SIEMENS

Automatic Transfer System

City of Cuyahoga Falls

Engineering Manual

CUYAHOGA FALLS
ELECTRIC SYSTEM
AMERICAN MUNICIPAL UTILITIES

Contents

1. System description

The Siemens High-Speed Automatic Transfer System (ATS) protects the load from a loss of power supply by automatically disconnecting the load from the faulted primary power source and reconnecting to the backup feed. The ATS scheme is accomplished by Siemens SIPROTEC 7SC80 automation controllers. Each controller governs the operation of reclosers situated on each side of the critical load using IEC61850 communication protocol over fiber optic links. When a loss-of-source is detected, the recloser on the faulted side opens while the other closes to maintain power to the load. The system operates autonomously in a peer-to-peer fashion with no need for master control. Incoming data to the controllers is checked periodically and any unexpected delays will cause a communication fault to be issued. System operations can be monitored, configured, and manually controlled through the automation controller HMI (Human Machine Interface) or SCADA.

In addition to source transfer functions, this system also provides voltage regulation by monitoring end of line values and adjusting substation regulators accordingly.

1.1 System architecture

The Automatic Transfer System architecture is shown on fig. 1. System includes 3 Siemens Distribution Reclosers (SDR) R1, R2, R3 controlled by the 7SC80 devices. The voltage regulators are equipped with MJ4 and 7SC80 controllers. The MJ4 provides voltage regulation based on the voltage at the substation. The 7SC80 controllers govern voltage regulators based on the line end voltage, measured by the reclosers. The operator can manually select which regulator to use either at the substation level or from HMI in the office. If system detects communication failure, the 7SC80 voltage regulator automatically transfers control over to the MJ4. All reclosers and voltage regulators connected via Single Mode fiber to the Ruggedcom Ethernet Switch in the SCADA room. The software based HMI is running on the SICAM HMI PC. This PC allows the operator to monitor and control the entire system. The DIGSI software package provides capability to remotely change settings or upload a new device configuration.

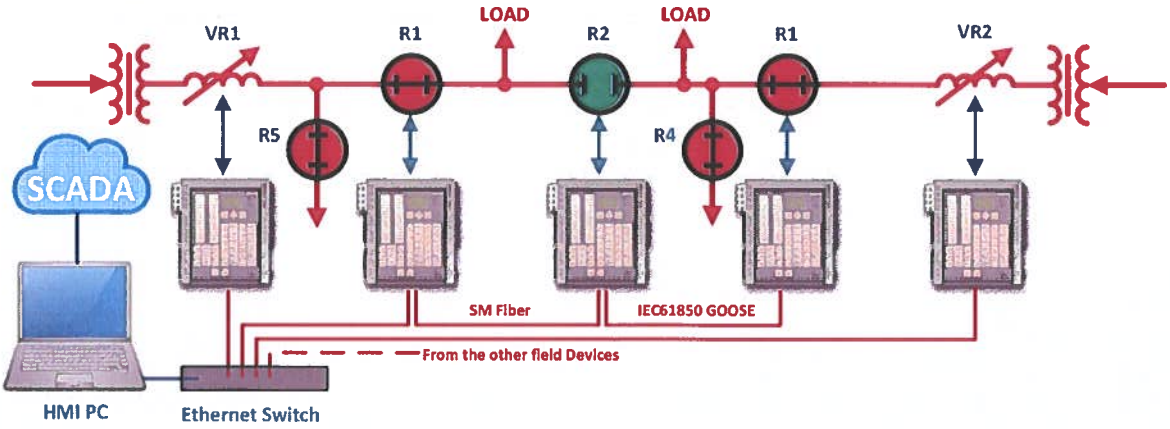


Fig. 1

The SCADA system is directly connected to the HMI PC. The field information from the reclosers and regulators is coming via IEC 61850 protocol. This data is converted to the DNP3 protocol and provided to SCADA for control and supervision purposes.

In the event of a fault or loss of source, the 7SC80 devices will generate the COMTRADE fault records. These files then automatically uploaded to the HMI PC for further analysis using SIGRA any other software compatible with COMTRADE format.

The distribution system also includes two standalone SDR reclosers. These two units perform only protection and autoreclose functions and are not carrying the ATS functionality. Standalone reclosers can be monitored and controlled from the HMI PC.

1.2 System Modes of operation

The source transfer system operates in the modes listed below. System operations are factory-programmed, but can be changed in the field as described under Operating Procedures (included to the document package for each recloser).

Mode	Description
Auto Source-Transfer Mode	The Auto Source-Transfer Mode enables all automatic source transfers / restoration sequences. Automatic operations are functional only when the LED 'Auto Mode ON' is on. NOTE: Auto Source-Transfer Mode is automatically blocked whenever the following conditions exist: • Fault Detected status indicator is lit; • Operation Fail status indicator is lit; • Comm Fault status indicator is lit; • A Hot Line Tag is in place at any recloser.
Automatic Restoration Mode	If Automatic Restoration Mode is activated, controllers will automatically initiate the restoration sequence to reconfigure system back to its original configuration five minutes after both sources have become available. When Automatic Restoration Mode is disabled, the automatic restoration sequence must be initiated by an operator by pressing the Restore Command button. The feeder can also be restored by manually operating each recloser from the automation controller HMI; in this case Auto Mode must be switched off.
Simulation Mode	Allows the operator to simulate the system events and test the system reaction without operating the primary switchgear
Voltage Regulation Mode	Provides regulator control based on the line end voltage values. System automatically determines the line end recloser to measure the voltage.

	NOTE: If Voltage Regulation mode is disabled, system allows operator to manually control the Regulators from the HMI PC. To maintain the automatic control either this mode should be activated or system should be switched over to MJ4 controller.

2. System settings

The ATS system performs source transfer, voltage regulation and protection functionality according to the table below:

Device	ATS & Protection functionality
VR1	Voltage regulation based on the line end voltage
R1	Undervoltage detection for the ATS, Source transfer logic, Overcurrent (50/51 TCC, 50N/51N TCC), jDiff™ (Jump differential protection), Autoreclose
R2	Source transfer logic, Overcurrent (50/51 TCC, 50N/51N TCC), jDiff™ (Jump differential protection), Autoreclose
R3	Undervoltage detection for the ATS, Source transfer logic, Overcurrent (50/51 TCC, 50N/51N TCC), jDiff™ (Jump differential protection), Autoreclose
VR2	Voltage regulation based on the line end voltage
R4	Overcurrent (50/51 TCC, 50N/51N TCC), Autoreclose
R5	Overcurrent (50/51 TCC, 50N/51N TCC), Autoreclose

2.1 Changing the line end voltage threshold

The line end voltage threshold can be changed remotely from the HMI PC through the 7SC80 WEB HMI. Both VR1 and VR2 employ two independent voltage thresholds. In order to apply the new line end voltage values, the operator should access VR1 or VR2 through internet explorer using the following IP addresses:

Voltage Regulator	IP Address
VR1	10.10.0.5
VR2	10.10.0.4

To access VR1, please type http://10.10.0.5 in the address bar. The following page (fig.2) will appear:

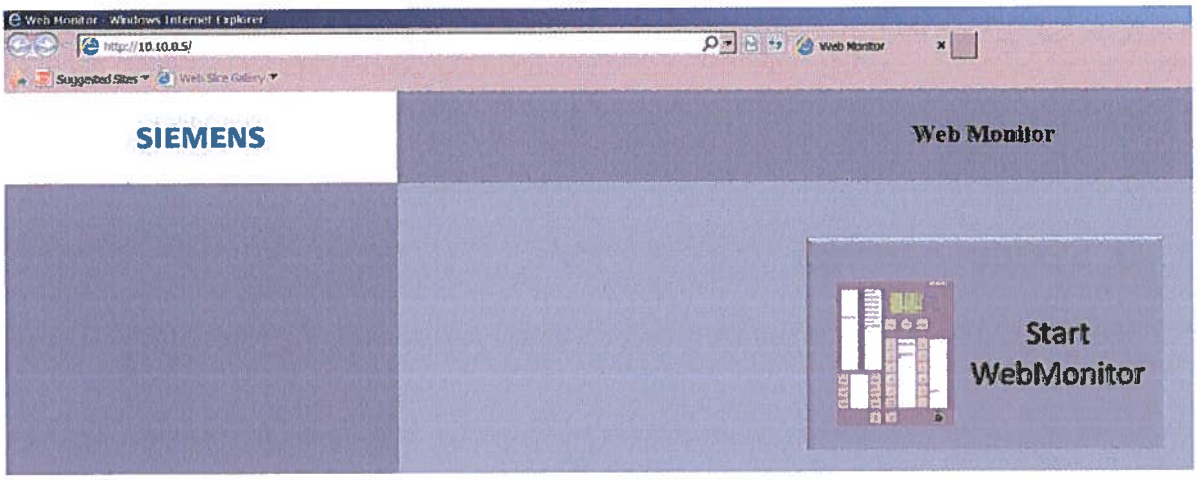


Fig. 2

Please click on the "Start WebMonitor" button, the internet explorer will launch java application (fig.3):

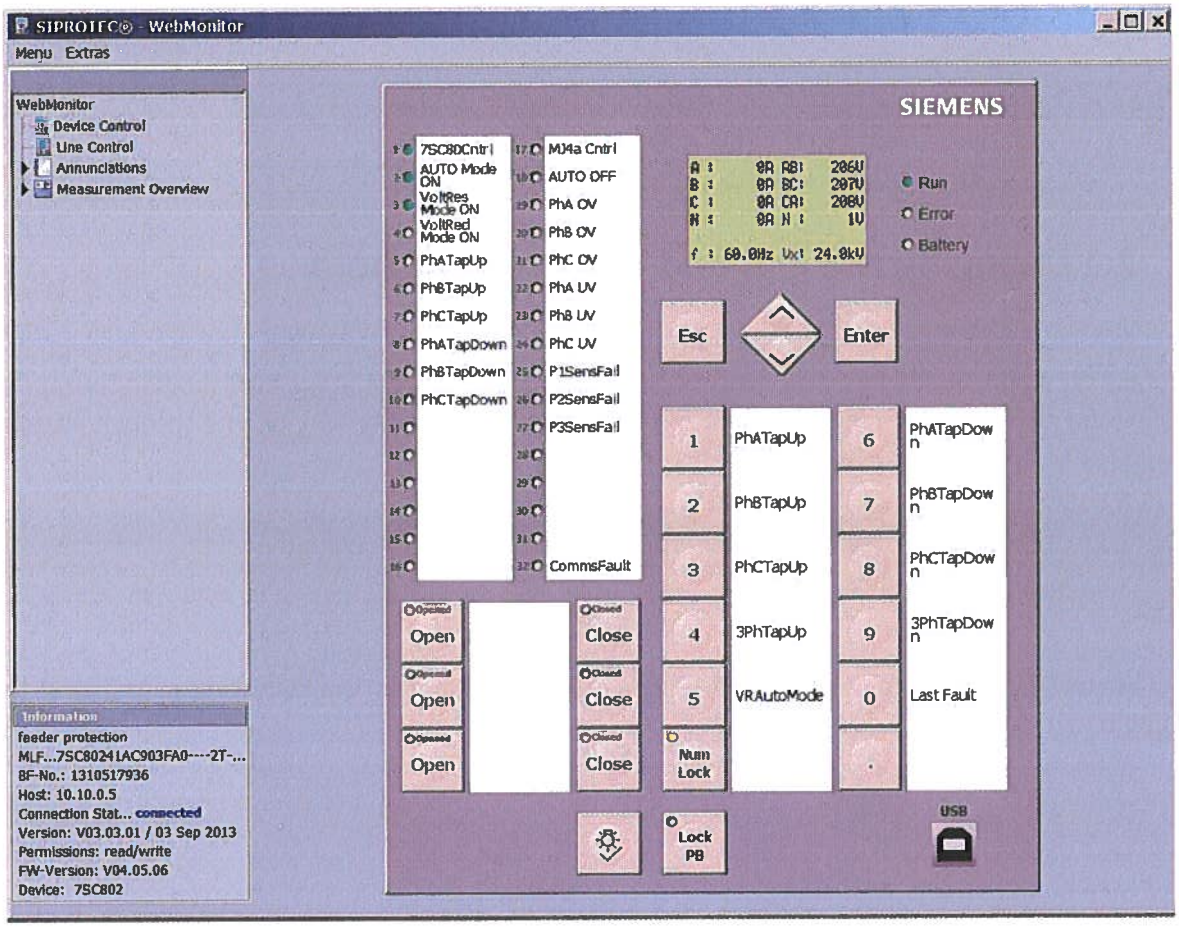


Fig. 3

Please click on "ESC" button, the device menu will appear on the screen (fig.4). Using "Up" and "Down" arrow buttons, select "Measurement" menu and press "Enter":

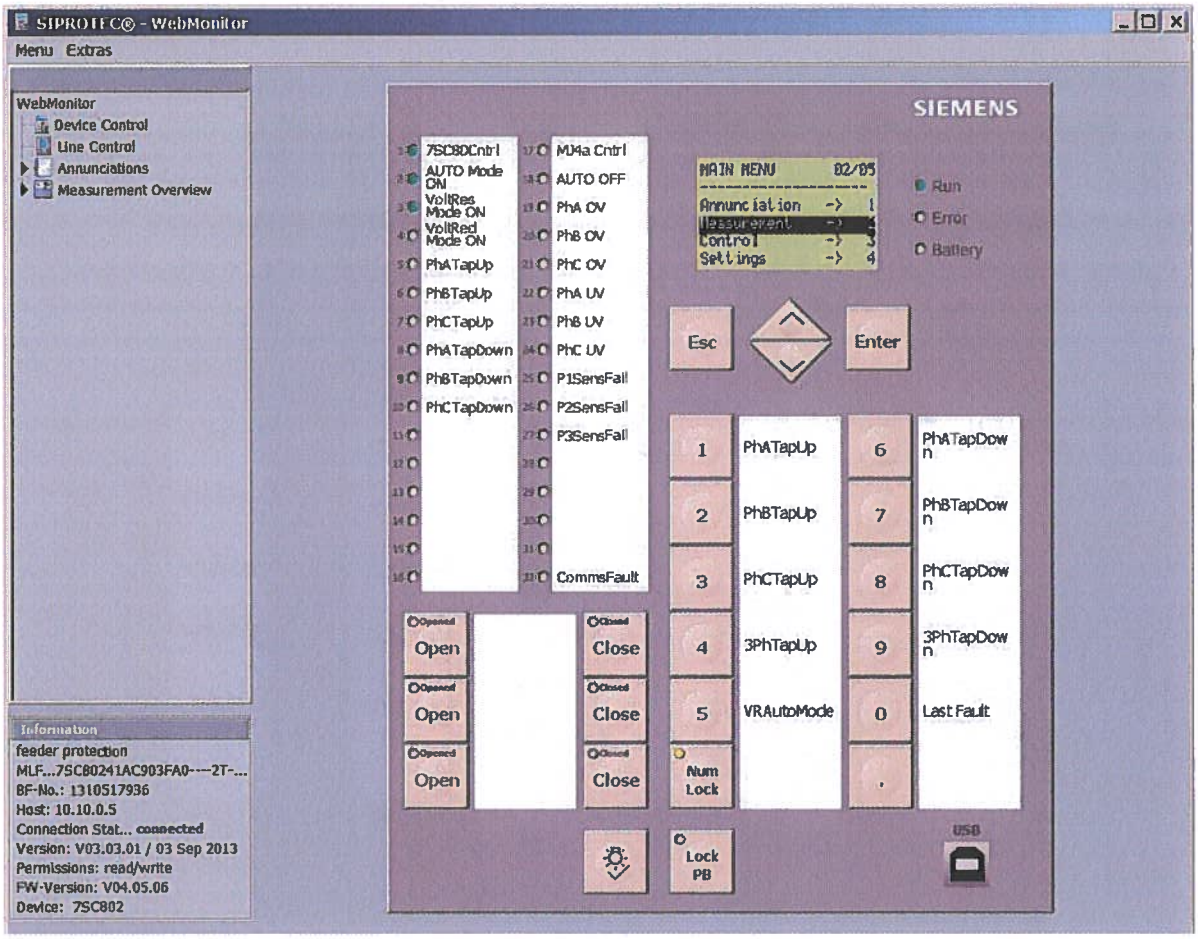


Fig.4

Under the "Measurement" menu, please select "Set Points (MV)":

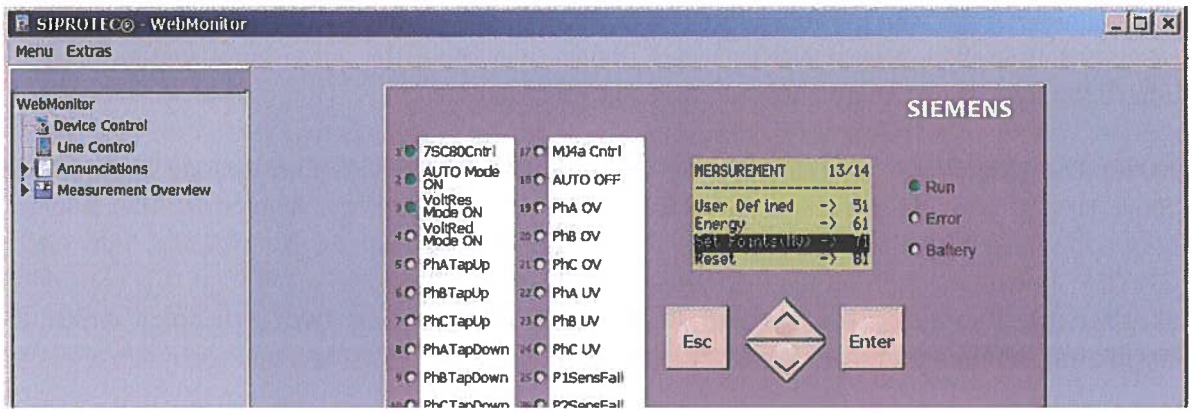


Fig.5

Under the "Set Points (MV)" menu, using "Up" and "Down" arrow buttons, scroll down to the LNEndVolt1 (Line End Voltage 1) and LNEndVolt2 (Line End Voltage 2) thresholds:

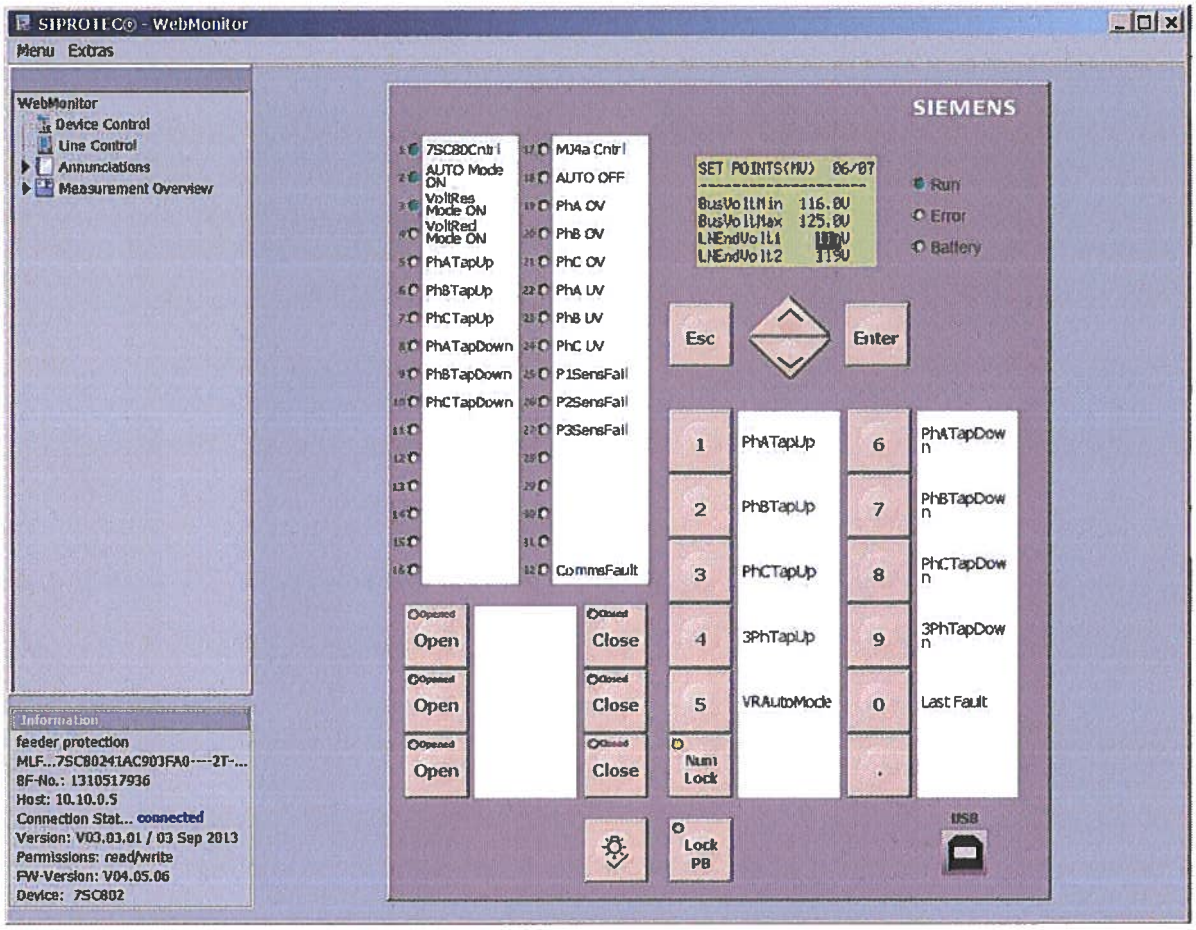


Fig.6

In order to apply the new value, please highlight the old value and press "Enter". Device will ask for the password. Please make sure that "Num Lock" button on the WEB HMI is active (yellow LED is illuminated). The default password is 000000, use numerical buttons to enter it. Once password is applied, please press "Enter", device will show the value input window (Fig. 7), where the new value can be entered using numerical keys.

NOTE: The LNEndVolt1 (Line End Voltage 1) and LNEndVolt2 (Line End Voltage 2) thresholds allow to set two independent regulation levels for this Voltage Regulator. The selection between these two thresholds can be done from SICAM HMI PC by pressing "Alt Setting ON/OFF" button on the Voltage Regulation Detail Screen. The Line End Voltage 2 is considered as alternate threshold. The Voltage Regulator 2 has his own two thresholds which are completely independent from Voltage Regulator 1.

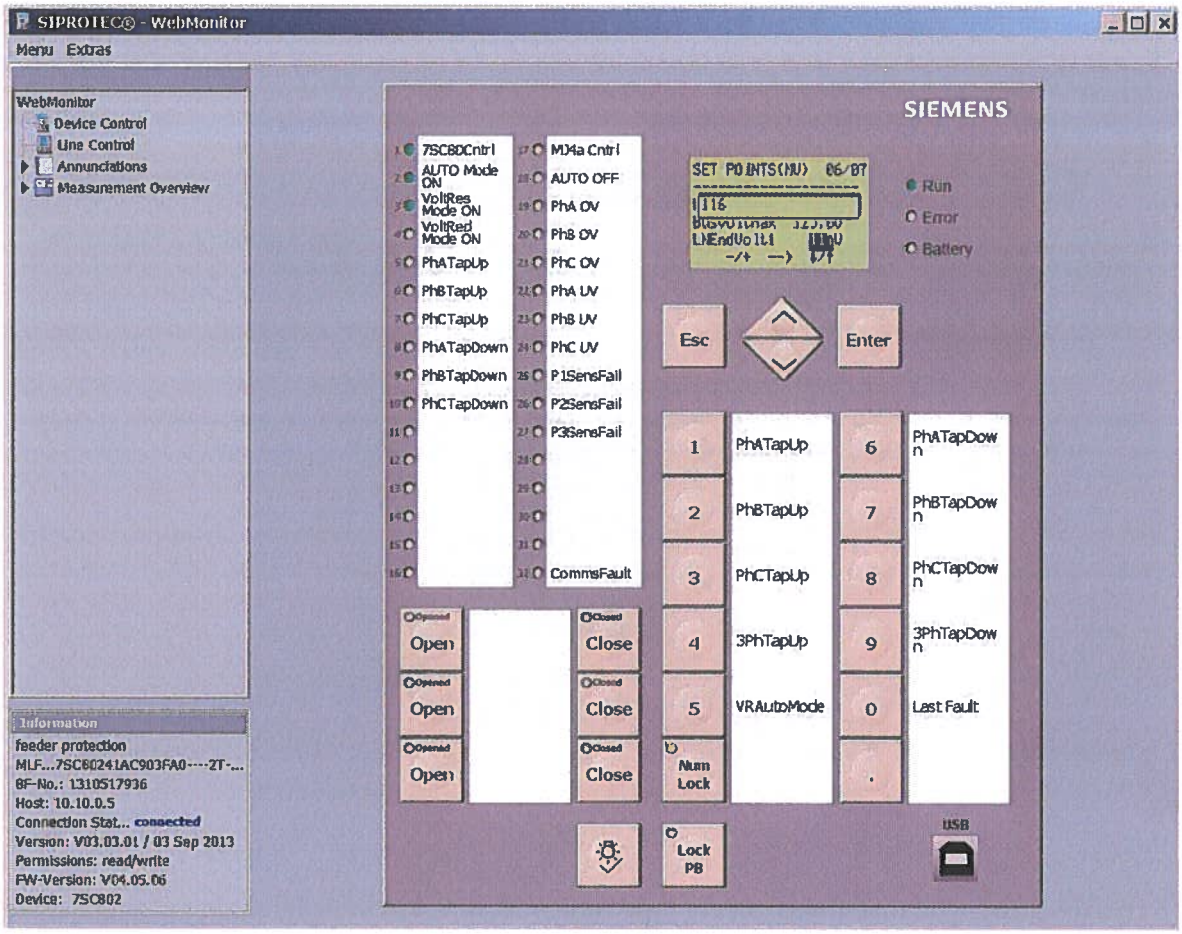


Fig.7

Once the new value applied, please press "Enter". Device will show blinking dot symbol next to "SET POINTS(MV)", this means that new setting require confirmation. Please press "ESC" button, device will ask to confirm the setting selection (fig.8). Select "Yes" and press "Enter".

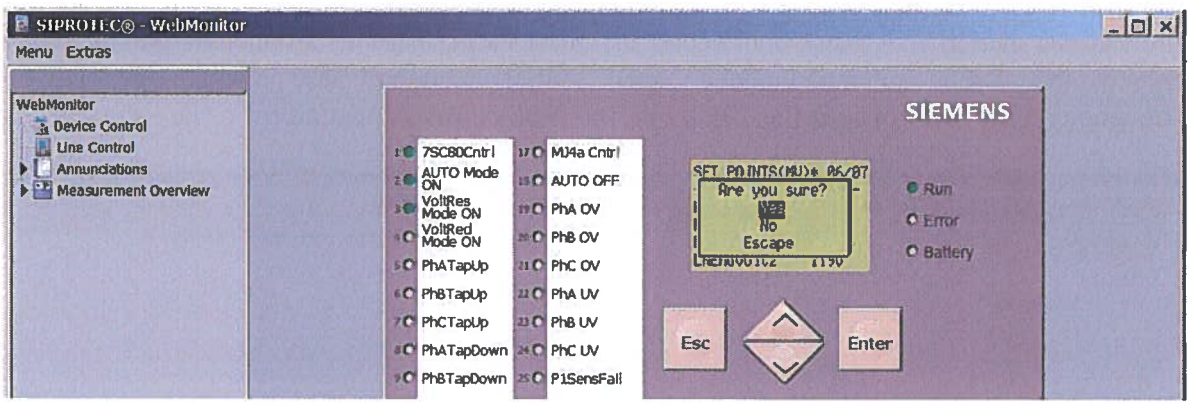


Fig. 8

Once new setting is applied, it can be verified on the Voltage Regulation Detail Screen (fig.9) as a nominal line end voltage Vnom (LNEndVolt2 will be in effect if ALT SETTING ON button is pressed)

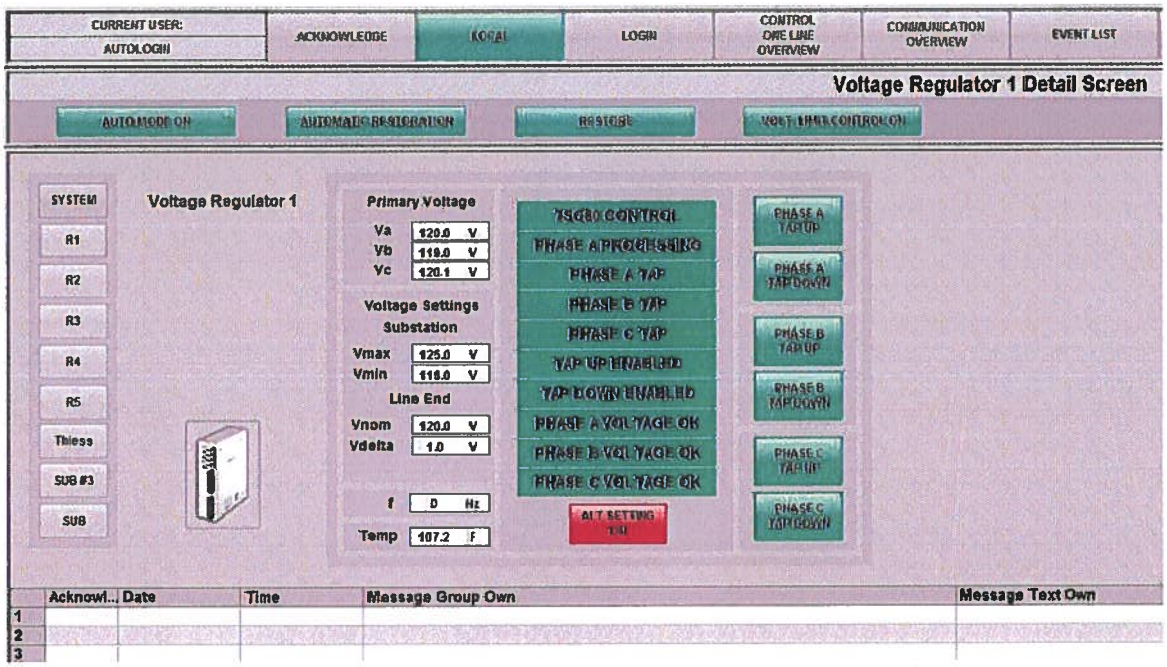


Fig. 9

To change access VR2 thresholds, please type http://10.10.0.4 in the address bar of the Internet Explorer and repeat the steps above.

2.2 Changing the settings on the reclosers

The protection settings can be updated using the DIGSI configuration software installed on the HMI PC. The changes to the settings should be made offline and then can be uploaded to the devices over the network connection. In order to access the device files offline, please launch the DIGSI software. Once open, DIGSI software will display the current "Cuyahoga_Falls_ATS" project (fig.10). If not, the project can be opened from File – Open menu.

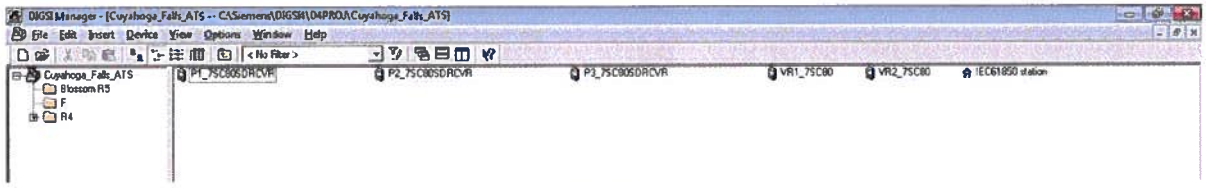


Fig. 10

Click on the "F" folder, the ATS devices will be displayed as shown on the picture above.

Device	Device file
VR1	VR1_7SC80
R1	P1_7SC80SDRCVR
R2	P2_7SC80SDRCVR
R3	P3_7SC80SDRCVR
VR2	VR2_7SC80

Please double click on the P1_7SC80SDRCVR file to access Recloser R1 file. The following window will appear where "Offline" option should be selected.

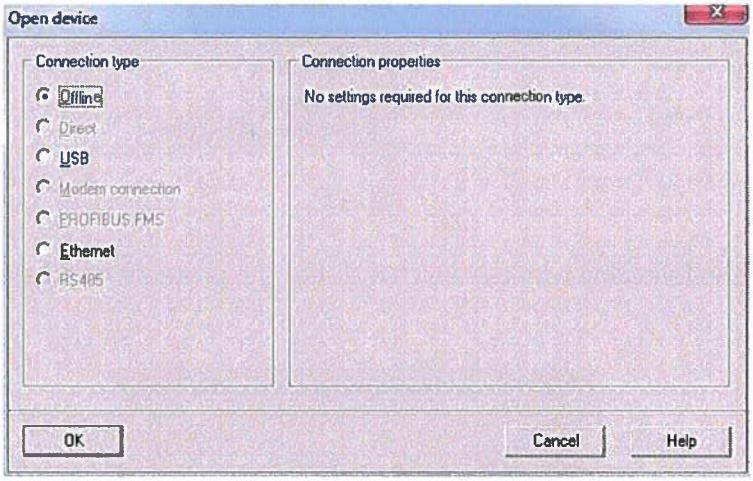


Fig. 11

DIGSI will open the device file in the next window (fig.12). Please double click on "Settings":

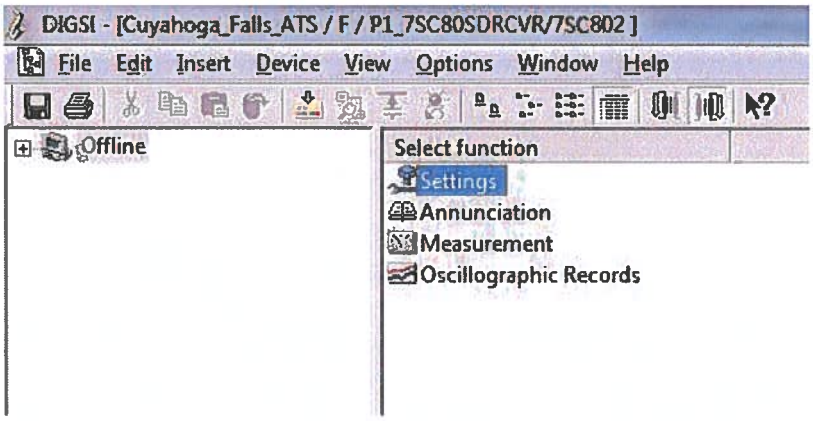


Fig. 12

The "Settings" window will display number of options, where the "Setting Group A" option should be selected (fig.13):

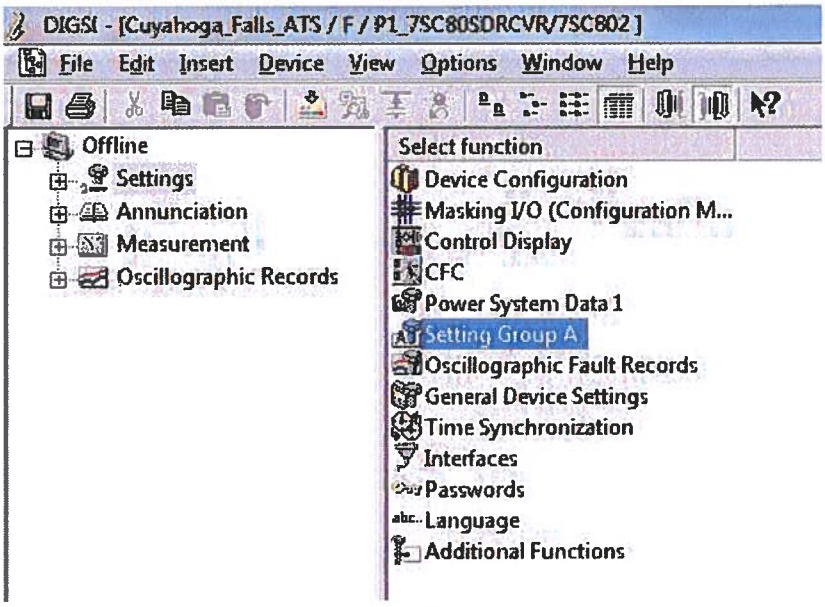


Fig. 13

DIGSI will display the following window which includes the protection and autoreclose functions:

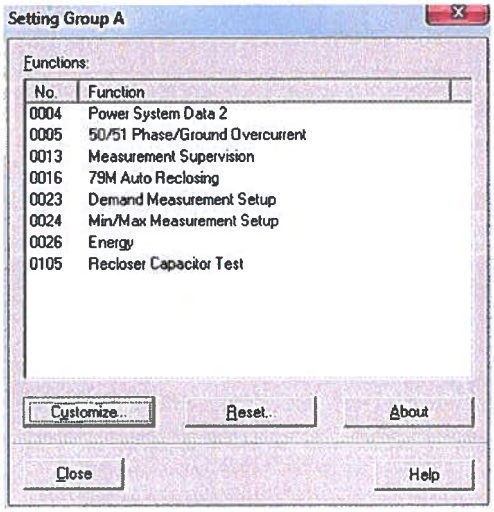


Fig. 14

In order to check or change the overcurrent protection settings, please select 50/51 Phase/Ground Overcurrent from the window displayed on fig. 14.

2.2.1 50 Phase Overcurrent Settings

First tab on the overcurrent setting window includes settings for 50 Element (Definite Time Overcurrent protection). The 7SC80 controller employs 3 stages with independent Pickup and Time Delay values. The overcurrent settings can be viewed either on the primary or secondary values (the example below is showing primary values). To switch between primary and secondary values, please refer to icons on the DIGSI toolbox as highlighted on fig. 16.

NOTE: Please use 800:1 CT ratio is secondary values are selected.

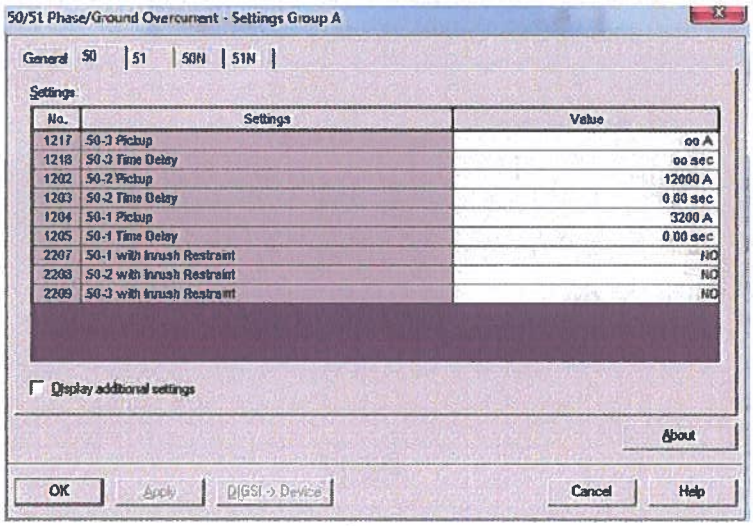


Fig. 15

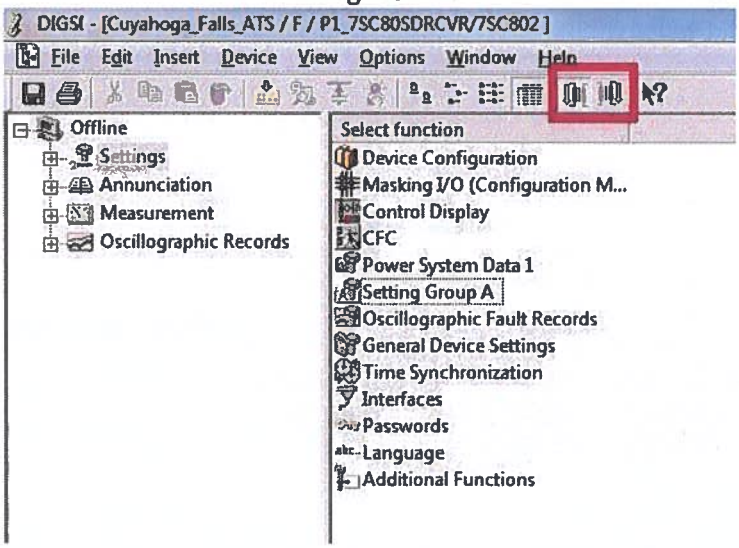


Fig. 16

If any setting should be changed, please apply a new value and click "Apply" button and refer to paragraph 2.2.6 to download changes to the device.

2.2.2 51 Overcurrent settings

The second tab on the setting window includes settings for the 51 TCC Phase Overcurrent Protection element (fig. 17).

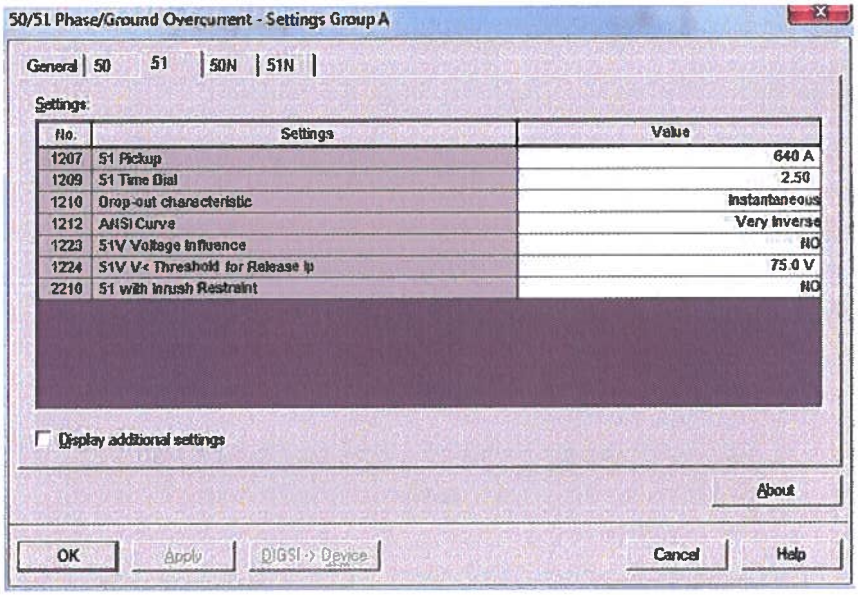


Fig. 17

The 7SC80 controller can accept the 51 pickup setting from 80 to 3200 A. The Time Dial can be set from 0.5 to 15. Device offers the following family of ANSI Curves (fig.18):

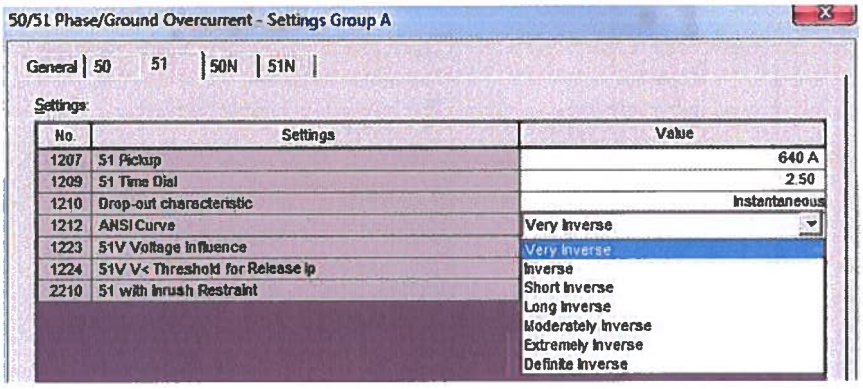


Fig. 18

If any setting should be changed, please apply a new value and click "Apply" button and refer to paragraph 2.2.6 to download changes to the device.

2.2.3 50N Ground Overcurrent Settings

The third tab on the window includes settings for 50N Element (Definite Time Ground Overcurrent protection). The 7SC80 controller employs 3 stages with independent Pickup and Time Delay values.

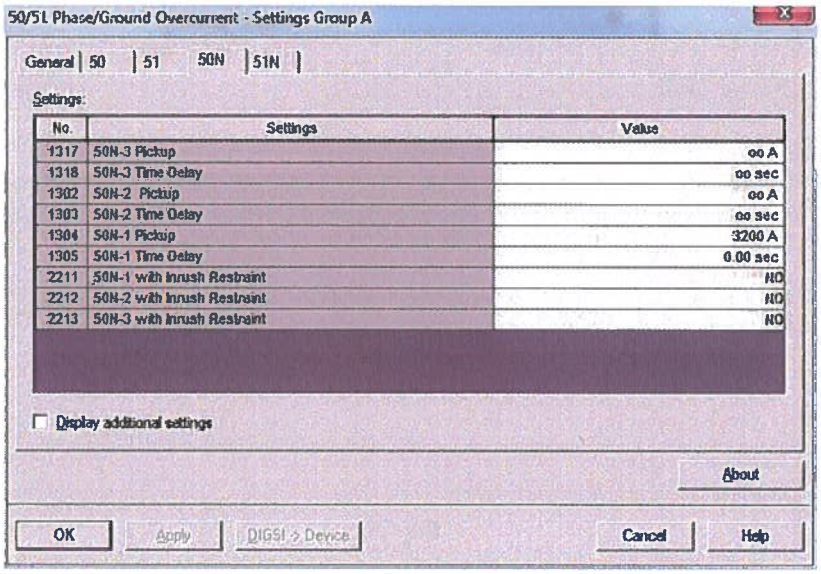


Fig. 19

If any setting should be changed, please apply a new value and click "Apply" button and refer to paragraph 2.2.6 to download changes to the device.

2.2.4 51N Ground Overcurrent settings

The last tab on the window includes settings for the 51N TCC Ground Overcurrent Protection element (fig. 20).

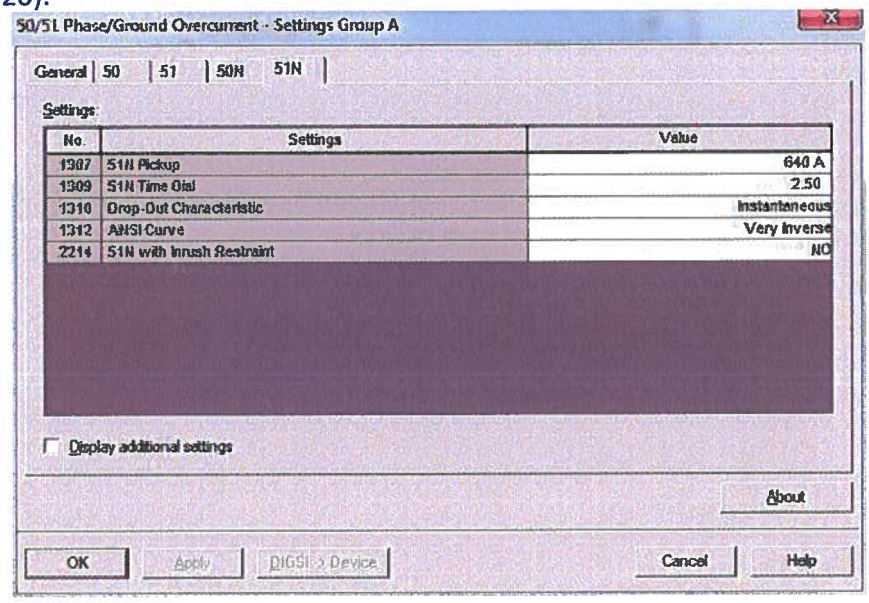


Fig. 20

The 7SC80 controller can accept the 51N pickup setting from 40 to 3200 A. The Time Dial can be set from 0.5 to 15. Device offers the following family of ANSI Curves (fig.21):

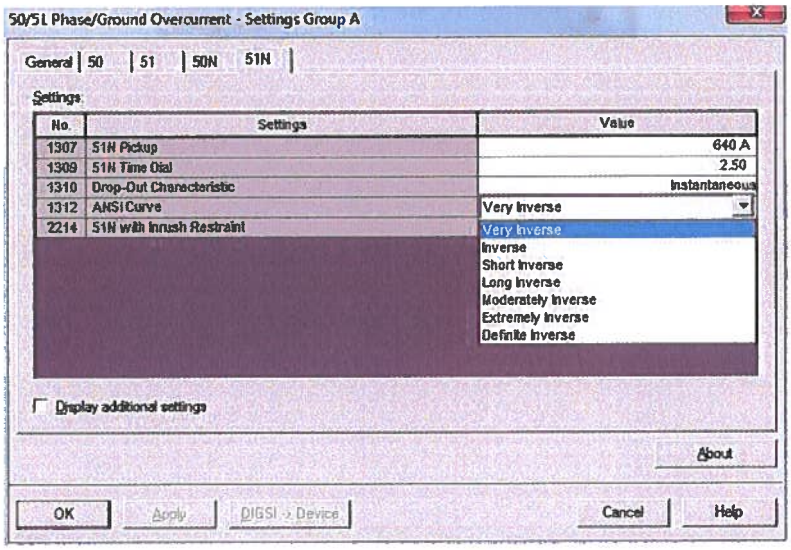


Fig. 21

If any setting should be changed, please apply a new value and click "Apply" button and refer to paragraph 2.2.6 to download changes to the device.

2.2.5 79 Autoreclose settings

The Autoreclose settings window can be accessed through Setting Group A -> 79M Autoreclosing (fig.14). The following window will appear where number of Autoreclose attempts can be configured under settings # 7135 and #7136 independently for phase and ground faults:

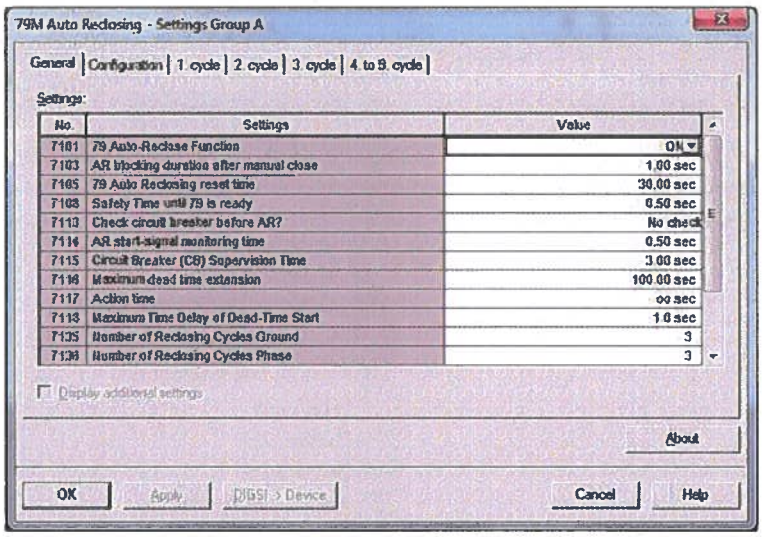


Fig. 22

The dead time for each autoreclose cycle can be configured under tabs "1. cycle", "2. cycle", "3. cycle", "4. to 9. cycle". As an example, fig. 23 shows 0.5 sec dead time for the first autoreclose cycle, followed by the first trip. The 7SC80 device provides the possibility to apply independent dead times for Phase and Ground faults.

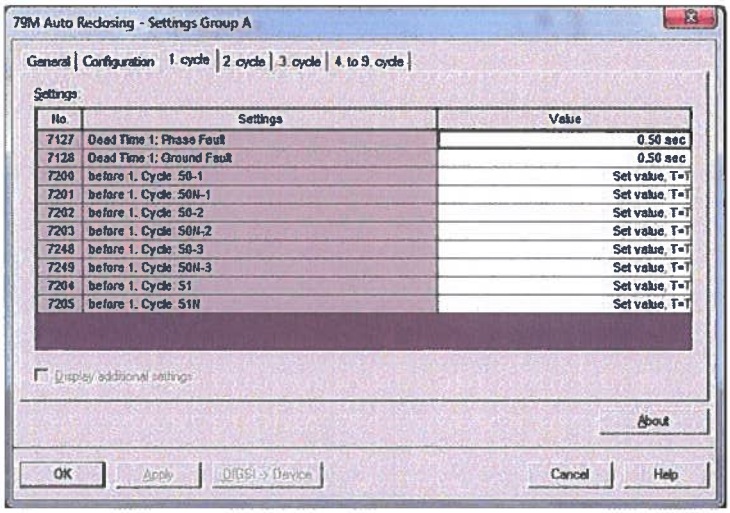


Fig. 23

If any setting should be changed, please apply a new value and click "Apply" button and refer to paragraph 2.2.6 to download changes to the device.

2.2.6 Downloading settings to the 7SC80 controller

After any changes were applied to the device, it should be saved by clicking on the save icon in DIGSI:

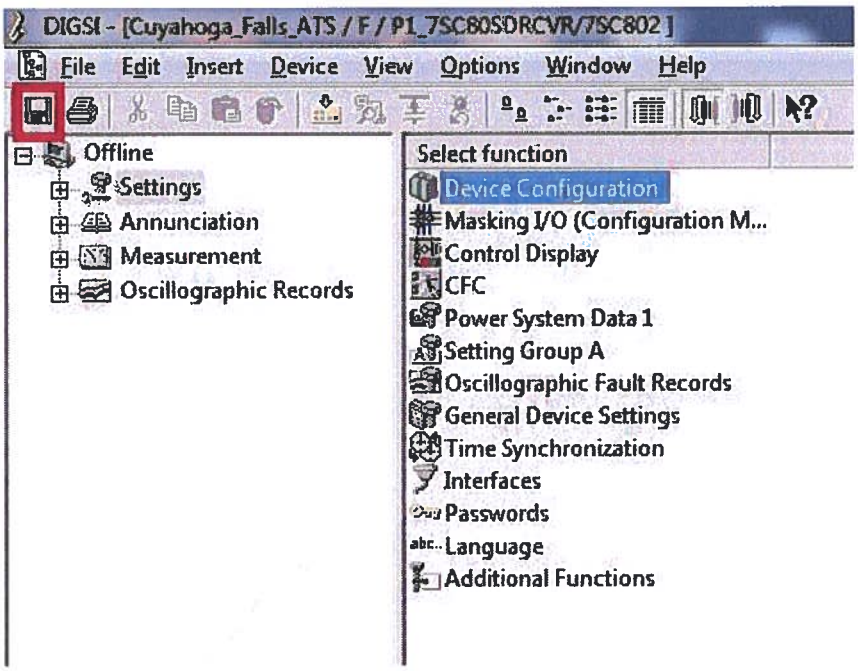


Fig. 24

The device file can be closed. Then in DIGSI manager right click on the device icon and select "DIGSI to device" option. DIGSI will automatically connect to the device and will ask to inter the password (default password is 000000). DIGSI will download the changes over the network and then report successful download.

3. Accessing the Fault Records

Following any system event the 7SC80 recloser controller automatically generate the COMTRADE Fault Records. Devices upload these files to the HMI PC within next two minutes. The records can be accessed if operator clicks on the "FAULT RECORDS" button on the HMI screen. The HMI PC has SIGRA software installed to view and analyze the Fault Records (fig.25). The SIGRA manual and guidance can be found on the HMI PC under Start -> All Programs -> Siemens Energy ->SIGRA. Fault records also can be forwarded to the Siemens Industry for detailed analysis.

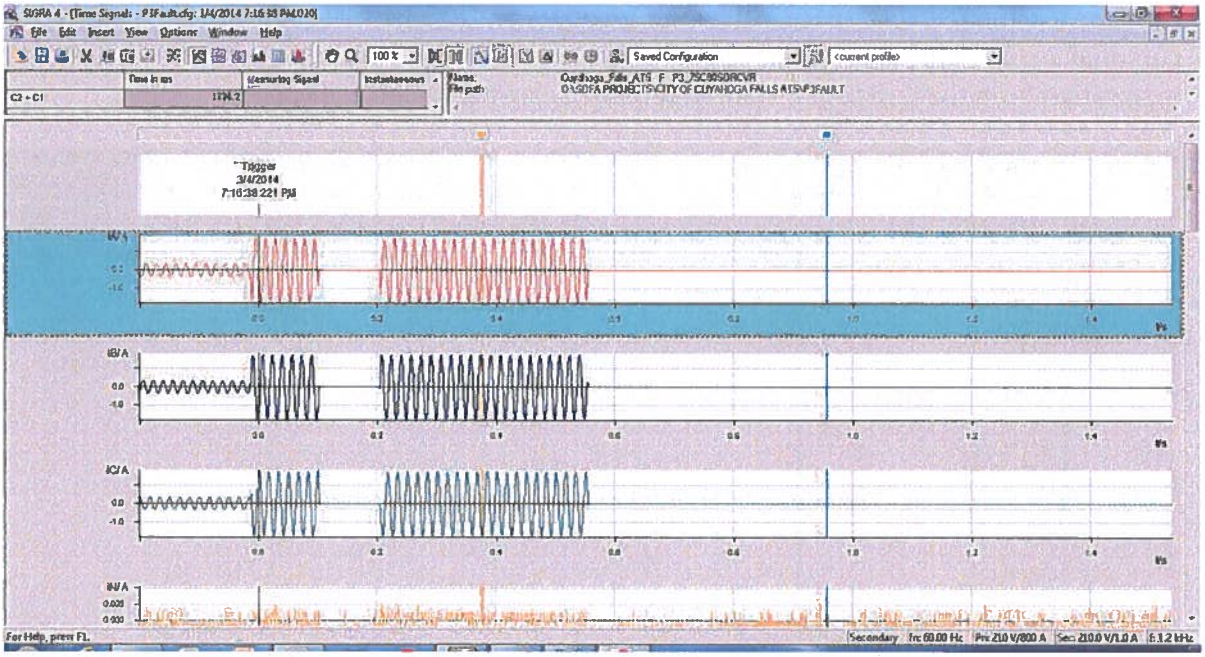


Fig. 25

4. Installing a new DIGSI project

If a new DIGSI project should be installed on the HMI PC, please close DIGSI and delete the old "Cuyahoga_Falls_ATS" folder from C:\Siemens\DIGSI4\D4Proj location on the HMI PC. Then unzip the "Cuyahoga_Falls_ATS" folder from the new project archive to that location. The new project then can be accessed from DIGSI.

5. Refreshing the SICAM PAS Database

If any device in the system is experiencing loss of communication it can be helpful to refresh the project database. This potentially can happen if HMI PC is restarted or communication interruption occurred on the network level. Please launch "SICAM UI Operation" application from the desktop or start menu. The following screen will appear:

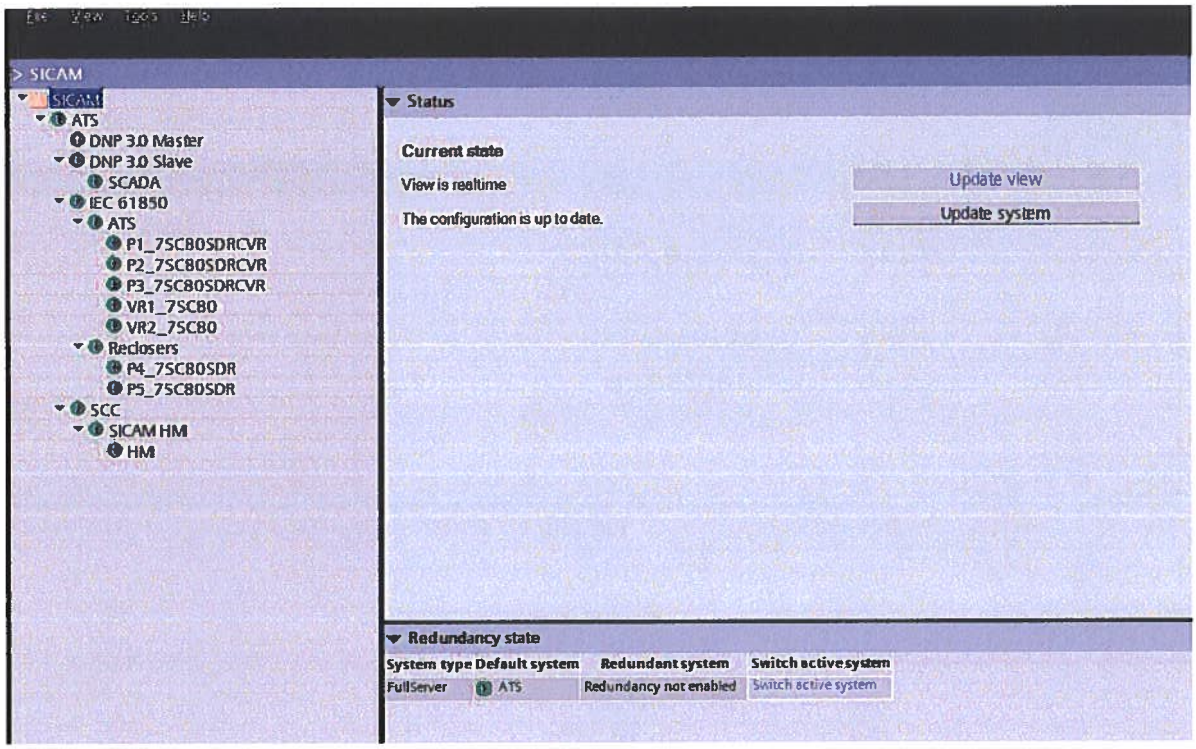


Fig. 26

Any communicating device is displayed with a green circle, not communicating – with a purple circle. To refresh the database please click on the "Update System" button. The application will go through an update and generate report. It might take couple minutes to refresh to complete the update.

Zimbra **doughertymd@cityofcf.com**

RE: How To Manual

From : Alexandr Stinskiy <alexandr.stinskiy@siemens.com>

Thu, Sep 10, 2015 11:29 AM

2 attachments

Subject : RE: How To Manual

To : Michael D. Dougherty <doughertymd@cityofcf.com>

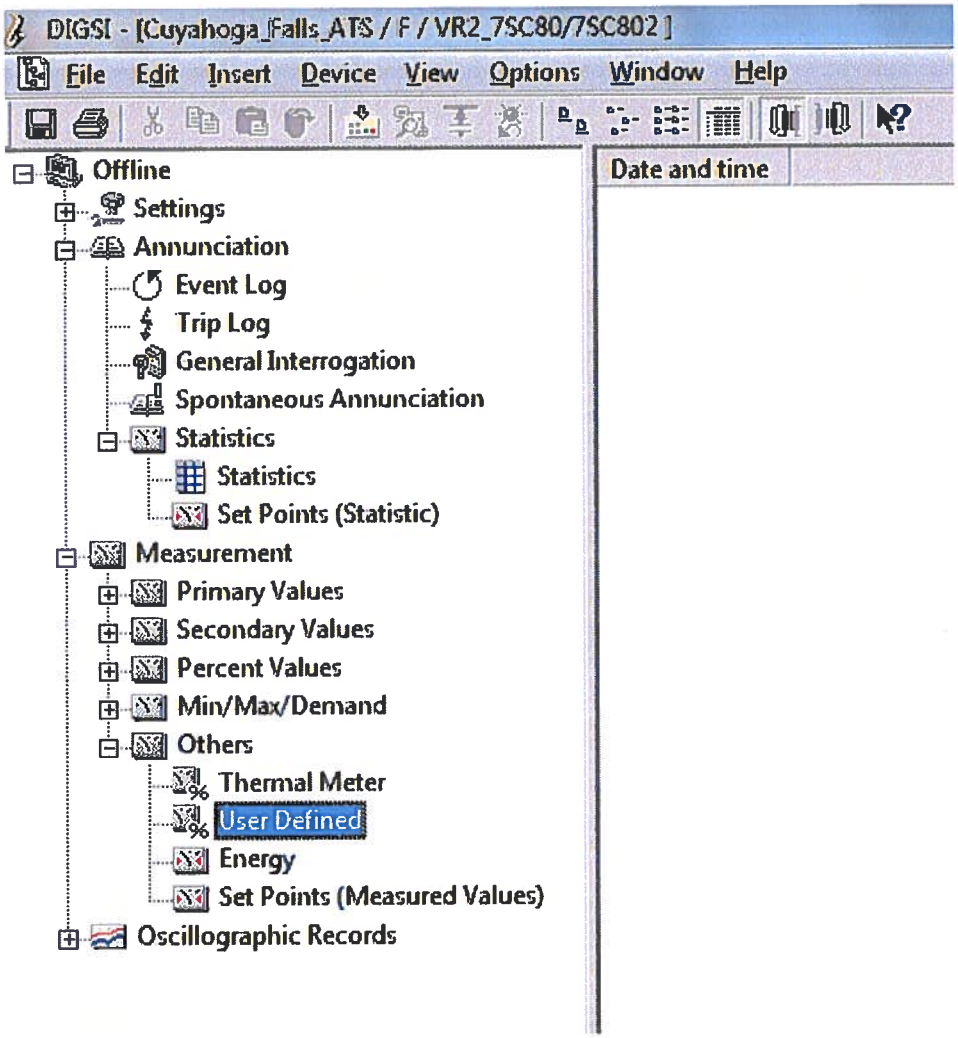
Cc : Vic Oeftering <oeftering@cityofcf.com>, Rodney L. Troxell <troxellrl@cityofcf.com>, Ron Boorman <boormanrj@cityofcf.com>, Andre Smit <andre.smit@siemens.com>

Hi Michael,

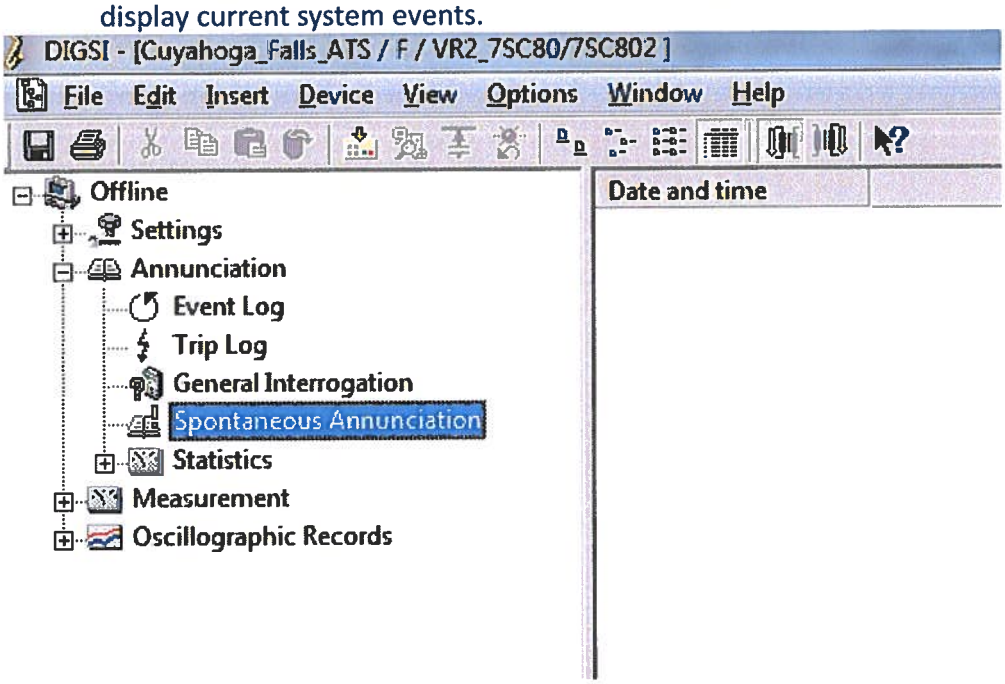
Thanks for your email and feedback. I'm planning to send the Manuals next week, sorry for the delay.

We would like to analyze the system behavior when it stops controlling the voltage in one phase. Could you please help us to get the following information:

1. Please open the VR2_7SC80 online from DIGSI project (double right click on the VR2_7SC80 device in the project and select "Ethernet")
2. Once DIGSI opens device online, please open "User Defined" log under measurements and print it out. Then please print the "Set Points (Measured Values)" log



3. Please open Spontaneous Annunciation log. It should open a new window where DIGSI will display current system events.



4. Switch system from MJ4 to 7SC80 in SICAM and let it run for 7-10 minutes. In DIGSI it should show some events recorded by the voltage regulator
5. After 7-10 minutes please print the Spontaneous Event log and send it to us along with two measurement logs.

6. Close DIGSI, if voltage is beyond the expected window, switch back to MJ4 regulator.

Please let us know if there are any questions regarding this information. Once we will have the event sequence, we will analyze and check the logic.

Once all data is collected, will it be possible to change the threshold back to 116 volts for a few minutes to see if system will perform as expected with the old threshold?

Thank you in advance!

With best regards,
Alex Stinskiy
+1(919)592-31-94

From: Michael D. Dougherty [mailto:doughertymd@cityofcf.com]
Sent: Thursday, September 10, 2015 9:42 AM
To: Stinskiy, Alexandr
Cc: Vic Oeftering; Rodney L. Troxell; Ron Boorman
Subject: How To Manual

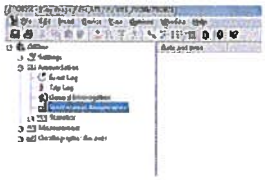
Alex,

Hi! Here is some feedback on the project here. The switching of the automation scheme works great. For the voltage control, I was able to set the voltage at 116 volts and the system was keeping the voltage down there just fine - and no one was complaining of low voltage. However, we did run into a problem with low voltage due to heavy load between the reclosers when the system switched. The feeder getting the load had too low of voltage after the switch, which caused a problem for one of our big customers. So, I set the voltage at 118 volts and so far switching has not been reported as an issue for voltage to the customers. The moral of this story is we can't keep the voltage down as low as possible when we could switch a significant amount of load instantaneously.

That was a lesson learned on how best to use this system. However, after we had the voltage set back at 118 volts, we ran into a problem again with the system not controlling voltage properly on Feeder 323 - this time only on A-phase. So, we had to switch the system to be controlled by the MJ4A controller. We are not sure why it decides to stop working on that feeder at times. We'll have to look at it further.

Speaking of looking at it further. How is it coming along with the How To Manual info you said you were putting together for us? With that info, we can look at the programming and make adjustments as desired. Please let me know. Thank you.

Michael Dougherty, CMRP, MBA
Electric Superintendent
Cuyahoga Falls Electric Department
330-971-8060



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