CSV)
- Log File (SCPU_LOG.CSV)

To access the S-CPU SD card functions press the **Setup** button



on the main menu bar. Then press the **SD card functions** button.



The **Backup** button can be used to:

Backup users programs – makes a backup of the five user programs that are stored in the S-CPU on the SD card..

Backup ACG data – makes a backup of the ACG groups and timing on the SD card.

Backup config – makes a backup of the S-CPU configuration parameters on the SD card.

The **Load** button can be used to load the user programs, ACG data, and configuration parameters from the SD card back into the S-CPU.

The **Update** button can be used to update the firmware in the S-CPU card. This will be described in the Updating Firmware Chapter of this Users Guide.

Smart-Rap-DSP

This section will describe the configuration of the DSP version of the S-RAP boards (NWL #D20659-AC & DC). One of the features of the DSP version is the elimination of the majority of the dip switches that were located on the board. These DIP switch settings are now stored in Non-Volatile memory and are easily backed up and restored via the SD-Card interface.

Board Address

If a complete rapper controller has been purchased, the S-RAP addresses have been set at the NWL factory. If you are exchanging or installing new boards, the proper board addresses will have to be set.

The board address for the S-RAP-DSP (D20659-AC or DC) is now set by two 10 position rotary selector switches as opposed to the prior DIP switches which required the user to be knowledgeable of binary coding. The upper switch will be used to set the first address digit (0-6) the lower will be used to set the second address digit (0-9) which will combine to set the board address within the allowable range of 01 to 64. For example to set a board address to 26 the upper switch will be set to 2 and the lower set to 6.

If the output LED's on the S-RAP board are flashing in a pattern that alternates between even and odd LED's being turned on, the board has an illegal address set.

Baud rate

To set the baud rate for the S-RAP boards, start by pressing the



S-RAP button on the main menu bar. The following screen will appear.



Set the *S-RAP*: parameter to the desired address. Press the **Configure** button and then the **Settings** button on the next screen.



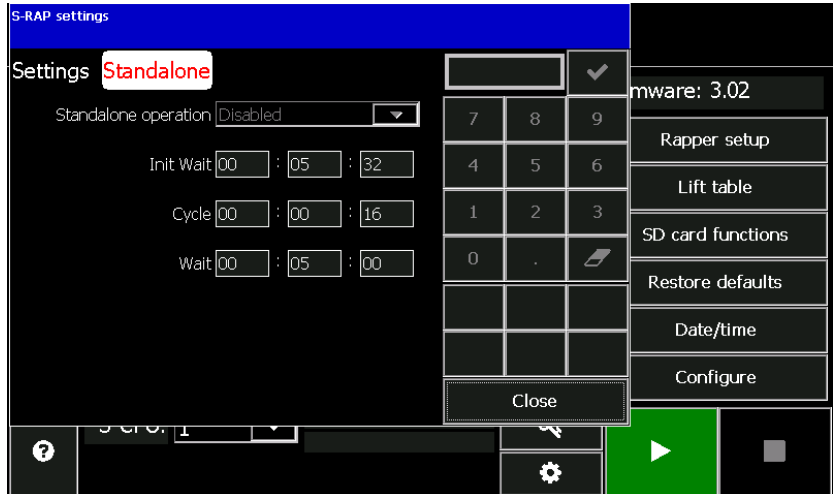
Set the **Net port baud** to the desired baud rate. The possible settings are, *9600, 19200, 38400, 57600, and 115200*. In order for the S-RAP to communicate with the NWL PCAMS and the older NWL S-CPU boards, the baud rate should be set for *19200*.

Standalone Operation

The S-RAP boards can be configured to switch over to a standalone mode of operation communication with the S-CPU

stops. In this case each S-RAP will energize all 16 outputs sequentially based on a pre-defined schedule. Since each S-RAP is acting independently, it is important that these parameters be adjusted such that simultaneous rapping does not occur on a single power feed. Otherwise the power transformer fuses may fail.

Press the **Standalone** button in the **Configure** window under the **S-RAP** screen.



Set the **Standalone operation** parameter to either *Disabled* or *Enabled*. Set the standalone timing parameters as follows:

Init Wait

The initial wait time of the S-RAP board is defined as the “one-time” delay before initiating rapper activity. The initial wait time is useful for offsetting S-RAP boards with identical timing. For example, S-RAP 1 and 2 both have a cycle time of 48 seconds (see Cycle time below). With an initial delay of 0, both boards will schedule rappers to fire at the same time. By assigning a 48-second initial wait time to S-RAP 2, S-RAP 1 will be completed firing before S-RAP 2 starts. Programmable from 00:00:16 to 02:00:00 in 16 second increments. If a value other than a 16 second increment is entered, the system will automatically increase and/or decrease in the 16 second increment.

Cycle

The cycle time of a S-RAP is defined as the amount of time it takes to completely “cycle” through all sixteen outputs on the board. Rappers will be evenly space throughout a group’s cycle time. For example, a board with a cycle time of 48 seconds will attempt to fire a rapper every 3 seconds ($48 / 16 = 3$). Programmable from 00:00:00 to 23:59:59.

Wait

The wait time of an S-RAP is defined as the amount of time to delay after the completion of a cycle period before restarting the cycle mode. For example, an S-RAP is assigned a wait time of 30 seconds. When the board completes the rapper sequence (fires all 16 rappers), it will “sleep” for 30 seconds and not attempt to fire any rappers. After the 30 second delay, the board will re-enter the cycle mode and attempt to fire the rappers again. Programmable from 00:00:00 to 23:59:59.

Device Type

The device type setting is used for identifying the specific type of device that the S-RAP board will be energizing. Each board can only be configured for one type of device. All sixteen outputs will be expected to be operating that type of device.

Go back to the **S-RAP** screen.



Press the **Rapper configure** button.



Make sure the **S-RAP:** parameter is set for the desired S-RAP address. Using the pulldown option on the next parameter, select the proper device type for that board. The options are: *120V MIGI, AC vibrator, AC/DC motor, Multi-impact, DC vibrator, POR output, or 240V MIGI.*

Lift regulation

Lift regulation is useful if changes in the ambient temperature causes changes in the coil resistance of the device which causes changes in the lift. If the **Lift regulation** is *On* then the number of half-cycles of voltage applied to the device will be adjusted to achieve the desirable Lift value; if the **Lift Regulation** is *Off* then the number of half-cycles will not be adjusted.

Standalone Settings

When a S-RAP board is configured to operate in “stand-alone” mode, the information used for firing the devices is setup in this window. In addition to stand-alone operation, the GRC System S-RAP module will automatically initiate energizing devices with these settings in the occurrence of an S-CPU failure.

The parameters can be set by highlighting the desired output # or pressing the Select all button then pressing the Edit button.

Output #

Shows the rapper output number (1-16) on the S-RAP module.

Lift

Sets the lift in inches for the MIGI style rappers. This value is used in stand-alone and auto-redundant modes only.

Programmable from 0 – 16 inches.

Frequency

Sets the frequency in cycles per minute for Multi-Impact type devices. Programmable in 13 preset steps from 200 to 600 CPM. Valid values are 200, 212, 225, 240, 257, 278, 300, 330, 360, 390, 450, 510, and 600. Press the <+Incr> or <-Decr> key to scroll through the available settings and press <Enter> to accept the change.

Intensity

Sets the intensity percentage for Vibrator and Multi-Impact type devices. Programmable from 0 – 100%. Changes to the intensity less than 100% will result in ½ cycles of power applied at less than full conduction.

Duration

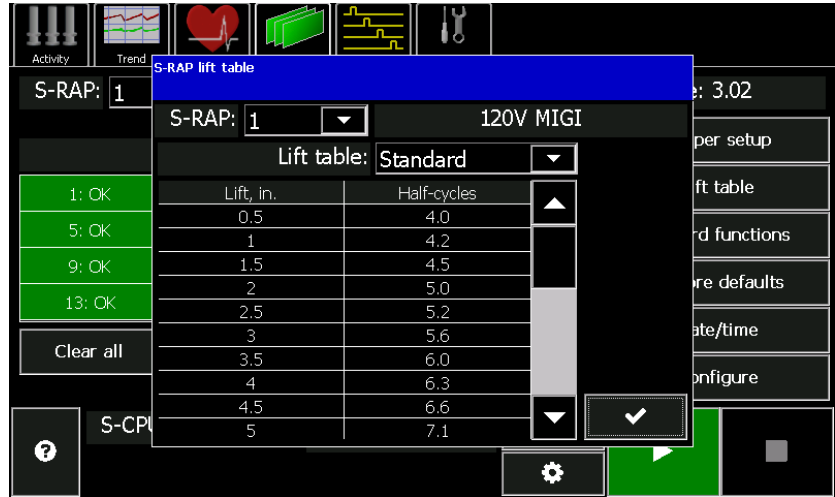
Sets the duration in seconds of Vibrator, Multi-Impact, and Motor type devices. Programmable from 00:00:00 to 23:59:59.

Undercurrent/Overcurrent

Each rapper output can be assigned current low and high alarm levels. When the S-RAP module detects 2 consecutive ½ cycles of current lower than the **Undercurrent** setting, it will flag the rapper output. Two consecutive failures will result in the output to be alarmed and removed from normal firing activity. The same will occur when the S-RAP detects a single ½ cycle of current higher than the **Overcurrent** setting. The default value for the **Undercurrent** is 1 amp and for the **Overcurrent** is 40 amp. The **Overcurrent** value should be adjustable to just under twice the operating current of any single device. This way if a triac fails and two devices on a single card are being energized, an alarm will occur and shutdown the SCR's before a fuse fails.

Lift Table

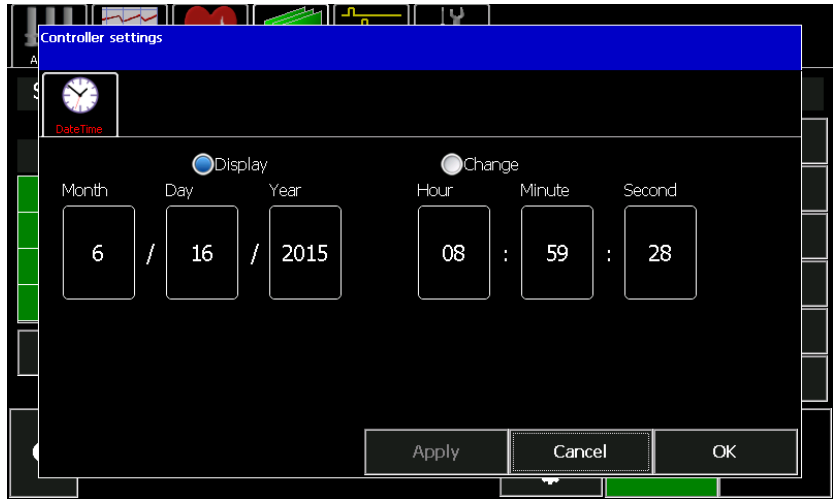
The lift table is what the S-RAP board uses to determine how many half cycles of power is required to achieve the desired lift for the specific type of MIGI being used. It is only applicable for MIGI devices. Press the **Lift table** button on the **S-RAP** screen.



The Standard table is the default. The Custom table is generated through the Calibration process which is described later in the manual.

Date/time

The Date and Time are used when logging events to the SD card on each S-RAP board. They can be viewed by pressing the **Date/time** button. The time for any individual S-RAP card can be entered here, however the date/time from the S-CPU card will automatically be synced to all of the S-RAPs boards at power up of the GRC and on an hourly basis thereafter and if the S-CPU date/time is changed.



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.

Restore Defaults

All of the S-RAP settings can be restored to the default values by pressing the **Restore defaults** button on the **S-RAP** page.



S-RAP SD Card

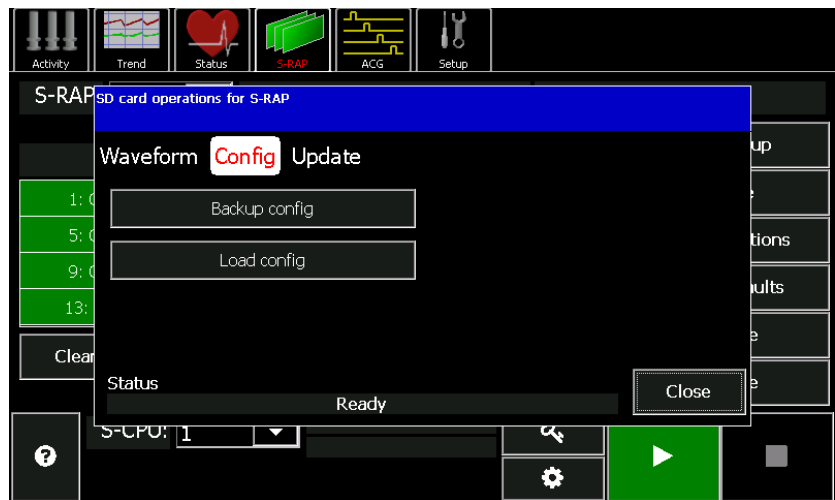
Each S-RAP board also has provisions for a 2 or 4 GB SD memory card. The card is located below the two rotary switches for setting the serial address.

The card contains the following files:

- User Saved Configuration file (USERHREG.CSV)
- Auto Saved Configuration file (HREG.CSV)
- Event Log (NWLLOG.CSV)
- Waveform file (WAVE.CSV)
- Diagnostic file for NWL use (DIAG.CSV)

The SD card features can be accessed by pressing the **SD card**

functions in the **S-RAP**  window.



The **Config** button will allow the backup and the loading of the S-RAP configuration parameters to/from the SD card.

The **Waveform** button is used to store a waveform from the device and will be further described in the Troubleshooting chapter.

The **Update** button is used to update the firmware in the S-RAP card. This will be further described in the Updating Firmware chapter.

Smart-Rap-Non DSP

This section will describe the configuration of the non-DSP version of the S-RAP boards (NWL #D20651-01 & 02). On this version of the S-RAP most of the configuration is performed by setting dip switches on the board. The same screen displays as previously described can be used to view the settings of the dip switches, but they cannot be set via the GDU.

Board Address

Again, if a complete rapper controller has been purchased, the S-RAP addresses have been set at the NWL factory. If you are exchanging or installing new boards, the proper board addresses will have to be set.

The board address can be configured using DIP Switch 8. The range of rapper outputs are assigned to a particular S-RAP address.

The table below links a particular S-RAP address to its corresponding rapper output range and DIP Switch 8 configuration.

Note: S-RAP board addresses 1...64 are binary 0...63

S-RAP board address	Rapper outputs range	Switch 8 position							
		1	2	3	4	5	6	7	8
1	1-16	x	x	0	0	0	0	0	0
2	17-32	x	x	0	0	0	0	0	1
3	33-48	x	x	0	0	0	0	1	0
4	49-64	x	x	0	0	0	0	1	1
5	65-80	x	x	0	0	0	1	0	0
6	81-96	x	x	0	0	0	1	0	1
7	97-112	x	x	0	0	0	1	1	0
8	113-128	x	x	0	0	0	1	1	1
9	129-144	x	x	0	0	1	0	0	0
10	145-160	x	x	0	0	1	0	0	1
11	161-176	x	x	0	0	1	0	1	0
12	177-192	x	x	0	0	1	0	1	1
13	193-208	x	x	0	0	1	1	0	0
14	209-224	x	x	0	0	1	1	0	1
15	225-240	x	x	0	0	1	1	1	0
16	241-256	x	x	0	0	1	1	1	1

NWL ENVIRONMENTAL TECHNOLOGIES

		1	2	3	4	5	6	7	8
17	257-272	x	x	0	1	0	0	0	0
18	273-288	x	x	0	1	0	0	0	1
19	289-304	x	x	0	1	0	0	1	0
20	305-320	x	x	0	1	0	0	1	1
21	321-336	x	x	0	1	0	1	0	0
22	337-352	x	x	0	1	0	1	0	1
23	353-368	x	x	0	1	0	1	1	0
24	369-384	x	x	0	1	0	1	1	1
25	385-400	x	x	0	1	1	0	0	0
26	401-416	x	x	0	1	1	0	0	1
27	417-432	x	x	0	1	1	0	1	0
28	433-448	x	x	0	1	1	0	1	1
29	449-464	x	x	0	1	1	1	0	0
30	465-480	x	x	0	1	1	1	0	1
31	481-496	x	x	0	1	1	1	1	0
32	497-512	x	x	0	1	1	1	1	1
33	513-528	x	x	1	0	0	0	0	0
34	529-544	x	x	1	0	0	0	0	1
35	545-560	x	x	1	0	0	0	1	0
36	561-576	x	x	1	0	0	0	1	1
37	577-592	x	x	1	0	0	1	0	0
38	593-608	x	x	1	0	0	1	0	1
39	609-624	x	x	1	0	0	1	1	0
40	625-640	x	x	1	0	0	1	1	1
41	641-656	x	x	1	0	1	0	0	0
42	657-672	x	x	1	0	1	0	0	1
43	673-688	x	x	1	0	1	0	1	0
44	689-704	x	x	1	0	1	0	1	1
45	705-720	x	x	1	0	1	1	0	0
46	721-736	x	x	1	0	1	1	0	1
47	737-752	x	x	1	0	1	1	1	0
48	753-768	x	x	1	0	1	1	1	1
49	769-784	x	x	1	1	0	0	0	0
50	785-800	x	x	1	1	0	0	0	1
51	801-816	x	x	1	1	0	0	1	0
52	817-832	x	x	1	1	0	0	1	1
53	833-848	x	x	1	1	0	1	0	0
54	849-864	x	x	1	1	0	1	0	1
55	865-880	x	x	1	1	0	1	1	0
56	881-896	x	x	1	1	0	1	1	1
57	897-912	x	x	1	1	1	0	0	0
58	913-928	x	x	1	1	1	0	0	1
59	929-944	x	x	1	1	1	0	1	0
60	945-960	x	x	1	1	1	0	1	1
61	961-976	x	x	1	1	1	1	0	0

		1	2	3	4	5	6	7	8
62	977-992	x	x	1	1	1	1	0	1
63	993-1008	x	x	1	1	1	1	1	0
64	1009-1024	x	x	1	1	1	1	1	1

Standalone Operation

The S-RAP module can be configured to operate in “Stand-Alone Mode” (without a S-CPU). The following DIP switches are used for configuring stand-alone operation and the associated parameters.

Switch 1 - Stand-Alone Operation

Switch Setting	Description
0	Disabled
1	Enabled

Switch 2 - Use Stand-Alone DIPs or Internal Register Values

Switch Setting	Description
0	DIPs
1	Registers

Switches 3, 4, 5 - Initial Wait, Cycle, & Wait Time (x 5 multiplier)

Switch Setting	Description
0 0 0 0	0 minutes
0 0 0 1	5 minutes
0 0 1 0	10 minutes
0 0 1 1	15 minutes
:	:
1 1 1 0	70 minutes
1 1 1 1	75 minutes

Note: For *cycle time only*, a setting of 0 seconds represents a 16 second cycle time.

Switch 6 - Device Fire Settings

Switch Setting	DC Impact	AC/DC Vibrator & DC Multi-Impact	AC/DC Motor
	Lift (inches)	Duration (seconds)	Duration (minutes)
0	4	2	5
1	8	4	Fire All Continuous

Stand-Alone Operation Defaults

DC Impact	Number of Times in Sequence = 1
AC Vibrator	Intensity = 100%
DC Vibrator	Intensity = 100%
DC Multi-Impact	Intensity = 100%, Frequency = 300 CPM
AC/DC Motor	Intensity = 100%

Device Type

The device type setting is used for determining specific methods of energizing devices. The following DIP switches must be setup for each S-RAP module before operation:

Switch 7 - Device Type

Switch Setting	Description
0 0 0	120 V Migi
0 0 1	AC Vibrator
0 1 0	AC/DC Motor
0 1 1	DC Multi-Impact
1 0 0	DC Vibrator
1 0 1	T/R POR Outputs
1 1 0	240 V Migi

Standalone Settings Using Internal Registers

The S-RAP module can also be configured using a GDU or PC to setup registers for the parameters listed below. These values will be used for Smart System rapping and Stand-Alone rapping if Switch 2 is set to 1 for “Registers”.

These registers can be set by pressing the Rapper setup button on the S-RAP screen.



The parameters can be set by highlighting the desired output # or pressing the Select all button then pressing the Edit button.

Output #

Shows the rapper output number (1-16) on the S-RAP module.

Lift

Sets the lift in inches for the MIGI style rappers. This value is used in stand-alone and auto-redundant modes only. Programmable from 0 – 16 inches.

Frequency

Sets the frequency in cycles per minute for Multi-Impact type devices. Programmable in 13 preset steps from 200 to 600 CPM. Valid values are 200, 212, 225, 240, 257, 278, 300, 330, 360, 390, 450, 510, and 600. Press the <+Incr> or <-Decr> key to scroll through the available settings and press <Enter> to accept the change.

Intensity

Sets the intensity percentage for Vibrator and Multi-Impact type devices. Programmable from 0 – 100%. Changes to the intensity less than 100% will result in ½ cycles of power applied at less than full conduction.

Duration

Sets the duration in seconds of Vibrator, Multi-Impact, and Motor type devices. Programmable from 00:00:00 to 23:59:59.

Undercurrent/Overcurrent

Each rapper output can be assigned current low and high alarm levels. When the S-RAP module detects 2 consecutive ½ cycles of current lower than the **Undercurrent** setting, it will flag the rapper output. Two consecutive failures will result in the output to be alarmed and removed from normal firing activity. The same will occur when the S-RAP detects a single ½ cycle of current higher than the **Overcurrent** setting. The default value for the **Undercurrent** is 1 amp and for the **Overcurrent** is 40 amp. The **Overcurrent** value should be adjustable to just under twice the operating current of any single device. This way if a triac fails and two devices on a single card are being energized, an alarm will occur and shutdown the SCR's before a fuse fails.

Lift Table Select

Lift Table is used for DC Impact type devices only. There are two Lift Tables: Default Lift Table and Calibration Lift Table. S-RAP can be configured to use a certain Lift Table. This is done by asserting position 1 of the Switch 8.

Switch Setting	Lift Table
0 x x x x x x x	Default
1 x x x x x x x	Calibration

Gain Switch

This switch will be set according to the load current range. If current range is from 0 to 10 Amps then the most accurate current measurement will be achieved with Gain Switch set to HIGH position. It could be set to LOW position, but the accuracy of the current measurement will be lower. If current range is greater than 0 to 10 Amps then the switch must be set to LOW position.

Switch S10 – Gain Switch


Gain	How to Set
Low	Switch moved toward U5 chip
High	Switch moved away from U5

Chapter 5: Operating Programs

The most important aspect of a rapper controller is the creation of optimum rapping programs. Rapper programs consist of timing values, lift information, etc. and are all important to achieving optimum performance. Either through experience or trial and error, operators can fine tune programs to produce the most effective results in the precipitator. The GRC System supports what the industry considers a “time-based” rapper controller. This type of controller is more flexible than older style “sequence-based” rapper controllers. Independent groups of rappers can be assigned different timing values. This is important for rapping inlet fields more often than center fields, and center fields more often than outlet fields. The GRC offers the most complex program capabilities in the industry. Up to 64 groups, 48 rappers per group, individual settings per rapper, and no limitation on assigning rappers to more than one group provide the user with the flexibility to create just about any program they desire. The user can “upload” a program into the memory of the GDU and make modifications while rapper firing continues in the background. When the changes are complete, the program can be saved or “downloaded” to the S-CPU and stored in FLASH memory.

The GRC is not pre-programmed at the NWL factory. The programs must be generated and installed based on the specific configuration of the ESP.

Creating a New Program

Start by pressing the **Activity** button  on the main menu bar.



Next press the Edit icon in the upper right corner of the screen.

If there are no programs that were previously loaded in the GDU program buffer a “*Program buffer is empty*” message will appear on the screen. This means that although there may be operating programs that are stored in the S-CPU, there are none in the GDU editor. At this point either a new program can be created or a previously stored one can be loaded into the GDU.

Since we are creating a new program, press the new program



icon in the lower left corner of the screen. A pop-up window will appear.



Press the **Create new operating program** button.



Since the GRC is a timed based system, the programmer must first define which rappers will be grouped together. All the rappers in a group will operate with the same timing parameters as defined below.

Group

Shows the current group number (1-64).

Init. Wait

The initial wait time of a group is defined as the “one-time” delay before initiating rapper activity. The initial wait time is useful for offsetting groups of rappers with identical timing. For example, groups 1 and 2 both have 10 rappers and a cycle time of 30 seconds (see Cycle time below). With an initial delay of 0, both groups will schedule rappers to fire at the same time. By assigning a 30-second initial wait time to group 2, group 1 will be completed firing before group 2 starts. Programmable from 00:00:00 to 23:59:59. See program example section below for a better understanding of the timing interaction.

Cycle

The cycle time of a group is defined as the amount of time it takes to completely “cycle” through all the assigned rappers. Rappers will be evenly space throughout a group’s cycle time. For example, a group with 10 rappers and a cycle time of 30 seconds will attempt to fire a rapper every 3 seconds (30 / 10 = 3). Groups that have 0 cycle time will be disabled regardless of whether rappers are assigned. Programmable from 00:00:00 to 23:59:59. See program example section below for a better understanding of the timing interaction.

Wait

The wait time of a group is defined as the amount of time to delay after the completion of a cycle period before restarting the cycle mode. For example, a group is assigned a wait time of 30 seconds. When the group completes the rapper sequence (fires all rappers), it will “sleep” for 30 seconds and not attempt to fire any rappers. After the 30 second delay, the group will re-enter the cycle mode and attempt to fire rappers. Programmable from 00:00:00 to 23:59:59. See program example section below for a better understanding of the timing interaction.

Mode

The GRC system allows for different “modes” of how the rappers will function. There are five modes to choose from.

1) *Normal*

This mode will raise the individual rapper once, at the assigned **lift** entered in the *SEQ* field, before moving onto the next rapper in that group sequence.

2) *Rip-rap*

This mode is used to turn the GRC feature “Rip/Rap” *On*. When *Rip-rap* is selected, the DC Impact devices will be fired using the Rip/Rap algorithm. Four “Rips” of power with increasing energy are applied to the rappers with the fourth “Rip” equal to the assigned **Lift** entered in the *SEQ* field.

3) *2x*

This mode will raise the individual rapper two times in succession, at the assigned **lift** entered in the *SEQ* field, before moving onto the next rapper in that group sequence.

4) *3x*

This mode will raise the individual rapper three times in succession, at the assigned **lift** entered in the *SEQ* field, before moving onto the next rapper in that group sequence.

5) *4x*

This mode will raise the individual rapper four times in succession, at the assigned **lift** entered in the *SEQ* field, before moving onto the next rapper in that group sequence.

NOTE:

For proper operation, when selecting the Rip-rap, 2x, 3x, or 4x modes, ensure the groups cycle time is set to allow a minimum

of 2 seconds for each DC Impact device. For example, let's say group #1 consists of 90 rappers and *Rip-rap* is selected, the group cycle time, at a minimum, would need to be set to 180 seconds or 3 minutes.

Rappers


The column identifies which devices are included in the group.

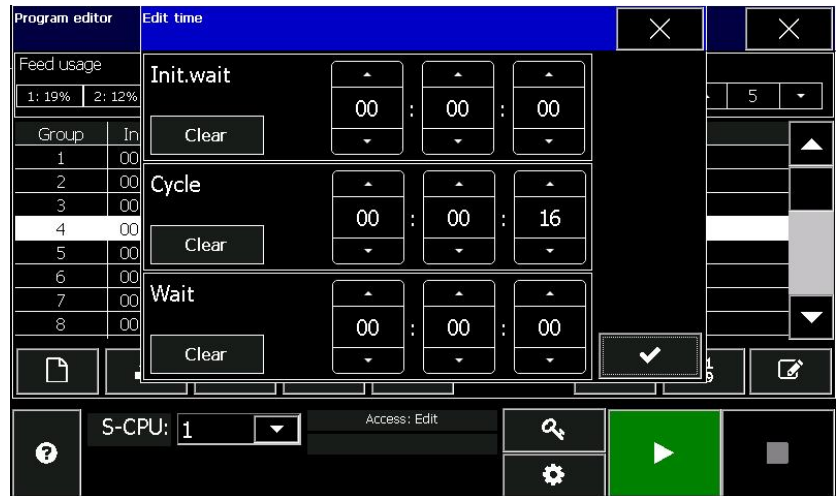
Feed Usage



The GRC will perform a timing check on the operating program and verify that each power feed has the capability to fire all devices before allowing it to be saved to the S-CPU. This prevents “lost” rappers due to timing constraints. The usage is expressed in terms of a % of maximum. Any feed usage should not exceed 100%.


Entering Group Timing

To enter the desired timing for each rapper group, start by highlighting the group by touching the Group # in the program table.

Then press the timing icon .




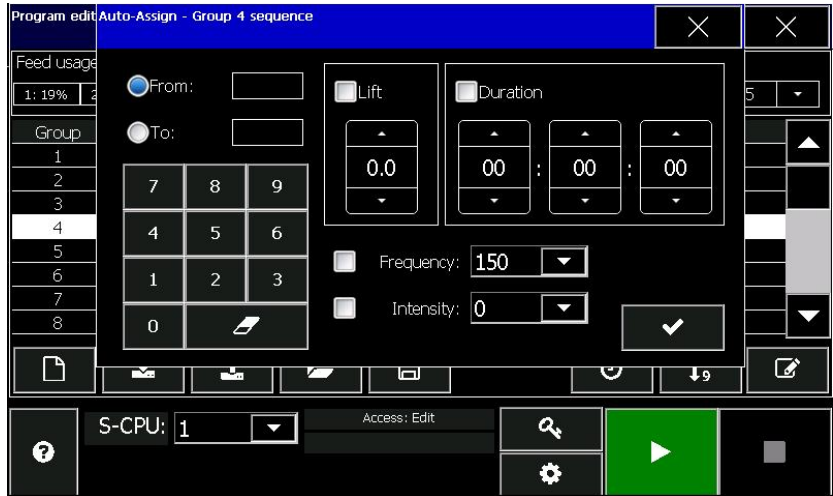
Enter the desired timing by using the  and  buttons for each of the parameters.

Press the  button when complete. Repeat for each of the groups within the rapper program.

Assigning Devices to a Group

To assign devices to each rapper group, start by highlighting the group by touching the Group # in the program table.

Then press the icon .



From: & To:

These fields provide a shortcut for assigning rapper output numbers to a sequence. Set the starting and ending rapper output number using the numeric keypad on the screen. Press the **From:** radio button to enter the starting output number in the group and the **To:** radio button to enter the last rapper output number in the group. The GDU will automatically assign rappers to the group's sequence. The sequence can be in either ascending or descending order of output number.

Lift

If the rappers assigned for this group are DC Impact type devices, and the lift is to be the same for the each device within the group, press the **Lift** box and enter the desired lift in inches. Otherwise, this parameter can be ignored. Programmable from 0 to 16 inches in .5 inch steps.

Duration

If the devices assigned for this group are Vibrators, Multi-Impacts, or Motor type devices, and the duration is to be the same for all devices in the group, press the **Duration** box and enter the desired duration value in seconds. Programmable


from 00:00:00 to 23:59:59. For DC Impact type devices, verify this value is 00:00:00 to prevent inaccurate results to the program timing check.

Frequency

If the devices assigned for this group are Multi-Impact type devices, press the **Frequency** box and enter the desired frequency in cycle per minute. Programmable in 13 preset steps from 200 to 600 CPM. Valid values are 200, 212, 225, 240, 257, 278, 300, 330, 360, 390, 450, 510, and 600. The setting will be applied to all devices within the group.


Intensity

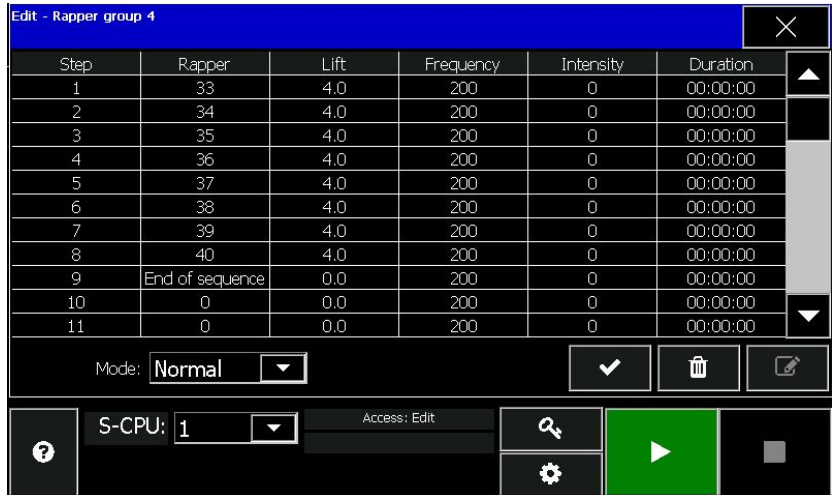
If the devices assigned for this group are Vibrators or Multi-Impact type devices, press the **Intensity** box and enter the desired intensity value in percentage. Programmable from 0 – 100%. Changes to the intensity less than 100% will result in ½ cycles of power applied at less than full conduction. This field must be set to 0 for AC/DC Motor type devices to prevent inaccurate results in Program Timing check. The setting will be applied to all devices within the group.

Press the  button when complete. Repeat for each of the groups within the rapper program.

Changing Parameters for an Individual Device


If the individual devices within a group require individual Lift, Frequency, Intensity, Duration, or a custom sequence they can be edited. Start by highlighting the group by touching the Group # in the program table.

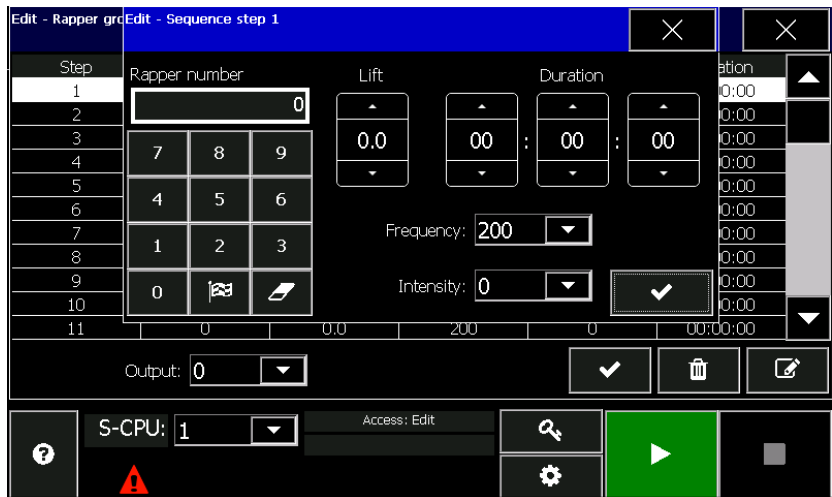
Then press the edit icon .




This screen is also used for setting the **Mode** parameter for the entire group. Select *Normal*, *Rip-rap*, *2x*, *3x*, or *4x* from the pull down box.

Next press the sequence step number that you wish to edit.

Then press the edit icon .

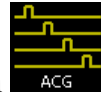


The desired rapper output number, Lift, Duration, Frequency, and Intensity can be set for the selected sequence step.

Press the  button when complete. Repeat for each of the sequence steps/groups to be edited.

Anti-Coincidence Grouping

Each of the GRC System’s program groups operates with individual timers and sequences. In order to prevent rappers within the same precipitator lane to fire together, anti-coincidence groups (ACG) must be configured. The GRC System supports up to 64 ACG’s. Each rapper can be configured to be in up to 4 different ACG’s.



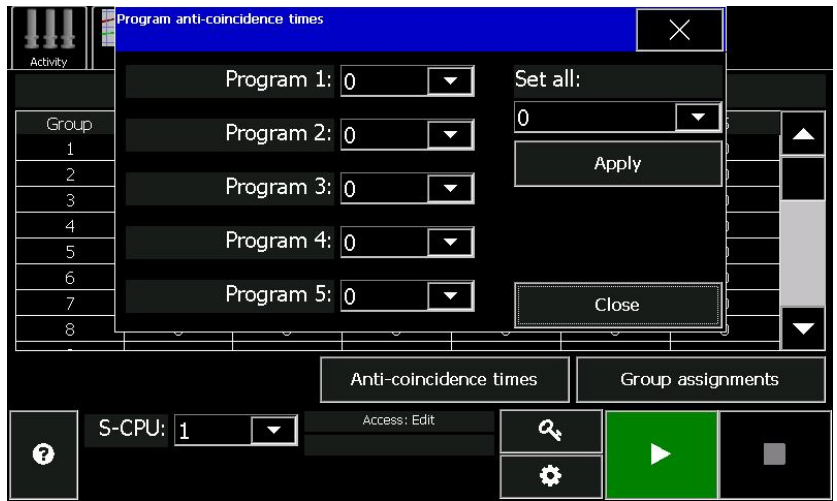
Press the ACG button on the main menu bar to start.

Group	Timer	1	2	3	4	5
1	5	5	1	3	6	8
2	4	4	14	15	16	0
3	0	0	4	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0

While the system is operating, the ACG FIFO’s (First In First Out) can be viewed from this screen. The table shows the first five devices in the firing queue for each of the 64 ACG’s. The presence of the red line represents an overflow. This occurs when system timing exceeds the capabilities of the GRC System and devices will not be energized.

When the S-CPU detects a conflict between devices of the same ACG, it will delay the higher number device by the preset ACG Timer. Typically, this is configured as the amount of time it takes for fly ash to completely pass through the precipitator. The *Timer* value in the above table displays the remaining time before the next device is energized.

To set the ACG timers, press the **Anti-coincidence times** button on the above screen.



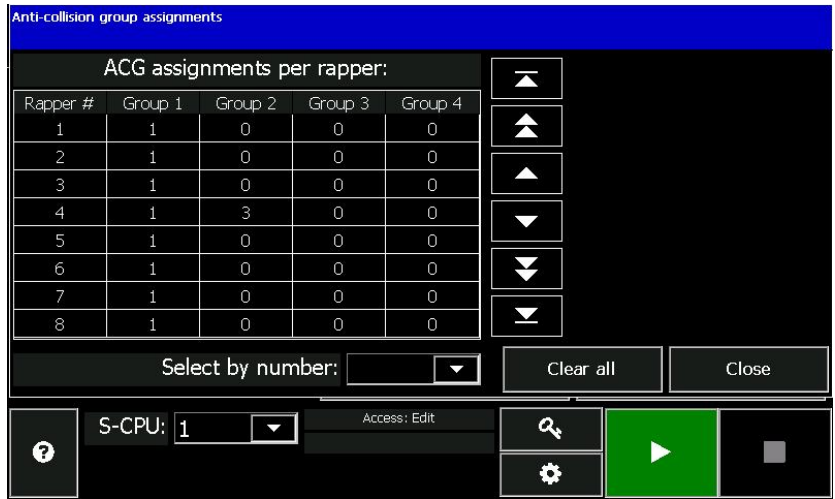
The ACG time can be set for each of the 5 possible rapper programs saved into the S-CPU memory. The ACG times for each program, can be changed individually or globally.

To set them individually use the pull down menu to select the desired time for each program. When completed, press the **Close** button.


To set the times globally, use the **Set all:** parameter to select the desired time for all of the programs. When completed, press the **Apply** button and that time will be transferred to each of the program parameters. Press the **Close** button to leave the screen.


The times are programmable from 0 to 99 seconds. A value of 0 disables the ACG algorithm.


To configure the group assignments press the **Group assignments** button on the **ACG FIFO:** screen.





This table shows the four possible anti-coincidence group assignments for each of the rapper numbers (1-1024). The rappers are shown in groups of 8. Use the arrows to the right of the table to scroll through all of the rappers.


 Goes to the beginning of the rapper list.

 Goes to previous group of 8 rappers.

 Goes to the previous rapper.

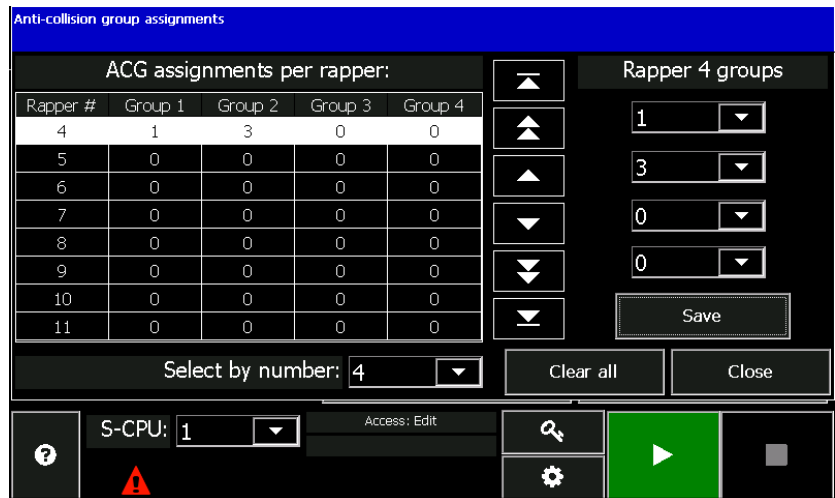
 Goes to the next rapper.

 Goes to the next group of 8 rappers.

 Goes to the end of the rapper list.

A specific rapper can also be selected by using the **Select by number:** feature.

To set or edit the anti-coincidence group assignments, please the desired rapper #. That row will be highlighted and four group assignment parameter fields will appear to the right of the table.



In the first assignment block, select the ACG group number that you would like the rapper to be in. If you would like the rapper to be in a second group, select that group number from the next assignment block. If so desired, continue in this manner identifying up to 4 groups for this rapper. If only one group is to be set, use the first assignment group and leave the remaining three set to zero. Once completed press the **Save** button.

Continue in this manner until all of the desired rappers have been assigned to the desired groups.


To clear all of the group assignments for all of the rappers press the **Clear all** button. To close the screen and return to the ACG FIFO screen, press the **Close** button.

Power Off Rapping (POR)

Separate from the normal operating programs, rappers can be scheduled to fire while power is removed or reduced from T/R sets. This type of rapping provides a more effective cleaning especially in situations with “sticky” fly ash. An output can be assigned to each Power Off Rapping (POR) group to signal third party T/R controllers to reduce or remove power while POR occurs. The GRC System supports up to 32 POR groups with 48 sequence members per group. Several POR program parameters are identical to normal operating program’s parameters but will still be covered in this section for simplicity.

Creating a new POR Program


Creating a POR program is very similar to creating an operating program. Many of the screens appear the same.

Start by pressing the **Activity** button  on the main menu bar.



The POR feature is activated by using the **POR:** field at the top of the screen. Simply set it to *On*.

Next press the Edit icon  in the upper right corner of the screen.

Since we are creating a new program, press the new program icon  in the lower left corner of the screen. A pop-up window will appear.




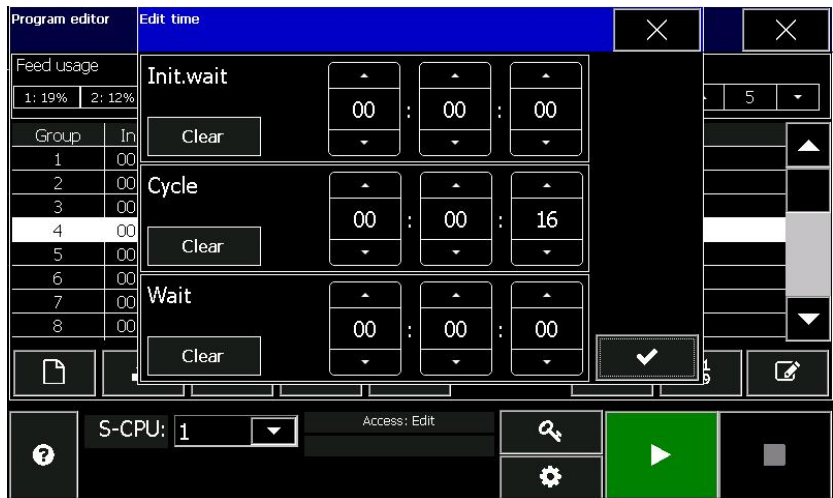
Press the **Create new POR program** button.



Entering POR Group Timing

To enter the desired timing for each POR group, start by highlighting the group by touching the Group # in the program table.

Then press the timing icon .



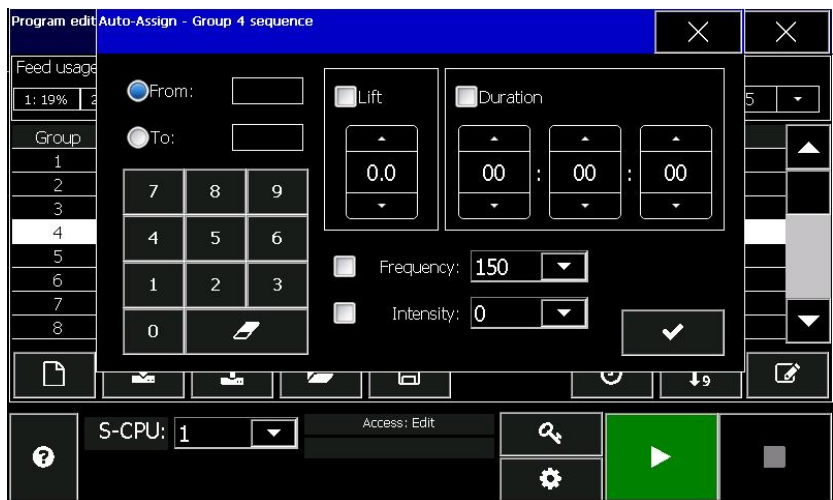
Enter the desired timing by using the and buttons for each of the parameters.

Press the button when complete. Repeat for each of the groups within the POR program.

Assigning Devices to a POR Group

To assign devices to each POR group, start by highlighting the group by touching the Group # in the program table.

Then press the icon .



From: & To:

These fields provide a shortcut for assigning rapper output numbers to a sequence. Set the starting and ending rapper output number using the numeric keypad on the screen. Press the **From:** radio button to enter the starting output number in the group and the **To:** radio button to enter the last rapper output number in the group. The GDU will automatically assign rappers to the group's sequence. The sequence can be in either ascending or descending order of output number.

Lift

If the rappers assigned for this group are DC Impact type devices, and the lift is to be the same for the each device within the group, press the **Lift** box and enter the desired lift in inches. Otherwise, this parameter can be ignored. Programmable from 0 to 16 inches in .5 inch steps.

Duration


If the devices assigned for this group are Vibrators, Multi-Impacts, or Motor type devices, and the duration is to be the same for all devices in the group, press the **Duration** box and enter the desired duration value in seconds. Programmable from 00:00:00 to 23:59:59. For DC Impact type devices, verify this value is 00:00:00 to prevent inaccurate results to the program timing check.

Frequency

If the devices assigned for this group are Multi-Impact type devices, press the **Frequency** box and enter the desired frequency in cycle per minute. Programmable in 13 preset steps from 200 to 600 CPM. Valid values are 200, 212, 225, 240, 257, 278, 300, 330, 360, 390, 450, 510, and 600. The setting will be applied to all devices within the group.


Intensity

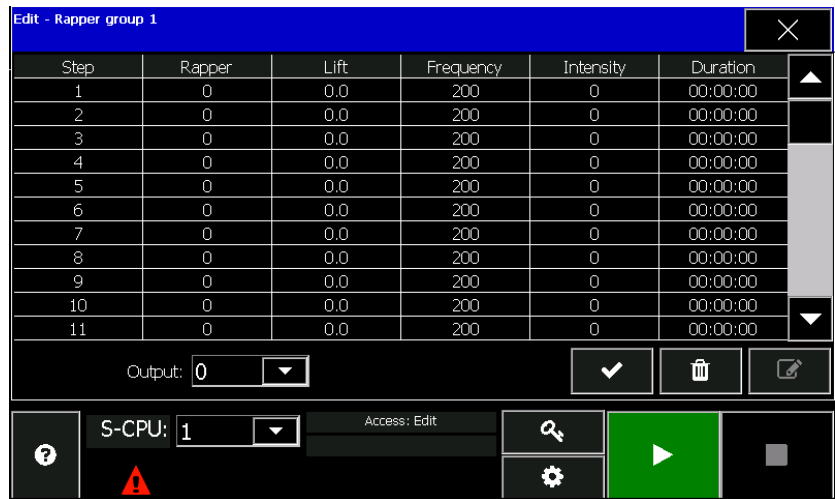
If the devices assigned for this group are Vibrators or Multi-Impact type devices, press the **Intensity** box and enter the desired intensity value in percentage. Programmable from 0 – 100%. Changes to the intensity less than 100% will result in ½ cycles of power applied at less than full conduction. This field must be set to 0 for AC/DC Motor type devices to prevent inaccurate results in Program Timing check. The setting will be applied to all devices within the group.

Press the  button when complete. Repeat for each of the groups within the POR program.

Changing Parameters for an Individual Device


If the individual devices within a POR group require individual Lift, Frequency, Intensity, Duration, or a custom sequence they can be edited. Start by highlighting the group by touching the Group # in the program table.

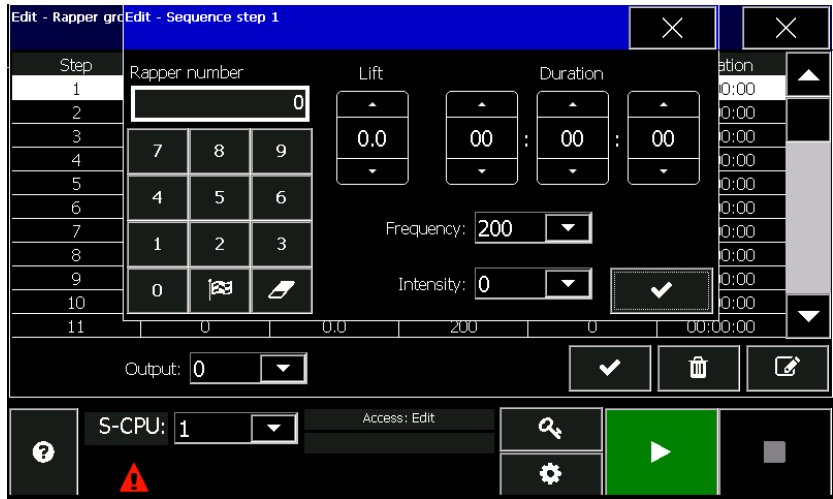
Then press the edit icon .




This screen is also used for setting the **Output:** parameter for the entire group. Select desired output number from the pull down box. This output will turn on sending 120 VAC to signal a third party T/R controller to remove or reduce power to the T/R while the GRC is rapping this POR group.

Next press the sequence step number that you wish to edit.

Then press the edit icon .



The desired rapper output number, Lift, Duration, Frequency, and Intensity can be set for the selected sequence step.

Press the  button when complete. Repeat for each of the sequence steps/groups to be edited.

Program Examples

Operating Program

The following example will illustrate typical program for a better understanding of the interaction of groups and their associated times. This first example does not take into account the possible anti-coincidence delays or Power Off Rapping devices that may affect rapper scheduling. All rappers in this program example are DC Impact type devices.

Given the following program:

Group	Init. Wait	Cycle	Wait	Mode	Seq.
1	00:00:05	00:00:10	00:00:00	Norm	1
					2
					3
					4
					5
2	00:00:05	00:00:10	00:00:10	Norm	6
					7
					8
					9
Group	Init. Wait	Cycle	Wait	Mode	Seq.

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					10
3	00:00:05	00:00:10	00:00:00	Norm	11
					12
					13
					14
					15

When the program is turned on (*time 0*), the following table illustrates when rappers will be scheduled to fire:

Time	Group 1	Group 2	Group 3
0			
1			
2			
3			
4			
5	1	6	11
6			
7	2	7	12
8			
9	3	8	13
10			
11	4	9	14
12			
13	5	10	15
14			
15	1		11
16			
17	2		12
18			
19	3		13
20			
21	4		14
22			
23	5	6	15
24			
25	1	7	11
26			
27	2	8	12
28			
29	3	9	13
30			
31	4	10	14

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Since groups 1 and 3 have identical cycle and wait times and same number and type of rappers all rappers in those groups will fire with the offset of 250 milliseconds (they need to be offset to prevent transformer overload).

ACG Affect on Program

Configuring a GRC with Anti-Coincidence (ACG) will have an affect on the normal rapper activity. With the same program above, we'll add the following ACG's:

ACG Time is 5 seconds
ACG 1 contains device # 1 and # 11

When the program is turned on (*time 0*), the following table illustrates when rappers will be scheduled to fire:

Note: rappers that are in the ACG group are enclosed in ().

Time	Group 1	Group 2	Group 3
0			
1			
2			
3			
4			
5	(1)	6	
6			
7	2	7	12
8			
9	3	8	13
10			(11)
11	4	9	14
12			
13	5	10	15
14			
15	(1)		
16			
17	2		12
18			
19	3		13
20			(11)
21	4		14
22			
23	5	6	15
24			
25	(1)	7	
26			
27	2	8	12
28			
29	3	9	13
30			(11)

As you can see, device 11 caused an ACG conflict with device 1 and was therefore delayed for 5 seconds before firing.

POR Affect on Program

Power Off Rapping programs are similar to normal operating programs. Each POR group is assigned a device sequence with associated firing parameters, and group timing (i.e. cycle time, etc.). Each POR group is also assigned an associated T/R number that is powered down prior to firing the devices in a POR group's sequence. Once rapping is complete, the T/R is

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returned to its previous power levels. This type of rapping is useful for effective fly-ash removal in high-resistivity conditions.

Given the first example above (no ACG), let's add a simple, 1 group POR program shown below:

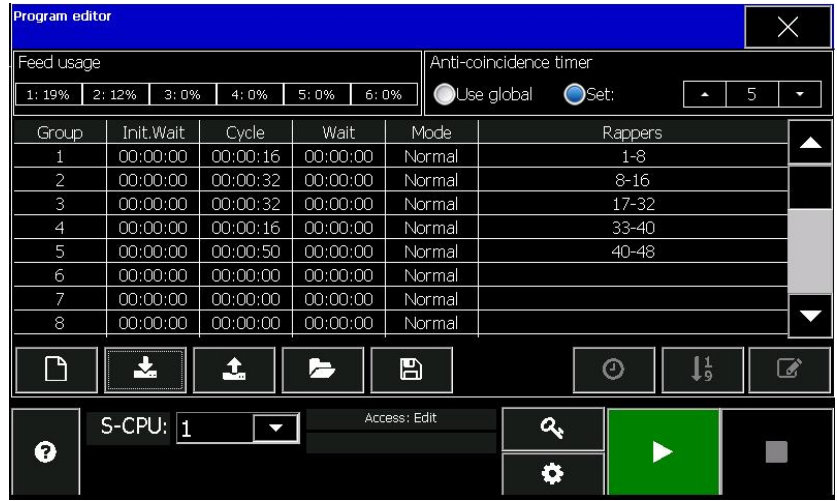
POR Group	Init. Wait	Cycle	Wait	T/R #	Seq.
1	00:00:00	00:00:05	23:59:55	1	1
					2
					3
					4
					5


When the program is turned on (*time 0*), the following table illustrates when rappers will be scheduled to fire:

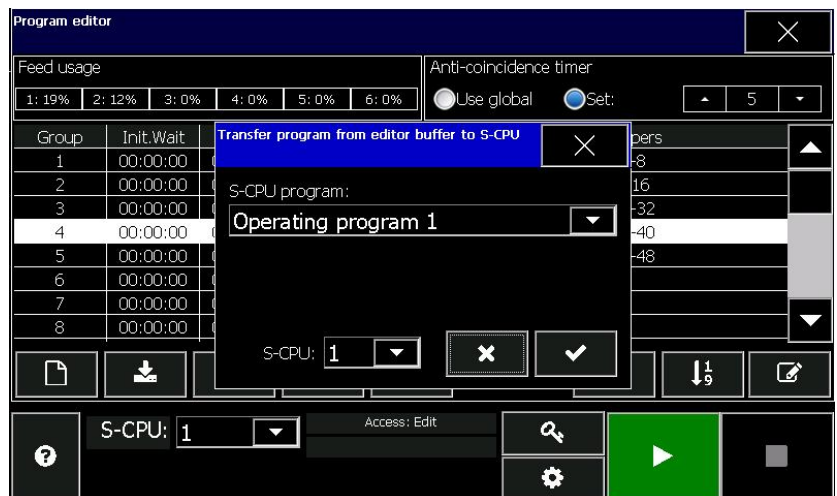
Time	POR 1	Group 1	Group 2	Group 3
0	1			
1	2			
2	3			
3	4			
4	5			
5		1	6	11
6				
7		2	7	12
8				
9		3	8	13
10				
11		4	9	14
12				
13		5	10	15
14				
15		1		11
16				
17		2		12
18				
19		3		13
20				
21		4		14
22				
23		5	6	15
24				
25		1	7	11

Saving Programs

When all desired changes are made to the operating program, it must be saved to the S-CPU before it can be used. The S-CPU can store up to five programs. The GDU can also be used to store programs. Rapper activity will be temporarily suspended during program download. When download is complete, the program automatically continues from where it left off. If the “active” operating program is overwritten, the S-CPU will restart the new program.




To save the program from the program editor screen to the S-CPU, press the upload icon .

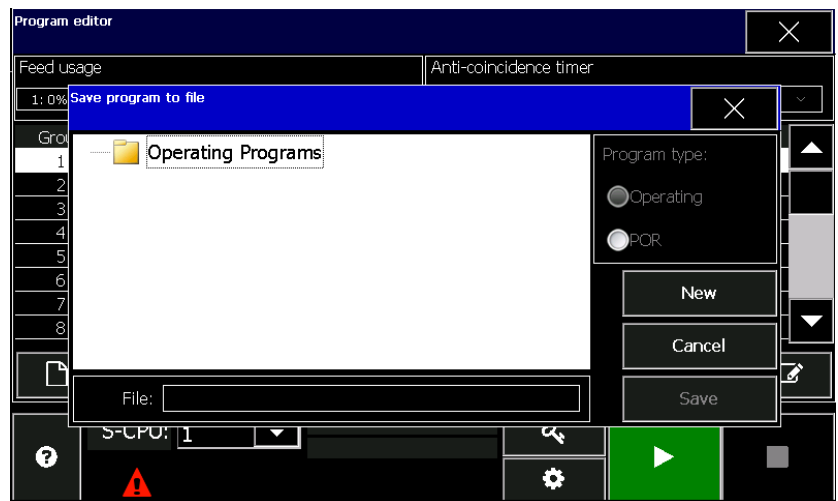


Use the **S-CPU program:** field to select which of the five operating programs will be the destination of the saved program. If the POR program is being saved the only choice will be POR program.

Set the **S-CPU:** field to the address of the S-CPU where the program will be saved.

Press the  button to initiate the save.

To save a program to the GDU memory, press the save icon






Press the **New** button and enter the new file name. Press the **Submit** button and then the **Save** button.


If the program being saved is an operating program, it will be saved in the Operating Programs subdirectory. If it is a POR program, it will be saved in the POR Programs subdirectory.

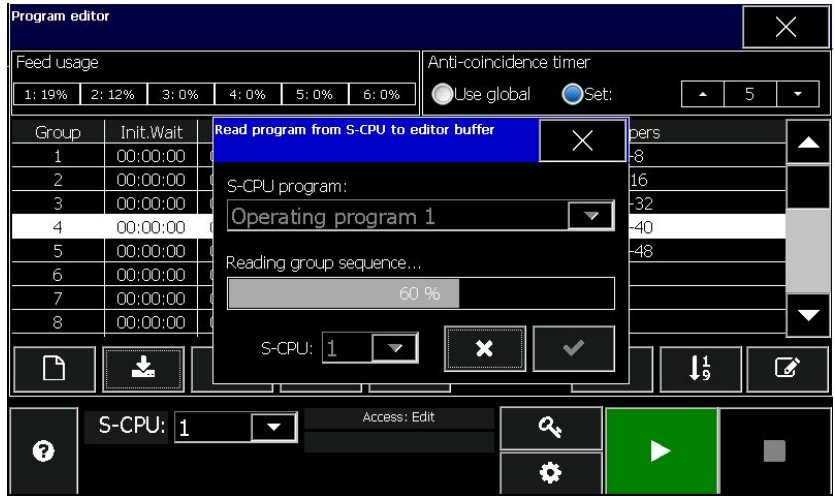
Loading / Editing Programs

To load a program from the S-CPU, first go to the Activity

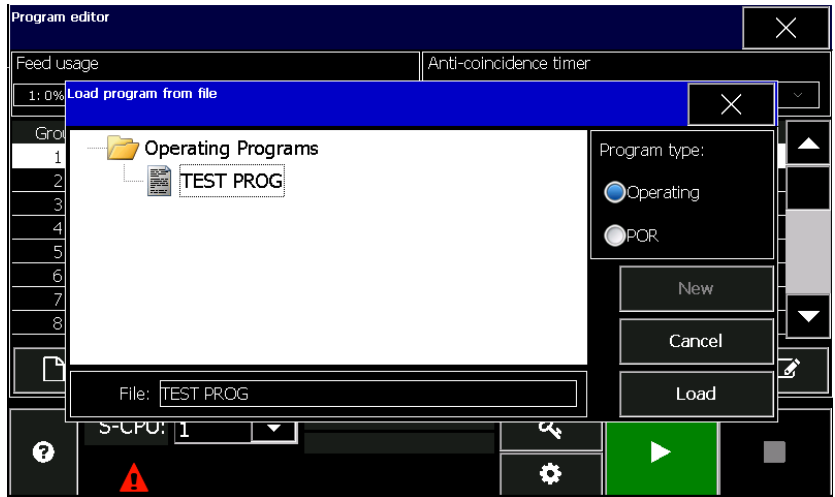
screen  and then press the edit icon .

Then press the download icon . Select the desired program from the

S-CPU program: field and press the  button. The program will be loaded into the GDU editor.



To load a program from the GDU memory press the open icon



Select the type of program to be loaded from the **Program type:** field. This will load either the Operating Programs subdirectory or the POR Programs subdirectory.

Press the name of the desired program on the screen and then press the **Load** button.

Editing the programs follows the same procedures and displays as previously described in the Creating Programs portion of this manual.

Selecting an Operating Program

The operating program is one of the five stored programs that the S-CPU is running. It can be selected manually or automatically. Manual selection can be performed via the GDU or the discrete Program Select inputs on the GRC. Automatic selection can be done using an Auto Program select feature of the GRC system.

The functionality of the various methods of selection is also dependent upon the setting of the S-CPU Remote Enable parameter and the state of the Local/Remote discrete input previously described. Refer to the previously shown Local/Remote Control Table.

Selecting the Operating Program via the GDU

To set the operating program, go to the **Activity** display.



The active program is set using the **Program:** field at the top of the screen.

Any of the stored programs can be loaded into the editor and viewed or modified while the active program is running.

Selecting the Operating Program via the GRC Discrete Inputs

To select an active operating Program via the Program Select inputs the following steps have to be taken by the User:

To run Program 1: apply 120VAC between 1TB – 4 and 1TB – 9 on the GRC Cabinet Backpanel.

To run Program 2: apply 120VAC between 1TB – 5 and 1TB – 9 on the GRC Cabinet Backpanel.

To run Program 3: apply 120VAC between 1TB – 6 and 1TB – 9 on the GRC Cabinet Backpanel.

To run Program 4: apply 120VAC between 1TB – 7 and 1TB – 9 on the GRC Cabinet Backpanel.

To run Program 5: apply 120VAC between 1TB – 8 and 1TB – 9 on the GRC Cabinet Backpanel.


The Program: field on the Activity screen will display the operating program selected. **These inputs will have priority over all other methods of selecting a program.**

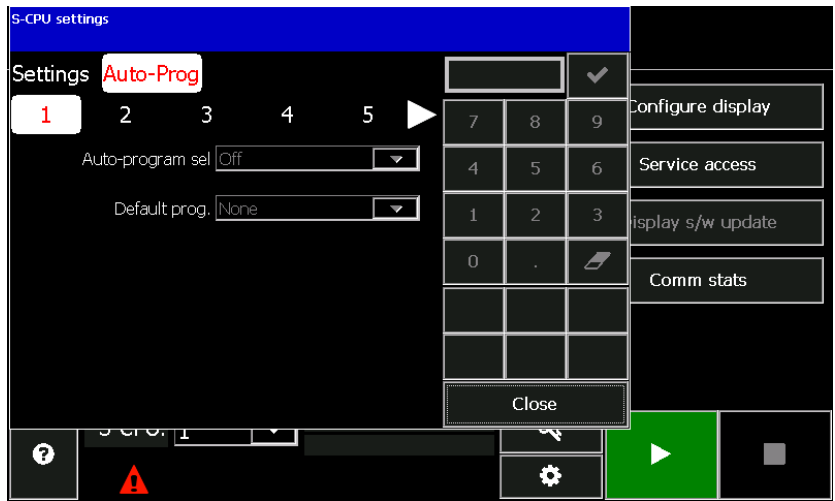
Selecting the Operating Program via the Auto Program Select

Automatic changes to the active operating program can also be triggered either by boiler load or time of day. This eliminates the need for operators to make constant program changes throughout the day or when load changes occur in the precipitator. Experience shows that different boiler loads require different operating programs to maintain an optimum level of performance.

A 4-20 mADC analog input of the boiler load must be connected to the GRC in order for the boiler load control to function.

To configure the Auto Program Select feature, press the

Operating Parameter Settings button  located below the Sign On button and next to the On button on the bottom section of any of the menu bar screens. Next press the **Auto-Prog** button and then the **1** button.



The parameters to be set are as follows:

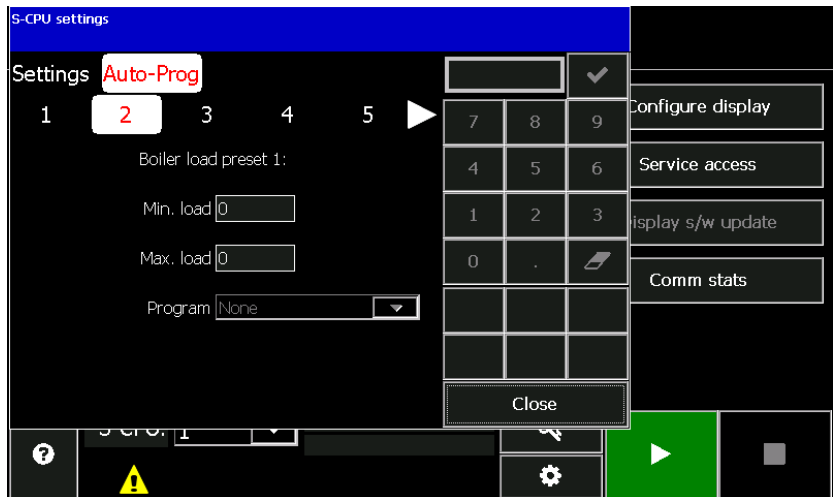
Auto-program sel

Setting to *On* enables the Auto – Program feature of the system.
 Setting to *Off* disables the Auto – Program feature.

Default prog.

When the S-CPU performs the auto-program select algorithm and no matches are found, the default program will be used.

There are three preset ranges of comparison for both the boiler load and the time of day. The boiler load ranges are accessed by pressing buttons **2**, **3**, and **4**.



The parameters to be set are as follows:

Min. load

Sets the minimum boiler load for this range

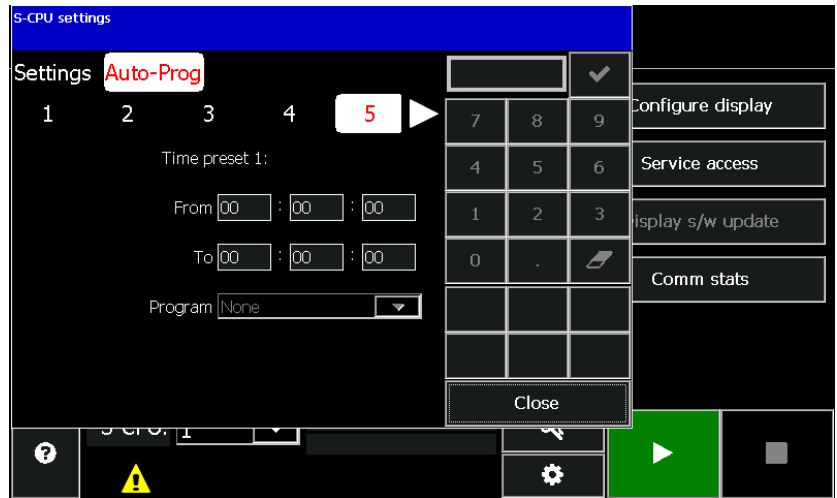
Max. load

Sets the maximum boiler load for this range.

Program

Sets the operating program to be run if the boiler load is between the minimum and maximum values for this range.

The time of day ranges are accessed by pressing buttons **5**, **6**, and **7**.



The parameters to be set are as follows:

From

Sets the starting time of the day for this range.

To

Sets the ending time of day for this range.

Program

Sets the operating program to be run if the time of day is between the From and the To values for this range.

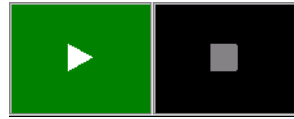
Chapter 6: Monitoring Operation

Starting the Rapping Program

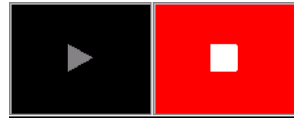
Once the system has been configured, and the rapping programs have been generated, the rapping system can be started.


Make sure that the desired rapping program has been selected. If required, make sure the POR feature has been turned On.

To Start the rapping program, press the green Start button at the bottom of the display.



Once pressed, the rapping program will start operation. The green Start button will turn black and the black Stop button will turn red.



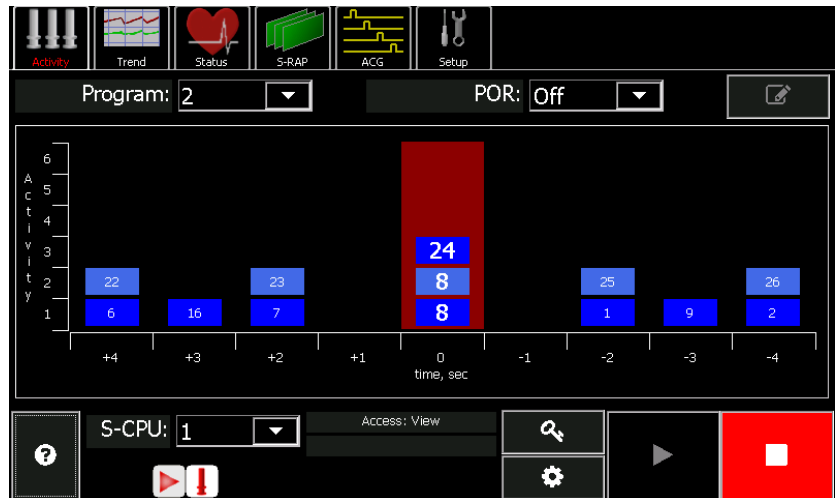
A small start icon  will also appear in the status section at the bottom of the screen.

To stop the rapping program, press the red Stop button. It will turn black again and the Start button will return to green.


Monitoring

Activity

The **Activity** screen on the main menu provides operators with a 9-second window of the GRC System's rapper activity. Up to 6 rappers can be energized in 1 second.



The horizontal axis shows the rapping queue for the 4 seconds before (-1 to -4 sec.) and the 4 seconds after (+1 to +4 sec.) the device is energized at t=0 seconds.

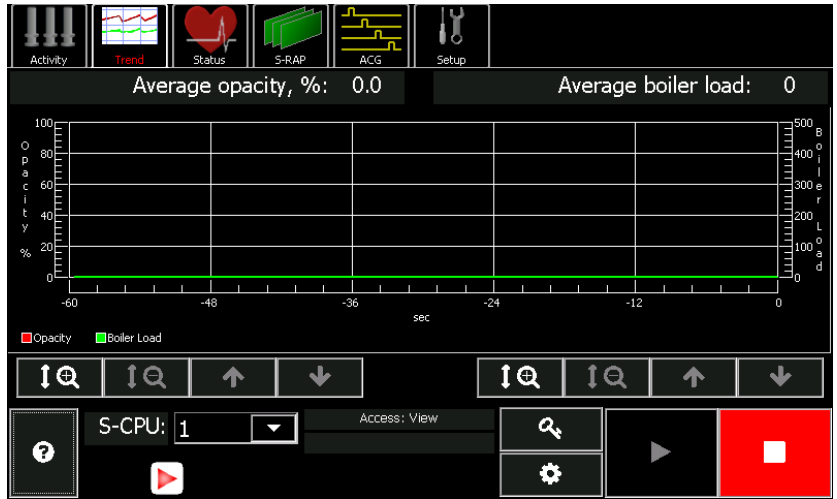
The vertical axis shows the devices being energized in each 1 second segment. Each time a device is energized, a rapper icon  will appear in the status section at the bottom of the screen. The output LED on the S-RAP board will also light when the output is energized.

Trend

The GRC can track trends in the boiler load and the opacity automatically. This provides the ability to manage ESP performance better by identifying the conditions that cause performance changes.

External 4-20 mADC analog feedback signals must be wired into the GRC in order for the trending to be functional.

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

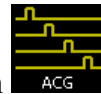


The operator can zoom and pan the meter value axis of the trend by using the navigation buttons at the lower portion of the screen. There is one for the opacity and one for the Boiler load.



ACG Operation

As previously described, the ACG operation can also be monitored.



Press the ACG button on the main menu bar.

Group	Timer	1	2	3	4	5
1	5	5	1	3	6	8
2	4	4	14	15	16	0
3	0	0	4	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0

The table shows the first five devices in the firing queue for each of the 64 ACG's. The presence of the red line represents an overflow. This occurs when system timing exceeds the capabilities of the GRC System.

When the S-CPU detects a conflict between devices of the same ACG, it will delay the higher number device by the preset ACG Timer. Typically, this is configured as the amount of time it takes for fly ash to completely pass through the precipitator. The *Timer* value in the above table displays the remaining time before the next device is energized.

Alarms

The S-CPU module will continuously monitor for S-RAP alarms. The status of these alarms can be viewed by pressing



the **Status** button on the main menu bar.



There will be a box for each of the S-RAP card in the GRC. The color of the box indicates the alarm status of card.

Green = Normal operation. No alarms exist on the S-RAP.

Yellow = Alarms exist on the S-RAP

Red = There is no communication to the S-RAP.

To get a more detailed status of any of the cards, press the box for that card and then press the **Detail** button.



The table shows the status of each of the sixteen outputs on the S-RAP card. If an alarm exists, the output box will be yellow and will indicate the type of alarm that exists. The output LED on the S-RAP board will also be blinking.

The list of possible alarms and their possible causes are:

Disabled - The output has been disabled.

Under - The output has failed on undercurrent. The current is less than the undercurrent setting in the rapper setup screen on the S-RAP display. This could be caused by the following:

1. Open in the rapper/device
2. Open in the wiring to the rapper/device
3. If all of the outputs on the S-RAP card are open, check the fuses on the card and the power transformer.
4. If all of the above check OK, problem may be in the S-RAP card.

Over - The output has failed on overcurrent. The current is more than the overcurrent setting in the rapper setup screen on the S-RAP display. This could be caused by the following:

1. Shorted rapper/device
2. Short in the wiring to the rapper/device
3. Shorted triac on the S-RAP board causing multiple rappers/devices to fire simultaneously.

Halfwave - The output has failed because both the positive and negative halfwaves from the power transformer are not making

it to the output. This will cause halfwave rectified power to be supplied to the DC devices instead of fullwave rectified. For AC devices it will cause halfwave rectified DC power to be supplied. This could be caused by the following:

1. One of the two fuses on the S-RAP board may have opened. This would cause the alarms to exist on all of the outputs.
2. One of the Mosfets (or SCR's on the older S-RAP boards) may have failed. This would cause the alarms to exist on all of the outputs.


A failure must occur on two consequent firings of the output in order for an alarm to be generated. If an output experiences a failure on one firing, but then operates properly on the next firing, it is considered suspect and a suspect alarm is generated. Suspect alarms are usually caused by intermittent conditions and should be further monitored and investigated. The suspect alarm are as follows:

Susp.UC - Suspect undercurrent condition exists.

Susp.OC - Suspect overcurrent condition exists.

Susp.HW - Suspect halfwave condition exists.



A flashing warning icon  will appear in the status section at the bottom of the display when an alarm occurs.

Suspect alarms will not activate the alarm icon or the alarm relay.

The alarms can be cleared by either pressing the **Clear all** button or by pressing alarmed output box and pressing the **Clear** button.

Outputs can also be disabled so that the rapping program will not try to energize them. Press the output box that is to be disabled, then press the **Disable** button. The box will turn black then indicate Disabled within it.

To enable an output, press the disabled output then press the **Enable** button.

Chapter 7: Troubleshooting

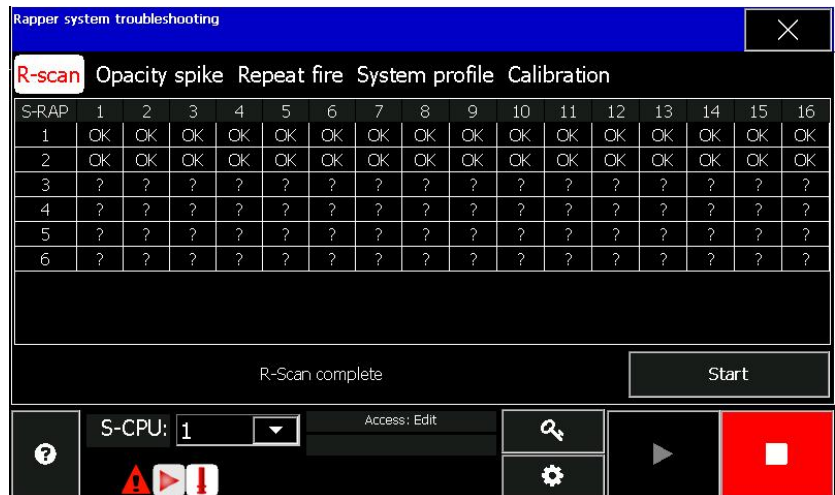
Quick determination of rapper controller system problems could prevent the unfortunate shutdown of the precipitator. The GRC System provides several tools to assist technicians in determining the cause of these problems. With a few simple keystrokes, a complete picture of the system can be retrieved. The following section describes each of these unique GRC features.

R-Scan

R-Scan is another of NWL unique GRC system features. This window allows operators to get operating status for each of the outputs within seconds. When R-Scan is initiated, the GDU will instruct each S-RAP module to quickly sample each output and return the status.



Go to the Setup screen from the main menu bar. Then press the **Troubleshoot** button. Press the **R-scan** button. Press the **Start** button to initiate the scan.



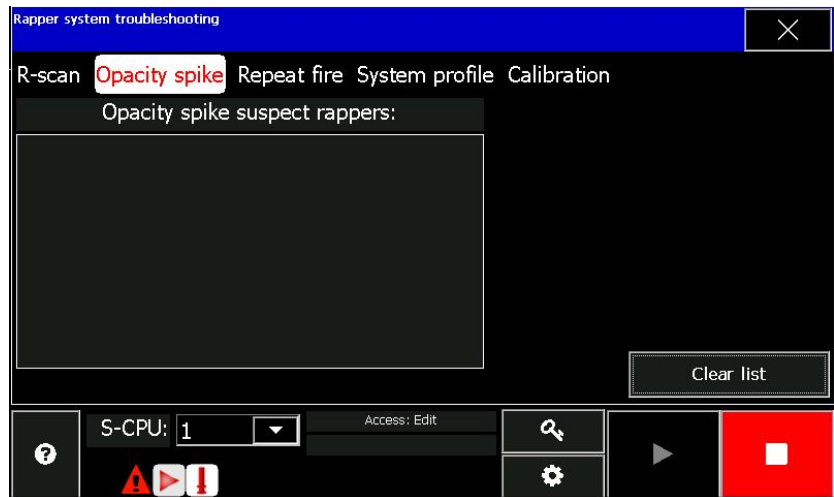
The table will display the status of each of the outputs on each of the S-RAP boards.

The status of each output will be displayed as below.

Alarm	Description
OK	Device OK
dis	Device disabled
o/c	Failed overcurrent test
u/c	Failed undercurrent test
h/w	Failed half-waving test
s.o/c	Suspect overcurrent
s.u/c	Suspect undercurrent
s.h/w	Suspect half-waving

Opacity Spike Detection

By using the opacity spike detect list, operators can fine tune rapper operating programs to minimize re-entrainment caused by specific rappers. Press the **Opacity spike** button to display this list.

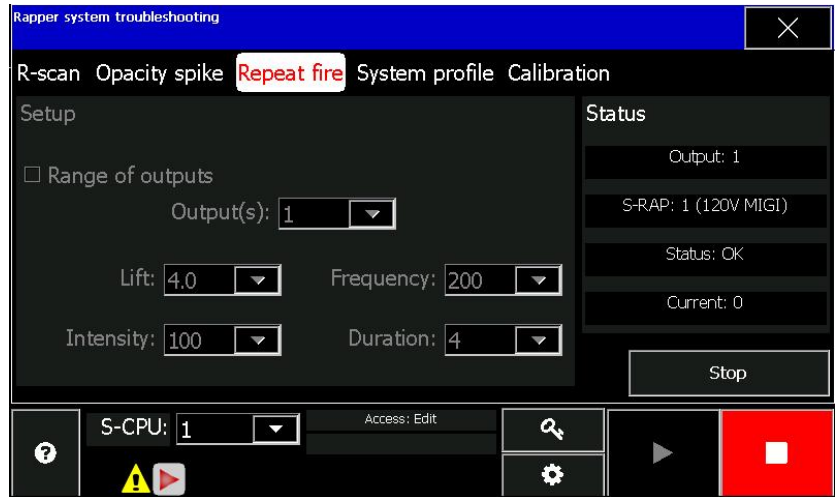


Rappers that are suspected of causing opacity spikes will be displayed in this window. When an opacity spike is detected, as defined by the *Opacity spike* parameter (see S-CPU configuration section) all rappers that fire within the *Flow Delay* (see S-CPU configuration section) will be flagged. Rappers that are flagged in three consecutive occurrences will be logged to this list.

The list can be cleared by pressing the **Clear list** button.

Repeat Fire

The **Repeat fire** window is a useful tool for technicians when checking the operating status of the GRC System. It can be used to fire a single device or multiple devices. If the operator leaves the window before stopping the repeat mode, the GDU will automatically turn off the repeat mode.



Range of outputs

Check this box if multiple outputs are to be repeated. Leave unchecked if a single output is to be repeated.

Output(s):

Select the output or the range of outputs to be repeated.

Lift:

This value is used for repeating or firing DC Impact type devices when repeat mode is enabled. Programmable to 16 inches in .5 inch steps.

Frequency:

This value is used for repeating Multi-Impact type devices when repeat mode is enabled. Programmable in 13 preset steps from 200 to 600 CPM. Valid values are 200, 212, 225, 240, 257, 278, 300, 330, 360, 390, 450, 510, and 600.

Intensity:

This value is used for repeating Vibrator and Multi-Impact type devices. Programmable from 0 to 100%.

Duration:

This value is used for repeating Vibrator, Multi-Impact, or Motor type devices. Programmable from 0 to 59 seconds.

The repeat operation can be started by pressing the **Start** button. Once started the button will switch to a **Stop** button. If the operator leaves the window before stopping the repeat mode, the GDU will automatically turn off the repeat mode.

Status

Once the repeat operation is started, this field shows the operating status of the last device fired. The output number, S-RAP card number, the status, and the current are all listed. If the device experiences an alarm, it will show on the status line. Devices that fail on an alarm condition in repeat mode will not be removed from normal program firing.

System Profile

Operators can get a “picture” of the operating status of each of the S-RAP modules by pressing the **System profile** button. When the Generate button is pressed, the GDU will poll each board and display the status in the fields described below.



S-CPU address:

Displays the address and the firmware of the S-CPU being polled.

S-RAP cards in power feed config:

Displays the total numbers of S-RAP cards that have been configured to all of the power feeds.

S-RAP

Displays the address of the associated S-RAP module.

Model

Displays the model of S-RAP board.

Type

Displays the type of the devices being controlled by the S-RAP board.

Firmware

Displays the firmware in the S-RAP board.

RS485

Displays the status of the RS485 communication link to the S-RAP board.

I2C

Displays the status of the I2C communication link to the S-RAP board. This is the communications link dedicated for use by the S-CPU to send the firing commands to the S-RAP boards.

Cal status

Displays the calibration status of each S-RAP board.

Calibration status can have the following modes:

Normal means that the S-RAP board successfully completed calibration.

Cal mode means that calibration is in progress for a particular S-RAP board.

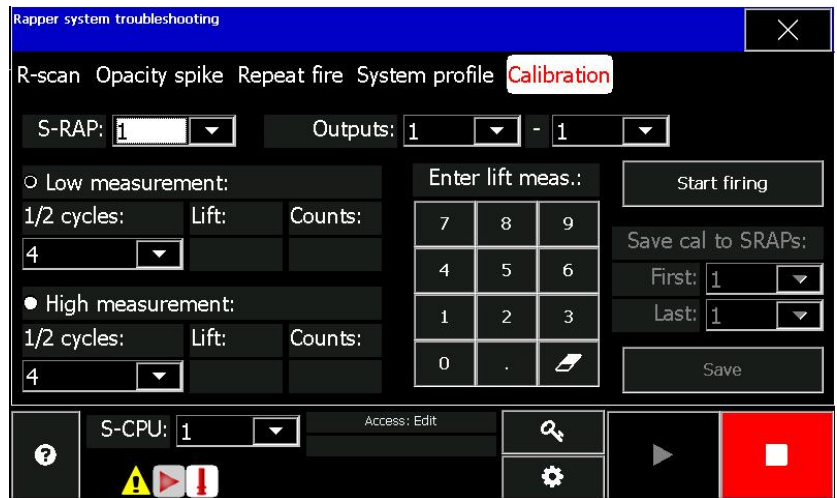
Failed means that the calibration failed.

Calibration

This feature will be used for DC impact devices, or MIGI style devices only.

Calibration feature needs to be used if the actual Lift value measured by the User differs from the programmed Lift value (due to excessive wiring length or varying characteristics of the different rappers). After Calibration is performed the lift accuracy will be significantly improved.

Press the **Calibration** button to access the calibration feature.



Following the below procedure.

S-RAP:

Enter the address of the S-RAP board to be calibrated.

Outputs... - ...

Enter the output or range of the outputs that need to be fired to calibrate the S-RAP.

Press the radio button to the left of **Low Measurement:**

1/2 cycles:

Enter the number of 1/2 cycles to fire the calibrated rapper. The recommended value is 5. The minimal value is 4.

Once the above parameters are set, press the **Start firing** button. The GRC will start firing the rapper at the selected number of 1/2 cycles.

Go to the rapper(s) being fired and actually measure the actual lift being obtained. Return to the GRC controller and press the **Stop firing** button.

Using the keypad on the screen, enter the lift measurement observed. The value will appear in the **Lift:** parameter box.

The **Counts:** box will show a digital representation of the current associated with that lift.

Next press the radio button to the left of **High measurement:** and repeat the above steps. The recommended value for the high **1/2 cycles:** is 10.

Once the actual measured lift for the **High measurement:** has been entered, the GRC will generate a custom lift table extrapolating between the two measured points.

This lift table can be saved to the selected and other S-RAP boards by using the **First:** and **Last:** parameter fields and then pressing the **Save** button.

In order for the S-RAPs to start using the new calibration, the **Lift table:** parameter must be changed from *Standard* to

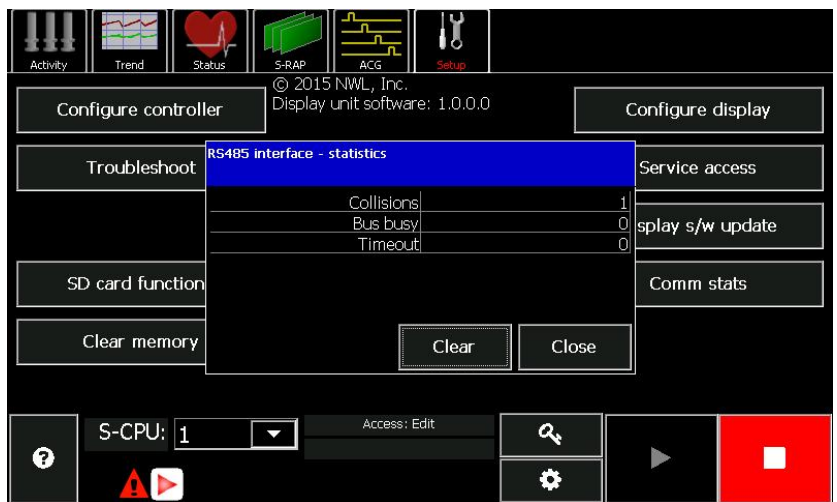


Custom on the **Lift table** screen in the **S-RAP** window.

If the actual Lift value still differs from the programmed value, the Calibration can be repeated using a different range of Low and High Measurement settings.

Communication Status

If the RS485 network communications appears to be problematic, additional information can be obtained by pressing the **Comm stats** button in the **Setup** menu.



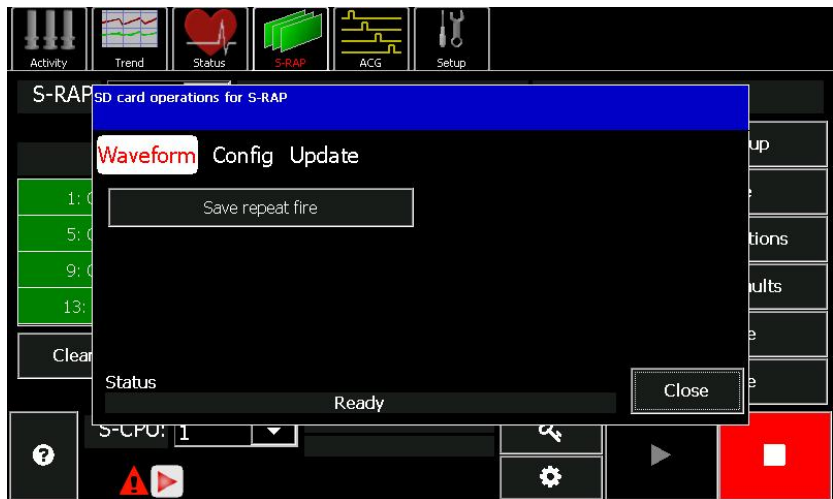
Device Waveform

The S-RAP is capable of saving the data points of the current waveform of the last device operated in the Repeat mode to the SD card. This file is in a .csv format and can be copied to another computer to generate a plot of the waveform.

Start placing the desired output in the Repeat mode as previously described. Operate in this mode long enough to get a energization of the device.



Return to the **S-RAP** window and press the **SD card functions** button. Next press the **Waveform** button.



Press the **Save repeat fire** button and the data is transferred to the SD card in a .csv file format.

Service Access

The **Service access** features under the Setup menu are meant for NWL service technician's use only.

Changing Boards

Below is the procedure for replacing the S-CPU and the S-RAP boards in the GRC.

S-CPU

It should be noted that the S-CPU board contains the memory where all of the rapping programs are stored. When replacing this board, the new board will not contain those programs. It is very important that you save the user programs, ACG data, and system configuration to the SD card prior to changing the board.

Use the **Backup** feature under the **SD card functions** option in the **Setup** screen.

De-energize the circuit breaker on the GRC cabinet. Loosen the screws on the bar that hold the boards in the cage captive and remove the S-CPU board. Set the rotary switch of the new replacement board to the same serial address position as the old board. Slide the new board into the cage, insuring that the edge connectors are properly seated in the backplane. Place the SD card from the old board into the new board.

Energize the cabinet circuit breaker. Return to the SD card functions screen and Load the user programs, ACG data, and configuration from the SD card back into the S-CPU memory.

The board exchange is now complete.

S-RAP (DSP Version)

All of the configuration settings for this board are stored in its internal memory. When replacing this board, the new board will not contain those settings. Use the **Config** feature under the **SD card functions** option in the **S-RAP** screen to backup the configuration on the SD card..

De-energize the circuit breaker on the GRC cabinet. Loosen the screws on the bar that hold the boards in the cage captive and remove the S-RAP board. Set the rotary switches of the new replacement board to the same serial address position as the old board. Slide the new board into the cage, insuring that the edge

connectors are properly seated in the backplane. Place the SD card from the old board into the new board.

Energize the cabinet circuit breaker. Return to the **SD card functions** screen and Load the configuration settings from the SD card back into the S-RAP memory.

The board exchange is now complete.

S-RAP (Non - DSP Version)

Prior to replacing the S-RAP board, scroll to the S-RAP screen and record the parameter settings in the Rapper Setup screen for the specific S-RAP board number being replaced.

De-energize the circuit breaker on the GRC cabinet. Loosen the screws that hold the boards in the cage captive and remove the S-RAP board. Set the dip switches S1 through S10 of the replacement board to the same settings as the old board. Slide the new board into the cage, insuring that the edge connectors are properly seated in the backplane.

Energize the cabinet circuit breaker. Re-enter all of the parameters that you recorded from the old board. If you are operating off of the default lift table, then the board exchange is complete.

If you are operating off of a user created calibration table, you should re-calibrate the S-RAP board that was just exchanged by following the calibration procedure outlined in this User Guide.

Chapter 8: Updating Firmware

NWL will periodically release firmware updates that either introduce new features or address past problems. The firmware in the S-CPU board, the S-RAP boards, 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.

Below is the detailed instructions on how to update the firmware for the GRC components.

Updating S-CPU Firmware

The firmware on the S-CPU board 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 rapping program off by pressing the *Stop* button.
3. Force an automatic save of the S-CPU parameters to the existing SD by turning the main circuit breaker off, waiting approximately 30 seconds, then turning the breaker back on.
4. Remove the SD card from the DSP board and insert the new SD card with the new application firmware.
5. Go to the **SD card functions** section under the **Setup** menu and press the **Update** button.
6. Press the **Firmware update** button.
7. A window will pop up to confirm that you want to update the S-CPU firmware. Press **Yes**.
8. The S-CPU will automatically load the new firmware. During the loading process there will be a loss of communications indicated. Communications will be re-established once the process is complete.
9. Turn off the main circuit breaker.
10. Remove the SD card and insert the original card with the saved parameters.
11. Turn the main circuit breaker on.
12. The **Setup** screen should now indicate the new S-CPU firmware version number.

Updating S-RAP Firmware

The firmware on the S-RAP board 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 rapping program off by pressing the *Stop* button.
3. Force an automatic save of the S-RAP parameters to the existing SD by turning the main circuit breaker off, waiting approximately 30 seconds, then turning the breaker back on.
4. Remove the SD card from the S-RAP board and insert the new SD card with the new application firmware.
5. Go to the **SD card functions** section under the **S-RAP** menu and press the **Update** button.
6. Press the **Firmware update** button.
7. A window will pop up to confirm that you want to update the S-RAP firmware. Press **Yes**.
8. The S-RAP will automatically load the new firmware. During the loading process there will be a loss of communications indicated. Communications will be re-established once the process is complete.
9. Turn off the main circuit breaker.
10. Remove the SD card and insert the original card with the saved parameters.
11. Turn the main circuit breaker on.
12. The **S-RAP** screen should now indicate the new S-RAP firmware version number.

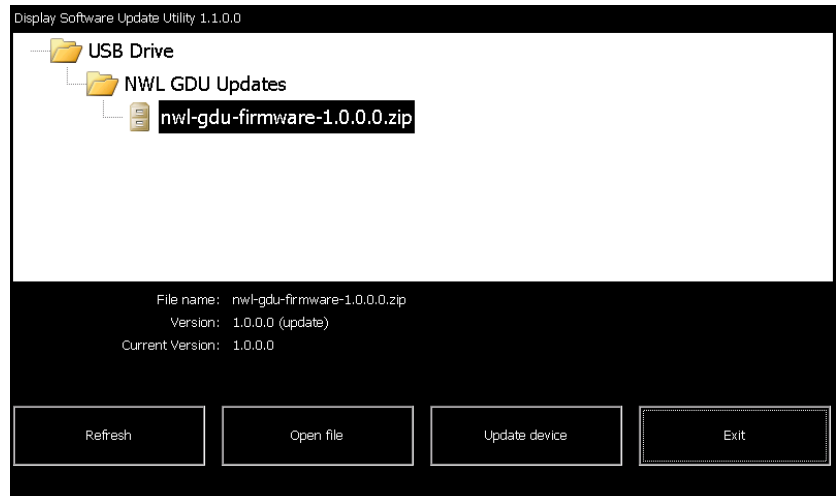
This procedure must be repeated for each S-RAP card being updated.

Updating GDU Firmware

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 password.

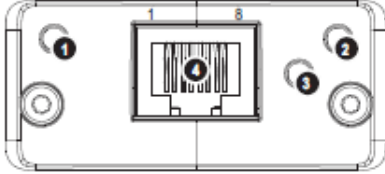
4. Press the **Display s/w update** button in the **Setup** screen.
5. A window will appear stating that the main application will be closed and the update utility will be started. It will ask if it should continue. Press Yes.
6. The following update utility screen will be displayed.



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 1 – 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

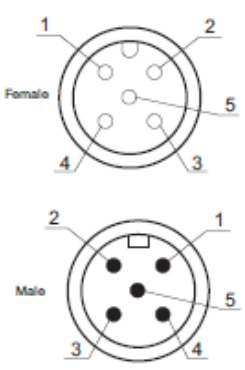
This connector provides DeviceNet connectivity.

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

Appendix 2 – S-CPU DSP Board Four Character LED Display Messages

Message Types

The 4-character display messages are classified as either "short" (4 characters or less) or "long" (more than 4 characters) messages.

The short messages are displayed for 2 seconds without scrolling. The long messages are scrolled once (with 250 ms per character scrolling rate).

When multiple event messages are pending in display message queue (see "Events" section below), the display sequence is accelerated as follows: short messages are only shown for 1 second, and long messages are scrolled twice as fast (125 ms per character rate). The maximum queue size is 4 messages, and if events occur quickly, the oldest ones will be "kicked out" from the queue (i.e., they will never be displayed).

Normal Operation

During normal operation, the 4-character display on the DSP board cycles through the following messages:

<i>Message</i>	<i>Description</i>
"Program: X"	Shows current operating program number, or "idle" if operating program is off.
"S-RAP: ok" "S-RAP: alarmed" "S-RAP: comm fail" "S-RAP: alm/comm fail"	Current status of S-RAP cards in the system. "alarmed" means that at least one S-RAP card has an output in alarmed state. "comm fail" means that at least one S-RAP card is not communicating with S-CPU.
"Opacity: xx.x%"	Displays opacity measurement (moving average). This is the value reported via RS485. A "faster" average is used for opacity spike detection.
"Boiler Load: x"	Displays boiler load measurement (moving average). This is the value reported via RS485.

Additionally, the following messages will be shown continuously when S-CPU is performing a time-consuming operation:

<i>Message</i>	<i>Description</i>
"busy"	S-CPU is writing or reading files on the SD card.
"Programming Mode"	Operating programs are being read or written by Handheld Programmer.

Events

At any time if an event occurs that needs to be displayed to the user, the normal display sequence described above will be interrupted and the event message will be displayed immediately.

Event messages:

<i>Message</i>	<i>Description</i>
"S-CPU Vx.xx"	S-CPU firmware version. Displayed after power-up.
"Default settings"	Default S-CPU settings are loaded, either because NVRAM check failed after power-up, or requested by user.
"Warm"	"Warm" reset occurred (as opposed to a "cold" reset due to a power cycle).
"Program ON"	Operating program is turned on via RS485, fieldbus, or discrete input.
"Program OFF"	Operating program is turned off via RS485, fieldbus, or discrete input.
"No SD card"	Displayed when an SD card operation is requested by user, but SD card is not present.
"SD config saved"	S-CPU configuration has been written to SD card.
"SD config restored"	S-CPU configuration has been read from SD card and applied.
"SD programs saved"	S-CPU programs have been saved to SD card.
"SD programs loaded"	S-CPU programs have been read from SD card into S-CPU's non-volatile memory.
"Saved ACG config"	Anti-Coincidence Group (ACG) configuration has been saved to SD card.
"Loaded ACG config"	Anti-Coincidence Group (ACG) configuration has been read from SD card into S-CPU's non-volatile memory.

14 Mar 2014

Appendix 3 – S-RAP DSP LED Status Definitions

There are 22 LED’s located on the D20659-xx board all “Red” in color and are located along the front edge on the SmartRap-DSP board. These LEDs are defined in the following table.

LED Definition		
Designation D# (Label)	Description	Purpose
D5 (RXA)	RS485 Local Port Receive Activity	Flickering indicates traffic on the rs485 local bus
D7 (TXA)	RS485 Local Port Transmit Activity	Flickering when this SmartRap is transmitting on the rs485 local bus.
D6 (RXB)	RS485 Remote Port Receive Activity	Flickering indicates traffic on the rs485 remote bus
D8 (RXB)	RS485 Remote Port Transmit Activity	Flickering when this SmartRap is transmitting on the rs485 remote bus.
D47 (ST1)	Status 1	Board Status indication – see Status table below
D48 (ST2)	Status 2	Board Status indication – see Status table below
D9 -> D24 (CH1 -> CH16)	Activity LEDs associated with each individual output channel	Channel Status indication see Status table below

Status		
Status	Board Status LEDs	Channel Status LEDs
Normal Operation with SCPU Supervision.	ST1 – Blinking 1Hz ST2 – Off	CHx – LEDs flash when associated output is ON
Board currently Firing in Stand-Alone Mode.	ST1/ST2 – Alternating at 2 Hz	CHx – LEDs flash when associated output is ON
Output are NOT firing due to No I2C communication and Stand Alone firing is DISABLED.	ST1 – Off ST2 – Off	CHx – No Activity
Channel(s) temporarily NOT firing due to excessive current detection.	ST1/ST2 – Alternating at 4 Hz	CHx – LEDs flash when associated output is ON
Board error due to one or more of the following: Over-Temperature Abnormal supply voltages Current feedback error Line Sync Incorrect board address (>64) Illegal device type configuration.	ST1 – Blinking 1Hz ST2 – Off	CHx – LED’s alternating between all ODD & EVEN channels.
Board in TEST mode	ST1/ST2 – Flashing simultaneously at 4 Hz	n/a

Note: Anytime a user changes either of the rotary address switches, the CHx LED’s will flash the address by utilizing the CHx LED’s. For example if the user changes the boards address from 11 to 12 by moving the “Ones” rotary from 1 to 2 then the board will temporarily flash CH11 and CH2 LEDs for ~ 1 sec. CH11 indicates the “Tens” rotary = 1 and “Ones” rotary = 2, therefore address = 12.

R.Zara 5/15/2015