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A	Release	9 December, 2010
B	Update 4.1.2 – Rear Panel Delete Section 4.3 – External Analog Control	20 October, 2015
C	New Case Design,	June, 2019

USER'S MANUAL

MODEL: 5971-160 Current Reversal Switch



PROPRIETARY

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Section 1

SAFETY

1.1 - Symbols Used In This Manual



Important information. This label indicates important information that must be read and understood prior to operation.



Warning relating to a trip hazard.



Warning relating to the potential for electrical shock.



Warning relating to the potential of injury due to lifting heavy weights.

1.2 - Installation, Operation, and Service Precautions



During installation and servicing this system must be locked out following the lockout/tagout procedure defined in section 1.3



Hazardous voltages are present within this equipment during normal operation. This equipment should never be operated with any of the covers removed.

Never service alone. The output of this equipment and its DC Power Supply is capable of delivering high voltages at high currents, and is potentially lethal. Do not perform service to this equipment or its associated DC Power Supply unless another person is present who is capable of rendering first aid.



Do not remove protective covers or leave cable terminations exposed. Do not operate if terminals or cables are damaged.

1.3 - Lockout/Tagout Procedures

Purpose:

To protect personnel and ensure that machines and equipment are isolated from potentially hazardous electrical energy. Lockout or tagout must occur before employees perform service, maintenance, or renovation. This is important where unexpected start-up could cause personal injury, fire, or equipment damage.

Policy:

All equipment shall be locked out where possible. Where such control is not possible, equipment may be tagged out-of-service. In all instances, equipment shall be made inoperable to protect against possible operation where such operation may cause personal injury or damage. Employees must not attempt to operate any switch or source of energy which is locked out or tagged out.

Procedures:

1. When working on systems which could accidentally be activated, the system shall be locked out or tagged out by use of a safety lockout device and padlock. In addition, a tag shall be used to identify the purpose of the shutdown, the employee involved, the date the unit was removed from service, and when the system may operate again.
2. If more than one source of energy is present, all such sources must be locked out or tagged out. Special procedures must be followed to ensure that the equipment is disconnected from an energy management system or emergency generator system that may start or energize the equipment.
3. A lockout is required on all systems where possible. A tagout is an acceptable means of protection on systems which are less hazardous. An example of less hazardous is a device, if started accidentally, would not cause personal injury.
4. If more than one person is involved in the repair, each person shall install a lock and or tag to the equipment energy source. An employee may not use the tag or lock of another employee.
5. After servicing, renovation, or maintenance is complete, the area must be checked for tools, parts, removed guards, and assurance that no personnel are in the danger zone. Then the lockout or tagout will be removed by the same employee who initially locked it out so energy may be restored to the equipment.
6. If the employee who locked out or tagged out the equipment is unavailable, the supervisor may remove the lock or tag if the following conditions are met:
 - a. Verification that the employee who applied the device has left for the duration of the shift and is not at the job site.
 - b. Made reasonable efforts to reach the employee.
 - c. Inform the employee that the lock or tag has been removed and the system is no longer de-energized, before the employee resumes work.
7. Employee's using lockout/tagout devices shall have training about this program, and shall have annual retraining to ensure that the employee understands and follows this program.

The training and retraining shall be documented with the training records maintained by the training coordinator.

8. Outside contractors are required to follow this policy or provide a similar policy that is in compliance with Occupational Safety and Health Administration (OSHA) Standard 1910.147. Under no circumstances are outside contractors authorized to remove a lockout/tagout device nor are they allowed to energize a locked out/tagged out system.

Lockout/Tagout Procedures Checklist:

The following steps must be followed in sequence to properly lockout/tagout and re-establish energy:

I. Understand the hazard:

Electrical

Electrical Shock and or burn could result from contact with the exposed conductors line voltage or high voltage equipment. Flying parts or fire could result if this circuit were shorted. Electricity should be controlled at the circuit breaker, main switch, or fuse box.

Mechanical

Equipment or machinery can inflict tissue or skeletal injury through crushing, laceration or impalement. This can be controlled through the main electrical switch, plug, circuit breaker or anti-motion pin.

Thermal

Can cause burns or fires. It can be controlled by the main electrical switch, electrical plug control, electrical circuit breaker, electrical fuse box, steam valve, fluid line valve or shielding.

II. Shutdown:

Know what type of energy the machine uses.

Identify its potential hazards.

Find the switches or other devices that control energy and need to be locked out.

Let employees know that you will be locking or tagging out the equipment and why.

Turn off the machine or equipment.

III. Isolate the source of energy

Electrical

- Locate the main switch box or circuit breaker.
- Open the breaker, open the switch or remove the plug.
- Attach a lockout enabling device if the circuit cannot otherwise accommodate a padlock.
- Place plug in a plug lock box.

Mechanical/Storage Potential Energy

- Lockout enabling device.
- Secure the energy controlling lockout by attaching a personal lock and completed tag to the lockout enabling device. If more than one person will be performing the work, each must apply their own lock to a multiple lock device.

- Release all stored energy.
- If there is a heat exposure, allow to cool.

Release from Lockout/Tagout

1. Inspect the surrounding area following completion of work for loose tools, parts, correct valve settings, system integrity, exposed conductors.
2. Check that all machine guards are in place and reconnected if applicable.
3. Notify others in the area that the equipment is about to be made operational and returned to service.
4. Remove personal lock, tag, and lockout enabling device. This step must be performed by the same person who applied the tag and lock.

Lockout/Tagout Training

The lockout/tagout program is designed to train employees on disabling powered equipment from their power sources before beginning any servicing or maintenance work.

Lockout/tagout training is required for all employees who may possibly need to lockout and tagout equipment.

Employees will receive annual training in the following areas:

1. Recognition of applicable hazardous energy sources.
2. Methods and Means necessary for energy isolation and control.
3. Restrictions and limitations of lockouts.

Section 2

SPECIFICATIONS

Table 1. Model 5971-160 Current Reversal Switch Specifications

Electrical

AC Power Input (Aux Power Supply) 85-264VAC, 50/60Hz, 2A

Power Input (From DC Supply) **200V**, 160A Maximum

Recommended DC Power Supplies

Sorensen DLM40-75E
Sorensen SGA 60/83 60V, 83A
Sorensen SGA 100/150 100V, 150A
Sorensen SGA 160/31 160V, 31A
Sorensen SGA 160/62 160V, 62A
Sorensen SGA 160/156 160V, 156A
Sorensen SGA 200/75 200V, 75A

Switch Voltage Drop (at 20°C) < 440mV at 150A

Switch Resistance at 150A (at 20°C) < 3mΩ

Control Modes

Computer Control

National Instruments Multifunction DAQ, Model USB-6351
Current Control Resolution: 16 bits
Current Programming Voltage: 0 - 10VDC
Current & Voltage Monitor Resolution: 16 bits
Digital read back of amplifier and magnet interlock status
Magnetic field read back resolution: 16 bits

Manual Control

Manual control of the DC current via the DC Power Supply's front panel controls
Manual control of the current polarity via the Current Reversal Switch's front panel controls

Mechanical

5971-160 Current Reversal Switch

Form Factor 3U rack mount fully enclosed chassis
Overall Dimensions 482mm (19") wide x 88.1mm (3.5") high x 507mm (20") deep
Weight 15.75 kg (35lbs)

5971-160 Current Reversal Switch & SGA Power Supply in Optima Rack

Overall Dimensions 560.5 (22") wide x 1,058 (41.6") high x 823 (32.4") deep
Weight (with Sorensen SGA 60/83) 105.75kg (235lbs)
Weight (with Sorensen SGA 100/150) 115kg (250lbs)

Section 3

INSTALLATION



Caution: In many cases, the Reversal Switch and DC Power Supply will be pre-installed by GMW into a 19" EIA equipment rack. If it is not, care should be taken during rack mounting to avoid personal injury or damage to the equipment.

3.1 - Unpacking Instructions and Damage Inspection

3.1.1 - Systems Shipped with a GMW Supplied Rack:

1. Remove all eight of the lag bolts located at the lower edge of all the side panels of the crate top cover.
2. Gently rock the crate top cover to work it loose from the shipping crate base.
3. Use one person on each side of the shipping crate grip the side panels of the crate top cover. Lift the crate top cover high enough to clear top of the rack, walk the cover sideways to a clear area and place it upon the floor.
4. Inspect the rack and its contents to ensure that no damage has occurred during shipment. If any damage is evident report the damage in detail to the shipper for claim and simultaneously notify GMW in case an assessment of the damage must be made. If no damage is found, proceed with the unpacking and installation.
5. Cut the straps that secure the rack to the pallet base.
6. Remove the wood block at the bottom front edge of the rack.
7. Carefully slide the rack forward and off of the pallet base.
8. Unpack any other system components as per their instruction manuals.

3.1.2 - Systems Shipped without a GMW Supplied Rack:

1. Open the outer shipping carton by cutting the packing tape along the joints.
2. Remove the inner shipping carton by carefully lifting it out.
3. Open the inner shipping carton by cutting the packing tape along the joints.
4. Carefully lift the reversal switch clear of the shipping carton.
5. Inspect the reversal switch for any damage.
6. Retain all packing materials for future shipping needs.

3.2 - Rack Mounting

When rack mounting the 5971-160 Reversal Switch it is important to note that the vertical mounting flanges alone are not strong enough to support the weight of the Reversal Switch. Support angles on each side, beneath the 5971-160, must also be used. Failure to use adequate support angles will result in equipment damage.

Take care when selecting a rack that it has enough depth to completely house the Reversal Switch and DC Supply. The RC-351930 Bench Height Rack offered by GMW has an internal depth of 762mm (30"). Typical installations would put the DC Supply at the bottom of the rack, with the Reversal Switch just above, thus keeping the center of gravity as low as possible in the rack. Other instrumentation may then be installed in to the upper sections of the rack.

Note: Telco style racks are NOT appropriate for the Reversal Switch and DC Supply.

3.3 - Electrical Connections



3.3.1 - Current Connections

Special care should be taken to insure that the current terminations are secure and do not work loose in operation. Local heating at the terminations can cause rapid oxidation leading to a high contact resistance and high power dissipation at the terminals. If left unchecked this can cause enough local heating to damage or destroy the current connection terminals.



3.3.2 - Interlocks

The 5971-160 Reversal Switch has interlock connections between the DC Power Supply and the Electromagnet load. The interlocks must be connected for proper system functioning and protection of the equipment, facility and to protect against personal injury. Attempting to operate the system with the interlocks defeated is not recommended and will void the warranty.

Even if the 5971-160 Reversal Switch was ordered as a complete system and assembled into a rack by GMW, it is still recommended to follow and verify the following section as connections may have loosened during shipment.

Refer to drawing 13907-0009-0, Rev. A for a detailed connection diagram.

3.3.3 - DC Supply and Electromagnet Connections

1. Connect the DC Supply to Switch Cable to the input +, input – and ground. This cable provides the DC power, ground and interlock signals between the DC Power Supply and the Switch. Ensure that ALL connections are tight, the polarity is correct and the interlock cable is properly connected.
2. Connect the Reversal Switch to Electromagnet Cable output +, output – and ground. This cable provides the current, ground and interlock signals between the Switch and the Electromagnet. Again ensure that ALL connections are tight, the polarity is correct and the interlock cable is properly connected.



It is critical that the DC Supply to the Reversal Switch and the Reversal Switch to Electromagnet cables are connected correctly to the Reversal Switch Rear Panel terminals. Incorrect connection may cause damage to the DC Power Supply or the Reversal Switch.

3.3.4 – Reversal Switch Power

Connect the 115Vac or 220Vac power cord to the Reversal Switch. - This provides the Reversal Switch with its required auxiliary power for the interlocks, computer interface, magnetic field sensor, and cooling fans.

3.3.5 - DC Supply Main Power

This procedure should be carried out by a qualified electrician.

1. Connect the DC Supply to the AC Mains service via an appropriate three-phase AC power disconnect / breaker panel. For a GMW supported power supply, the maximum input currents per phase are given below.

DC Power Supply	Voltage	Phases	Current per Phase
DLM40-75E, 3kW	180-264V	3	16A
SGA 60/83, 5kW	187-242V	3	21A
SGA 100/150, 15kW	187-242V	3	62A
SGA 160/156, 25kW	187-242V	3	103A

2. Ensure that the Electromagnet, Reversal Switch and DC Power Supply grounds are connected. The DC Power Supply must be connected to the local service ground.

Section 4

SYSTEM DESCRIPTION

4.1 - System Description

A complete system would typically consist of an appropriate DC power supply, the GMW 5971-160 Current Reversal Switch, a Senis Magnetic Field Transducer, an Electromagnet, and a control computer and software.

The DC Supply provides current to the electromagnet via the Reversal Switch, and is safety interlocked by means of a relay contact in the Reversal Switch. The Supply's output is enabled on a closed contact, providing protection should the interlock cable be disconnected. Two conditions will cause the interlock relay to open and shut down the DC Supply's output: An internal fault detected in the Reversal Switch or a failure in the temperature or water flow interlocks on the electromagnet.

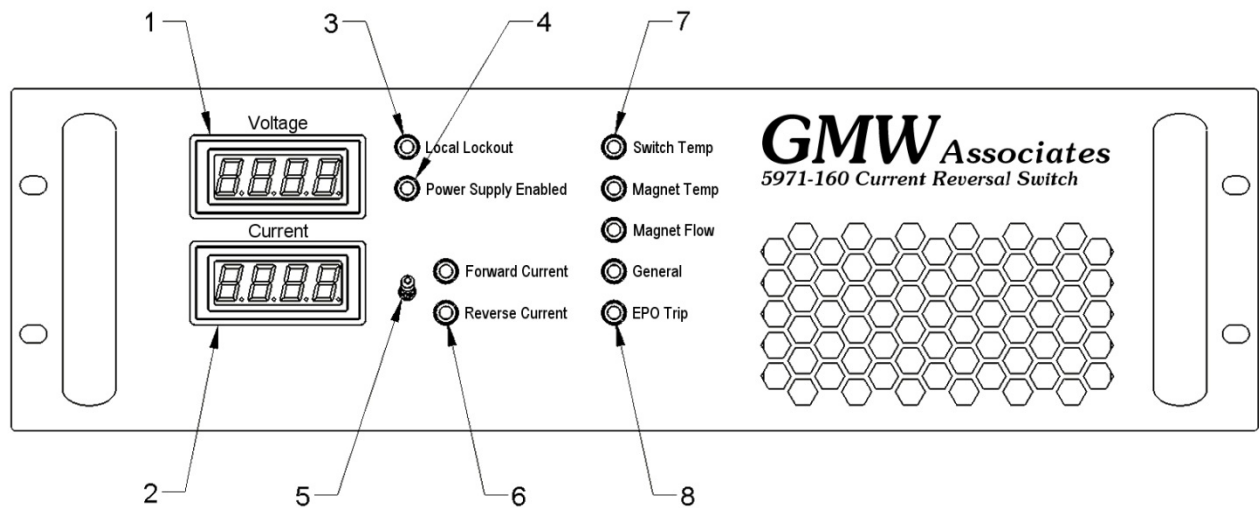
The 5971-160 Current Reversal Switch is comprised of several sections: A proprietary MOSFET switch and associated control electronics, a National Instruments USB-6351 Control with USB interface and an auxiliary power supply all integrated into a single 3U, 19" rack mounting chassis. Refer to drawing no. 13907-0008-0, Rev. A for an internal block diagram.

The auxiliary power supply provides power for the cooling fans, interlocks, control circuitry and interface. It also provides -12V and +12V (400mA each) on the rear panel for an optional external Senis Magnetic Field Transducer for magnetic field measurement and closed-loop field control.

The interlock circuit for the magnet requires a 'closed contact' connection. Provision for both the magnet over temperature and water flow is provided, and a failure of either one is indicated on the front panel of the Reversal Switch. When using the NI USB-6351 DAQ, this information is available via the computer control software. In the event of a magnet interlock fault, the output of the DC Supply is inhibited.

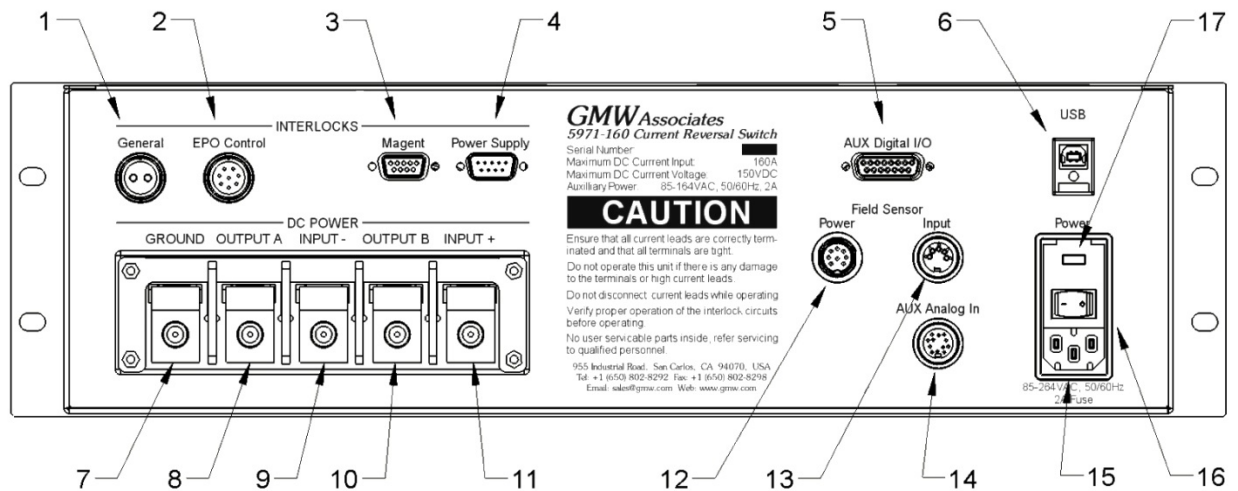
The NI USB-6351 DAQ interface provides computer control and monitoring of the system. It uses a 16-bit analog output (0-10V) to provide the programming signal to the DC Supply. The output voltage and current are monitored by two 16-bit input channels. Complete Reversal switch and magnet interlock status is also monitored via its digital input channels. When using an optional Senis Magnetic Field Transducer, the field is read back on a third 16-bit analog channel. For more information, please refer to the NI USB-6351 Manual and section 4.5 in this manual.

4.1.1 - Front Panel



1. **Output Voltage Display**
This meter will display the output voltage of the 5971-160. The voltage displayed will always show as a positive voltage.
2. **Output Current Display**
This meter will display the output current of the 5971-160. The current displayed will indicate the polarity of the output.
3. **Local Lockout Indicator**
This indicator will illuminate when the 5971-160 is in remote (computer) control mode.
4. **Power Supply Enabled Indicator**
This indicator will illuminate when the DC Power Supply output is enabled.
5. **Manual Current Polarity Control**
Use this control to manually change the output polarity of the 5971-160.
6. **Output Current Polarity Indicators**
One of these two indicators will illuminate to show the output polarity selected. Note that if the 5971-160 is in remote mode, the indicator may not necessarily conform to the manual switch setting.
7. **Interlock Indicators:**
Switch Temp, Magnet Temp, Magnet Flow, & General. These indicators show the status of the system interlock circuits and are normally green. If any interlock circuit is in fault mode the indicator will show red, and the DC Power Supply output will be disabled. The interlock fault must be cleared to enable the DC Power Supply.
8. **EPO Trip**
This special indicator shows that the DC Power Supply PDU has been tripped off. **An EPO Trip event will not disable the DC Power Supply output.**

4.1.2 - Rear Panel



1. General Interlock Input
The general interlock serves as a spare interlock input for use as a user defined interlock. The input requires a normally 'Open' switch or relay contact. The switch must be closed for operation.
2. EPO Control
This provides read-back of EPO status and control of the EPO 'OFF' signal.
3. Magnet Interlock Input
Provides input for the magnet temperature and water flow interlocks.
4. Power Supply Interlock Connection
Output for the DC Power Supply control signals.
5. Auxiliary Digital I/O
Allows user connection to spare digital channels in the National Instruments DAQ. Refer to section 4.4.1 USB-6521 DAQ for details
6. USB
USB connector for computer control cable.
7. Ground
Power Supply and Electromagnet GROUND connection.
8. Output A
Positive output terminal to Magnet.
9. Input -
Power Supply Negative Input terminal.
10. Output B
Negative output terminal to Magnet.
11. Input +
Power Supply Positive Input terminal

12. Sensor Power
 $\pm 12\text{V}$ power for Senis Magnetic Field Transducer
13. Sensor Input
Senis analog Magnetic Field Transducer input
14. Auxiliary Analog Inputs
Allows user connection to spare analog channels in the National Instruments DAQ.
Refer to section 4.4.1 USB-6521 DAQ for details
15. AC Power Input
65 - 264VAC Power Input for the internal auxiliary power supply
16. Power Switch
17. Fuse Holder
Holder for the 1971-160 2A fuse and a spare.

4.2 - Initial Operational Testing – Local Mode

Once the Power Supply, Reversal Switch and Electromagnet system are connected it is time to perform initial system operational checks.

Start by switching on the Reversal Switch. The front panel meters, the power supply enable and the polarity indicator as selected by the polarity control should all illuminate. All interlock indicators should show green.

Temporarily disconnect the Magnet Interlock connector from the Reversal Switch. The 'Magnet Temp' and 'Magnet Flow' interlock indicators should illuminate red signifying a problem with the magnet interlocks. Re-connect the Magnet Interlock connector. The interlock indicators on the front panel should change to green.

Remove the 'General' interlock plug from the rear of the reversal switch. The 'General' interlock indicator should light up red. When the plug is replaced, the light should show green.

The 'EPO Trip' indicator requires a special connection to test. The 5971-160 will be supplied with the EPO Trip input disabled.

Insure that the 'Voltage' and 'Current' controls on the DC Supply are turned down to their minimum values and switch on the DC Power Supply. Turn up the voltage to the maximum, and slowly increase the current control until about 5 amps is indicated on the DC Supply display. The panel meters on the Reversal Switch should show similar values for voltage and current.

It is important to note that for normal operation, the DC Power Supply voltage be set at Maximum. If this is not done, the DC Power Supply will be voltage limited and full output current may not be achieved.

4.4 - Computer Control

The 5971-160 is provided with a LabVIEW driver that allows basic control and monitoring of the Reversal Switch and DC Power Supply.

Start up the computer software and ensure that everything configured correctly. Please refer to section 5 of this manual for more information.

4.4.1 - USB-6351 DAQ

The National Instruments USB-6351 DAQ together with GMW's Magnet Control software provides control and monitoring of the 5971-160 Reversal Switch. If GMW's Magnet Control software is not used, it is still possible to computer control the 5971-160 Reversal Switch by writing custom software to communicate with the USB-6351. The table below describes the channels used and their functions.

USB-6351 Connections			
Signal	Type	Direction	6351 Terminal
Current Control Output 10V output proportional to 100% current output	Analog Single Ended	Output	AO-0
Current Control Common	Ground	Ground	AO-GND
Voltage Monitor 10V / 100% of the power supply's rated output voltage	Analog Single Ended	Input	AI-0
Voltage Monitor Common	Analog	Input	AI-GND
Current Monitor 10V / 100% of the power supply's rated output current	Analog Single Ended	Input	AI-1
Current Monitor Common	Analog	Input	AI-GND
Y-Axis Field Monitor +	Analog	Input	AI-2
Y-Axis Field Monitor -	Analog	Input	AI-10
X-Axis Field Monitor +	Analog	Input	AI-3
X-Axis Field Monitor -	Analog	Input	AI-11
Z-Axis Field Monitor +	Analog	Input	AI-4
Z-Axis Field Monitor -	Analog	Input	AI-12
Field Monitor Common	Ground	Ground	AI-GND
- Reserved -	Digital	Input	P0.0
Switch Temp - Low = Okay	Digital	Input	P0.1
Magnet Flow - Low = Okay	Digital	Input	P0.2
Magnet Temperature - Low = Okay	Digital	Input	P0.3
P/S Enabled - High = Enabled	Digital	Input	P0.4
Polarity Status - High = Forward	Digital	Input	P0.5
Local Lockout - High = Remote	Digital	Output	P0.6
Polarity Control - High = Forward	Digital	Output	P0.7
General Interlock - Low = Okay	Digital	Input	P1.0
EPO Trip - Low =	Digital	Input	P1.1
EPO Control - High =	Digital	Output	P1.2
Interlock Status Common	Ground	-	DGND
+5V Power	Power	-	+5V

USB-6351 Connections - USER ACCESSABLE			
The analog input channels below are available on the rear panel of the 5971-160 for user connection. They may be configured as single-ended or differential. The full-scale ranges may be configured as $\pm 2V$, $\pm 5V$, or $\pm 10V$			
Signal	Type	Direction	6351 Terminal
Analog Channel 5	Analog	Input	AI-5
Analog Channel 6	Analog	Input	AI-6
Analog Channel 7	Analog	Input	AI-7
Analog Channel 13	Analog	Input	AI-13
Analog Channel 14	Analog	Input	AI-14
Analog Channel 15	Digital	Input	AI-15
Analog Input Ground	Ground	Ground	AI-GND
	Digital	Input or Output	P1.3
	Digital	Input or Output	P1.4
	Digital	Input or Output	P1.5
	Digital	Input or Output	P1.6
	Digital	Input or Output	P1.7
	Digital	Input or Output	P2.0
	Digital	Input or Output	P2.1
	Digital	Input or Output	P2.2
	Digital	Input or Output	P2.3
	Digital	Input or Output	P2.4
	Digital	Input or Output	P2.5
	Digital	Input or Output	P2.6
	Digital	Input or Output	P2.7
Digital Common	Ground	-	DGND
+5V Power	Power	-	+5V

Please refer to the National Instruments USB-6351 DAQ manual for configuring the analog and digital channel inputs.

Section 5

SOFTWARE

The 5971-160 Reversal Switch is provided with basic control and monitoring software. This section covers the installation and basic operation of the software.

5.1 - Software Installation

Install the software packages in the order below. This should ensure that all components are correctly installed and working.

1. Install the National Instruments software and driver package, NI-DAQmx, according to the instructions in the National Instruments software manual.
2. Connect the Reversal Switch to the computer.
3. Using the National Instruments software, Measurement and Automation Explorer, verify communication between the computer and the Reversal Switch.
4. Install the GMW Reversal Switch software.

The GMW supplied software allows basic control and monitoring. There are two options when installing the software. The first is a basic run-time version that does not allow modification of the software. The second option is a set of virtual instruments (VIs) that may be modified to suite a custom application. Note that the ability to use the VI version requires the purchase of the complete National Instruments LabVIEW software package.

5.1.1 - Installing the Run Time software version

1. Insert the GMW supplied software disc in to the CD or DVD drive.
2. Run the setup.exe located in the directory \Installer\Volume.
This will install both the runtime and source VIs and by default, the installer will place the files in the directory c:\program files\GMW 5971 Reversal Switch\. You may change this at the time of installation.
3. After the setup has completed, read the readme file for any last minute changes or notes.

5.2 - Operating the Reversal Switch using the GMW Software

Once the software is installed, it will be possible to control and monitor the Reversal Switch using the supplied software.

5.2.1 - Running the software

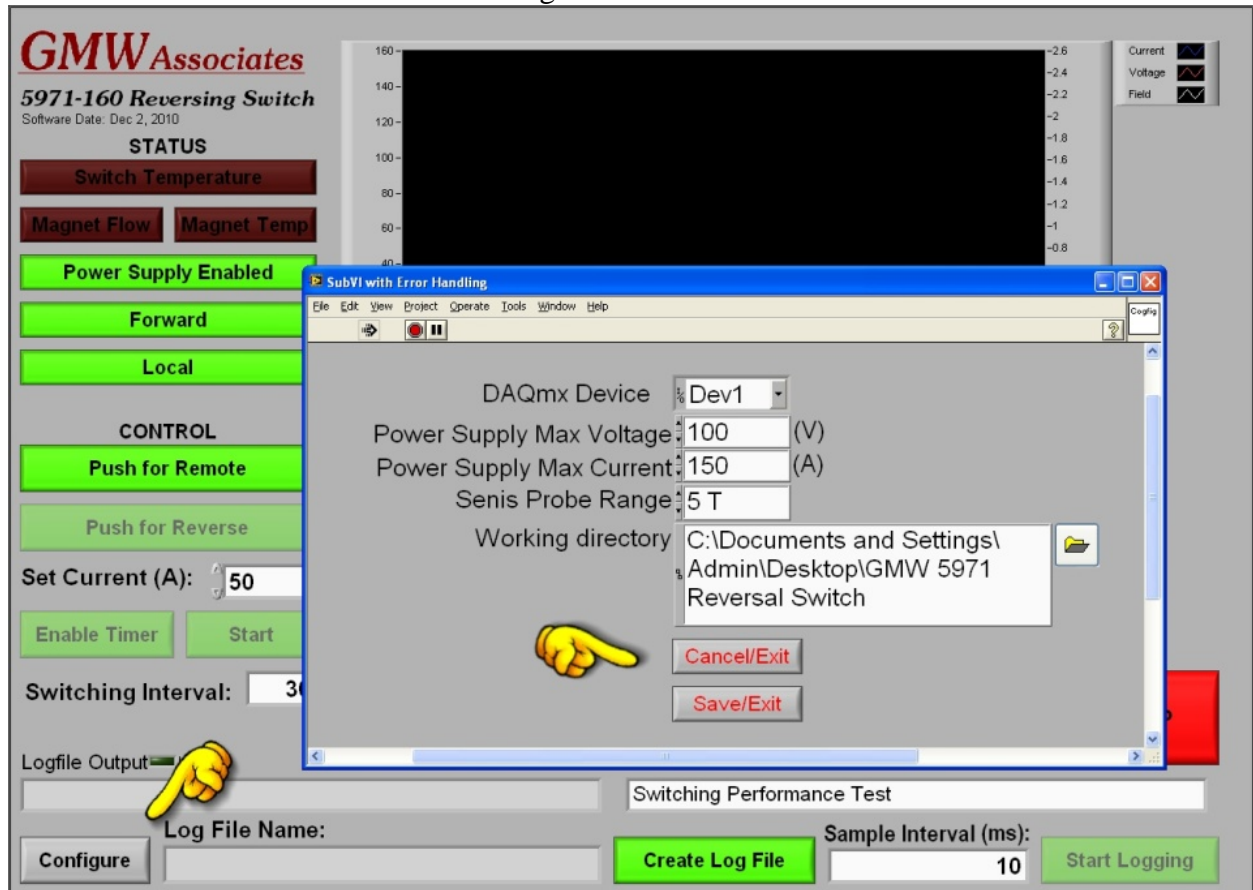
1. The runtime version is accessed via the start menu:
Start > All Programs > GMW 5971 Reversal Switch V1_0> GMW Reversal Switch 5971-160.exe
2. The source VIs are located in the directory c:\program files\GMW 5971 Reversal Switch V1_0\Source VI\. Note that LabVIEW 8.6.1 or later is required to run, view or modify the source VIs.

5.2.2 - Software Configuration

Upon the first run of the software, a simple configuration screen will be presented. Select the DC Power Supply type from the provided list. If the power supply that is being used is not listed, enter the maximum voltage and current of the DC Power Supply that you have. Then select the address of the USB-6351 DAQ from the list. You may also enter the default directory to be used for storing data generated from the data logger.

Save and exit the configuration screen.

Configuration Screen



5.2.3 - Basic Operation

Once configured, the normal operation screen will be presented. This screen provides control of current and polarity and monitoring of the DC Power Supply's output voltage and current. It also provides status read back of the Reversal Switch and Electromagnet interlock status.

It is important to note that when operating remotely, the DC Power Supply front panel controls be set as follows: Voltage to Maximum, Current to zero. If this is not done, the DC Power Supply will be voltage limited and full output current may not be achieved.

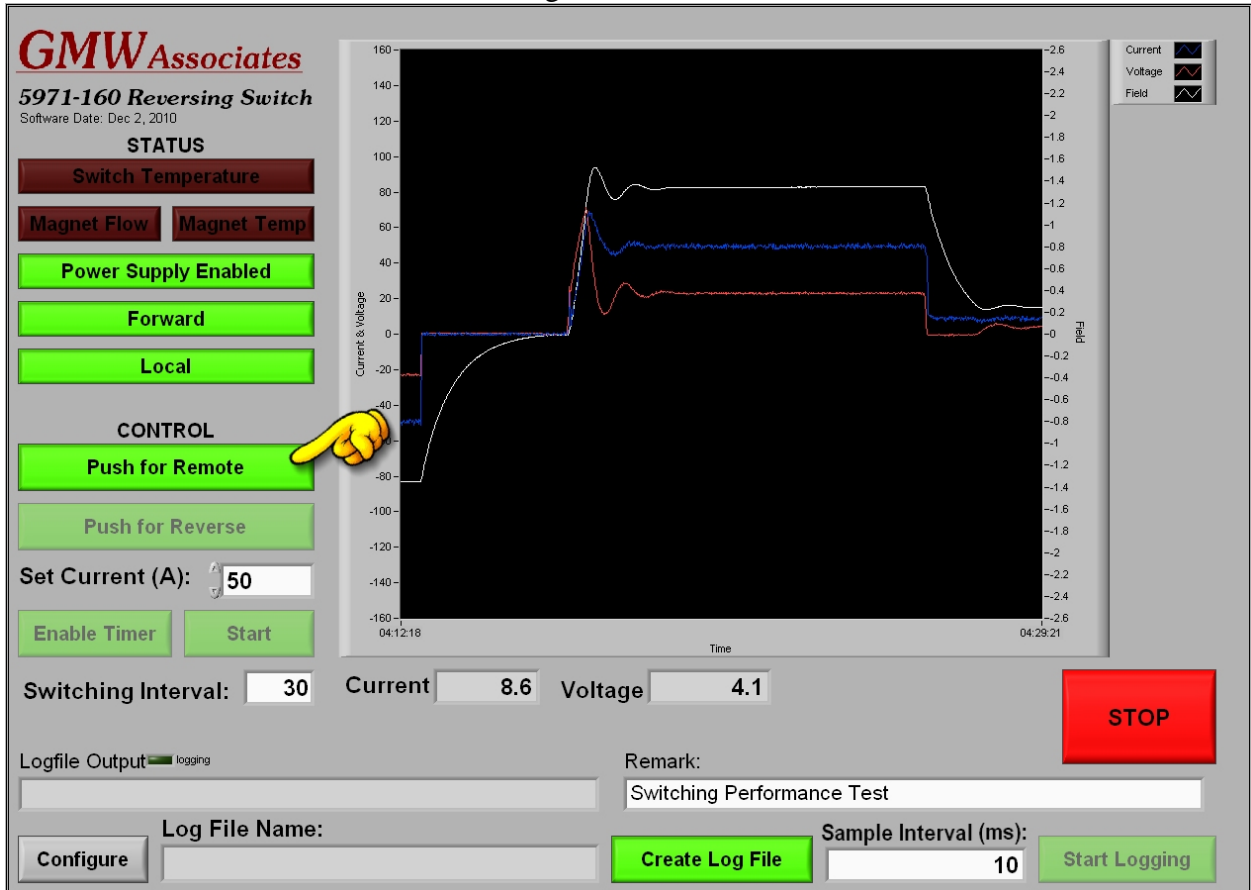
5.2.4 - Local / Remote

The Reversal Switch software defaults to local operation. In order to control the Reversal Switch it must first be placed into the 'Remote' mode. This is done by clicking on the Local / Remote' Control. This control will change its state depending on what mode it is in. The two states are:

'Local' - The control is green and displays the legend 'Push for Remote'

'Remote' - The control is yellow and displays the legend 'Push for Local'

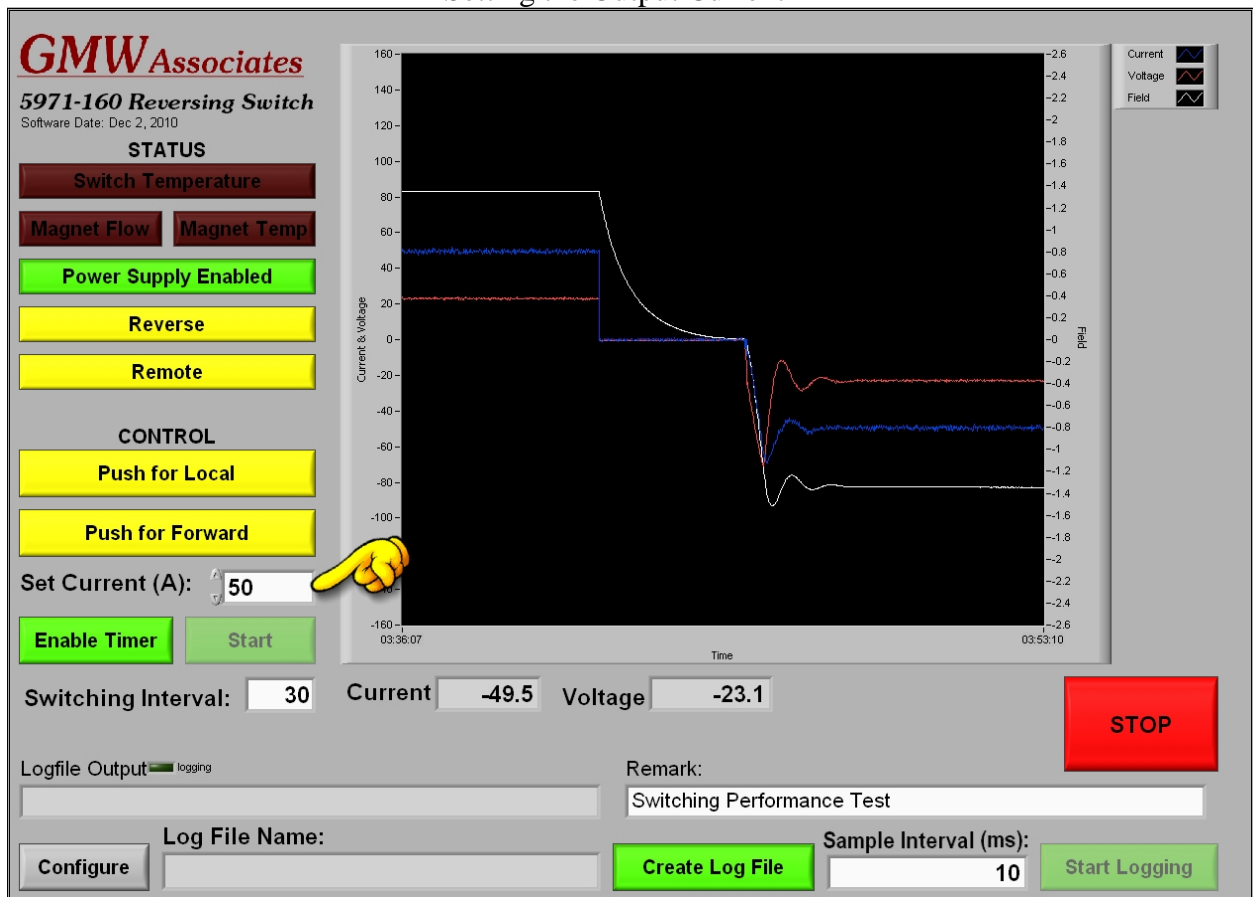
Selecting Local or Remote



5.2.5 - Setting the output current

The output current is simply set by entering the desired output current in the current control box.

Setting the Output Current

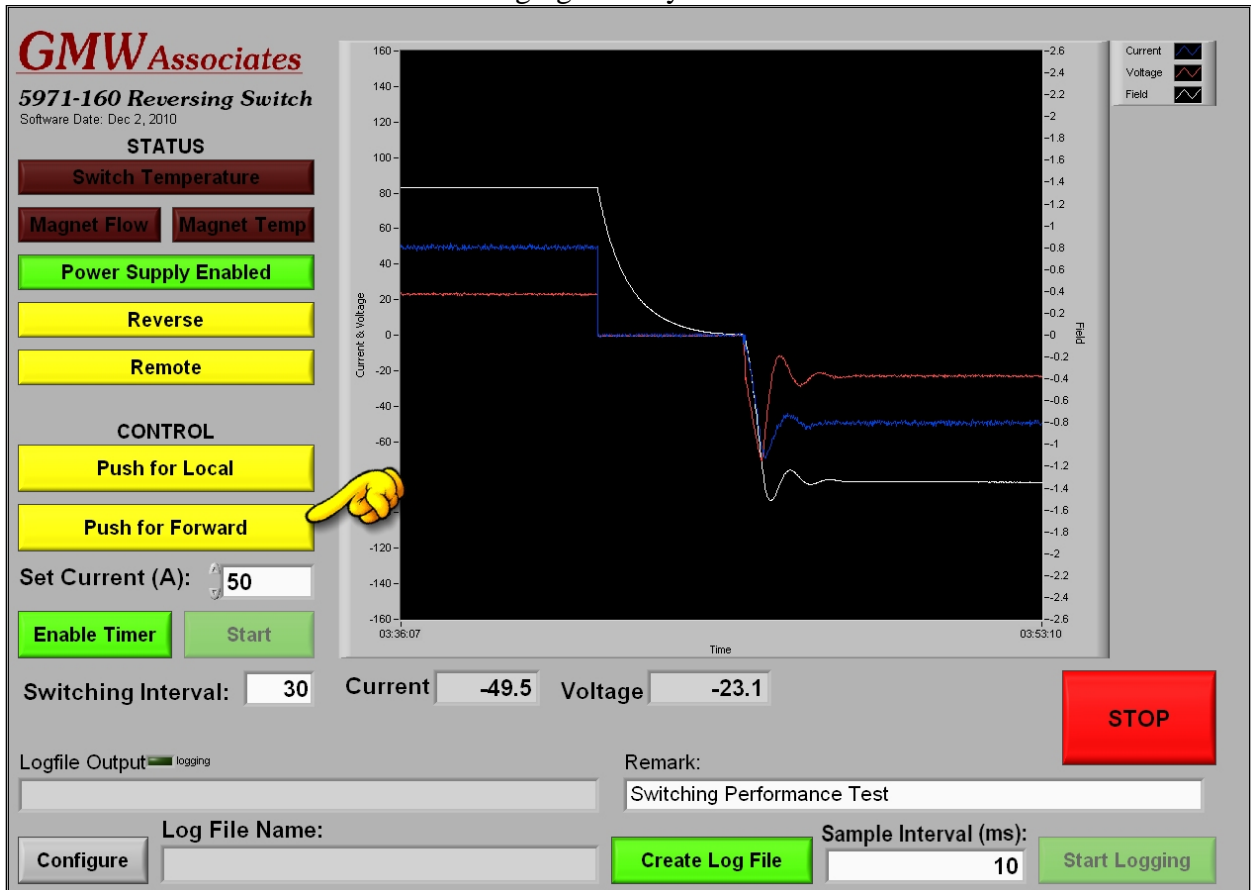


5.2.6 - Selecting the Reversal Switch polarity

To change the Reversal Switch polarity, simply click on the polarity control toggle. The Reversal Switch will then inhibit the DC Power Supply's output, wait for the voltage to drop to a safe level, change polarity and then re-enable the DC Power Supply's output.

The switching time will depend on the configuration of the load. Switching times may approach 20 seconds.

Changing Polarity

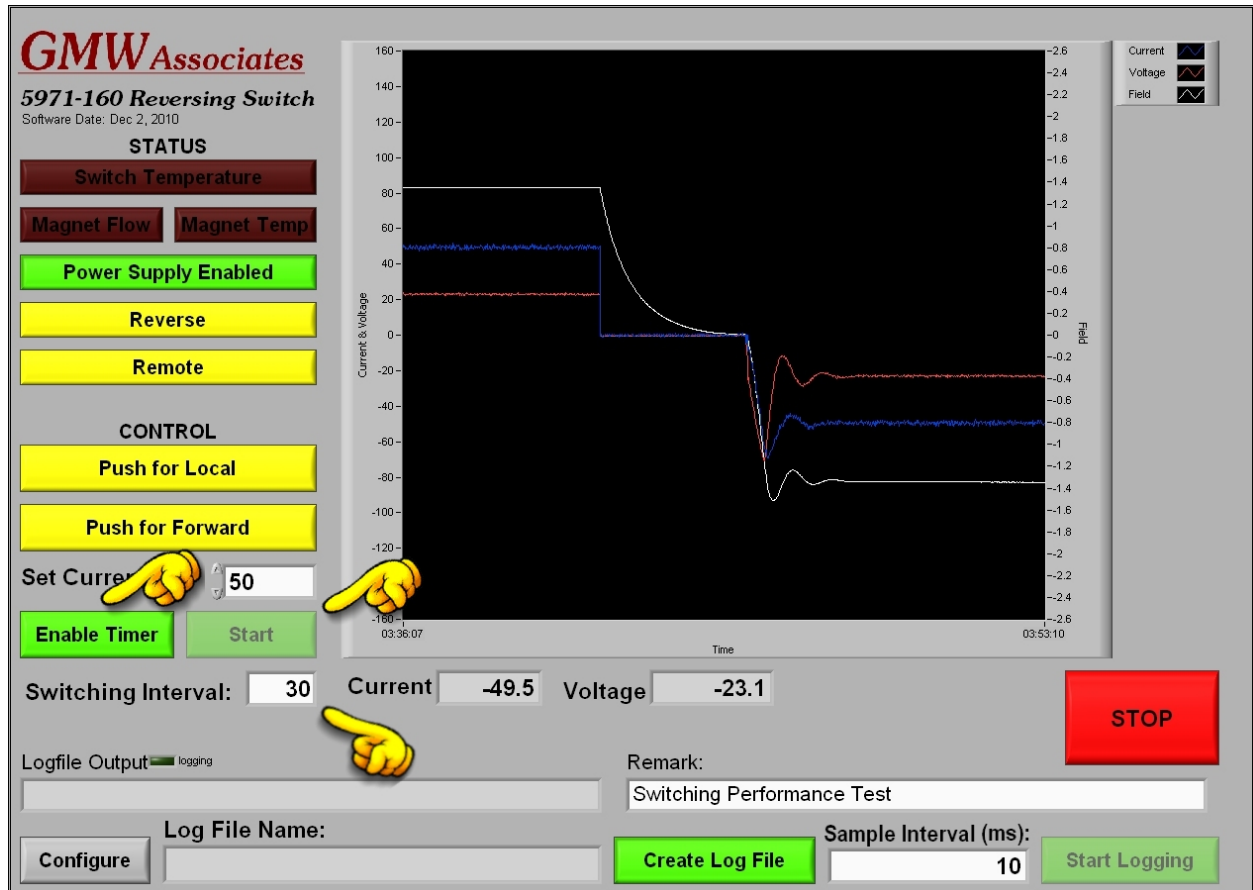


5.2.7 - Timed Switching

The software has the ability to automatically switch at a rate chosen by the operator. To use the timed switching function follow the procedure below.

1. Push the 'Enable Timer' button.
2. Enter the desired time switching interval in seconds. Note that 30 seconds is the minimum interval.

Timer Enable and Interval



3. Press the 'Start' button.

Note that while timed switching is enabled, the regular forward / reverse control is disabled..

5.2.8 - Data Logging

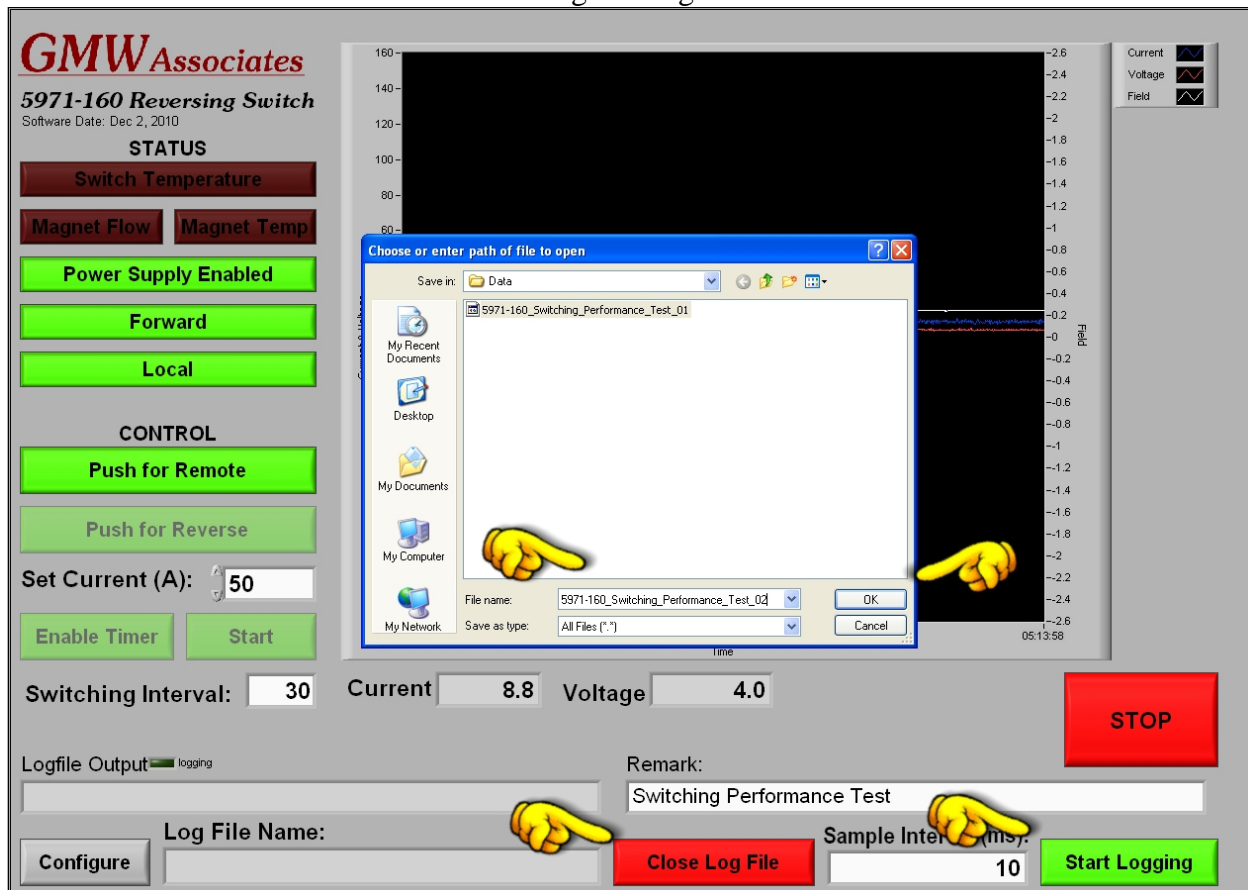
There are a few things to set up in order to use the data logger:

1. Push the 'Create Log File' button. This will open a dialog box that will prompt for the file name of the log file. If the file exists, it will prompt for confirmation to over write the existing file.
2. Enter a log file sample interval (in mili-seconds). Set to 0 to log every sample.

Note at this time, data is NOT being logged.

3. To start the logging, click on the green 'Start Logging' button. The button will then change to a red 'Pause Logging' Button.
4. To stop or pause the logging, click on the red 'Pause Logging' button. The button will change back to the green 'Start Logging' button.
5. To close the log file, click on the 'Close Log File' button.

Creating the Log File

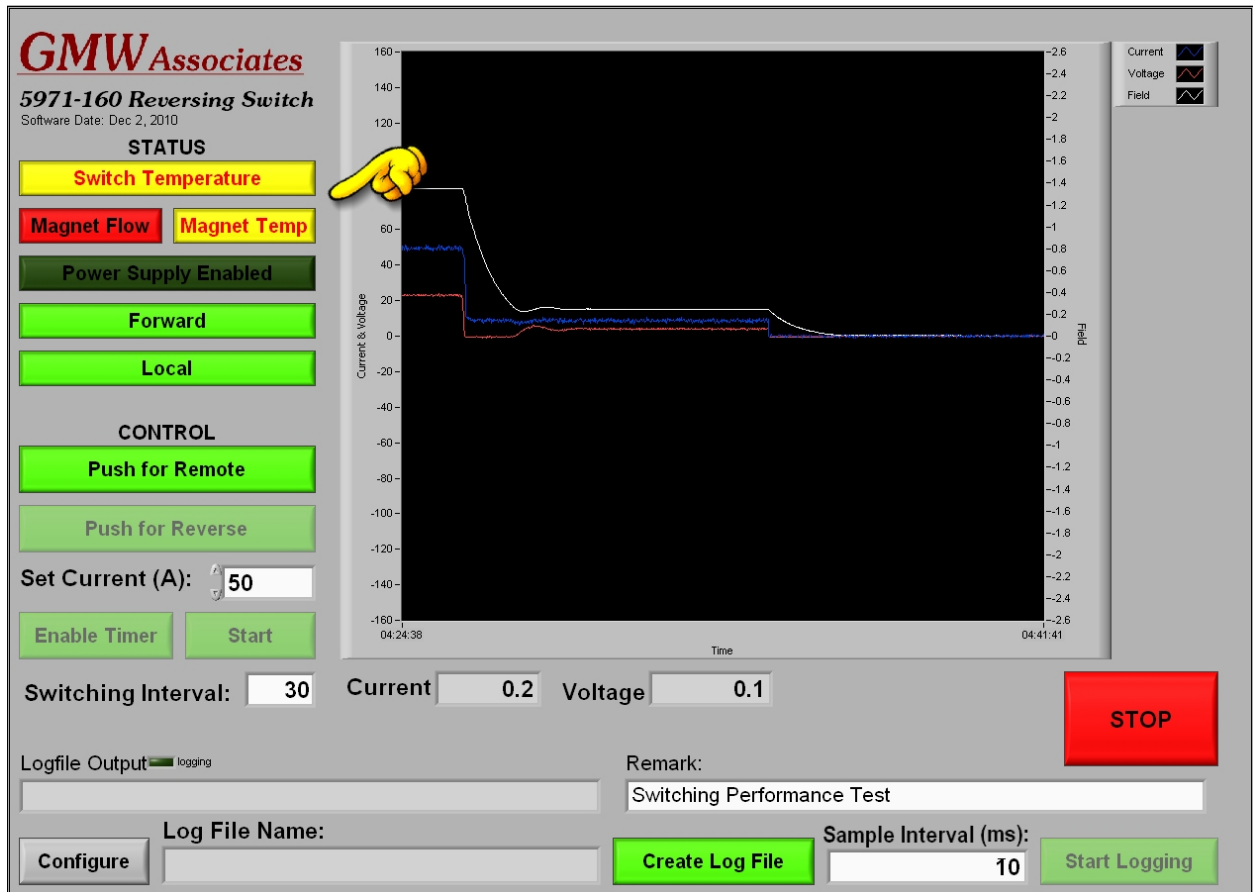


5.2.9 - Status Read Back

This software will read back the Reversal Switch status regardless of its Local / Remote status. The status read back consists of three interlock indicators and the general status indicators.

If any one of the interlock conditions exists, the corresponding indicator will flash on the screen and the DC Power Supply's output will be disabled.

Interlock and Status Indicators



Section 6

MAINTENANCE

The 5971-160 Current Reversal Switch should operate for many years without any trouble provided that the following basic maintenance points are observed. Always remember that the AC power should be disconnected before performing any maintenance procedure. The 5971-160 may generate lethal voltages and must not be operated with damaged components, protective covers or cable insulation. For more information, please refer to Section 2, Warnings

1. Electrical Connections: Ensure that all electrical connections are clean and tight. Ensure that the insulation of all electrical cables is undamaged and repair or replace if necessary. All electrical termination covers must be in place and firmly secured.

A corroded and / or loose high current connection will cause a voltage drop across the connection. A drop of 0.1V at 160A results in 16W being dissipated at the connection. The connection will increase in temperature which will result in oxidation of the connection, higher resistance and a further increase in power dissipation. If this situation is left uncorrected the cable and Reversal Switch insulation will melt and possibly the copper connections will melt as well. Not only will the Reversal Switch and nearby equipment be damaged, but there is the possibility for fire.

2. Warning Labels: Ensure that all protective covers on the system and the magnet are in place. There are warning labels on all removable covers.

3. Cooling: Check that the fans are clean and free of blockage. Ensure that the fans are operating at full efficiency.

4. Cleaning: To clean wipe the case with a soft cloth with a mild detergent or plain water. Do not use any solvents as they may damage the finish.

Section 7

DRAWINGS

Section 8
PHOTOGRAPHS



5971-160 Front View



5971-160 Rear View

Section 9

5971-160 with GMW ELECTROMAGNETS

9.1 Table - GMW Electromagnets and appropriate DC Power Supplies for use with the 5971-160 Current Reversal Switch

GMW Electromagnet	Peak DC Power	Ametek - Sorenson Power Supply
5403, 5403EG, 5403FC, 5403AC	70A, 33V, 2.3kW	DLM40-75E, 40V, 75A, 3kW
5404	70A, 160V, 11.2kW	SGA 200/75, 200V, 75A, 15kW
3472-50, 3472-70	70A, 50V, 3.5kW	SGA 60/83, 60V, 83A, 5kW
3473-50, 3473-70	70A, 59V, 4.1kW	SGA 60/83, 60V, 83A, 5kW
3474, 5501	140A, 76V, 10.6kW	SGA100/150, 100V, 150A, 15kW
5414	140A, 116V, 16.2kW	SGA160/150, 160V, 150A, 25kW
5451	70A, 25V, 1.75kW	DLM40-75E, 40V, 75A, 3kW

9.2 Performance Data