APP Engineering, Inc.

APP-601 Recorder

Operating Manual

Manual Part Number

APP00161

Edition

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Safety Notices

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to APP Engineering, Inc. for service and repair to ensure that safety features are maintained.

WARNING	**A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like, that if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until you fully understand and are prepared to address the indicated conditions.**
CAUTION	**A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until you fully understand and are prepared to address the indicated conditions.**
WARNING	**(Personnel)** **Only qualified, service-trained personnel who are aware of the hazards involved should install, open any doors, remove any covers, or disconnect the instrument (APP-601 Recorder). Disconnect power before attempting any service or maintenance.**
WARNING	**(Fuse)** **For continued protection against fire, replace the line fuse only with a fuse of the specified type and rating.**
WARNING	**(Live Circuits)** **Replacement of chassis, components, fuses and internal adjustments must be performed by qualified personnel. The system main power must always be disconnected before servicing. If the system utilizes voltage and/or current test switches make sure they are open and understand that the back of these switches are still live! If the system utilizes sliding link terminal blocks for the digital channels and alarm outputs, ensure that the sliding links are open and understand that one side of the sliding link terminal block is still live!**
WARNING	**(Operating Environment)** **This instrument should not be used in an explosive environment. It should not used in the presence of flammable gases or liquids. This instrument should not be used in a damp or wet environment or an environment that is subject to condensation.**
WARNING	**(Grounding)** **All chassis, cabinets, panels, and rack mount equipment must be connected to an electrical earth ground. Grounding must be done to prevent shock hazard to people. Instruments provided with a power terminal block are provided with an appropriate means for connecting an electrical safety earth ground. Only qualified and trained personnel should connect power to this instrument. If the instrument includes a three prong AC power cord, ensure that your power receptacle is properly earth grounded.**

WARNING **(Two Person Rule)**
Do not service or adjust equipment alone. Ensure that another person is present that knows emergency procedures and is capable of giving first aid.

Additional Document Notes

Throughout this manual, the APP-601 Recorder™ may be referred to as the "Recorder" or the APP-601 Multifunction Recorder.

Throughout this manual an event channel or event input may be referred to as a digital channel or digital input.

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1. Introduction

1.1 Overview

The APP-601 multifunction recording instrument was designed to meet the monitoring and reporting needs in the power transmission, power distribution, and power generating areas. The APP-601 lends itself useful to other industrial applications because of its wide voltage input range, current input range, digital input range, GOOSE message, Sampled Values, status output capability and various recording speeds. When coupled with APP ClearView™, a master station software package and COMTRADE viewer, it provides a powerful platform for data acquisition, analysis, and reporting.

1.2 History

The APP-601 recorder is derived from its successor the APP-501 Recorder. The APP-501 Level 1 & Level 2 Data Chassis have been removed from our standard offering but are available if needed. The APP-501 Computer Chassis continues to be manufactured and is offered as a computer control chassis choice for the APP-601 recorder system. The APP-601 recorder can be purchased with either of the following chassis configurations:

APP-601 Computer Chassis and APP-601 Data Chassis, and APP 618 Controller

APP-501 Computer Chassis and APP-601 Data Chassis

1.3 Features

Major features of the APP-601 recorder include the following:

- Windows based software (Linux OS is available as an option)
- Distributed or centralized architecture
- Easy and intuitive setup
- Simultaneous recording functions
- Optional Computer Unit Redundant (CUR)
- DC coupling
- Data alignment within 1msec
- Auto diagnostics
- Remote power toggle
- Independent data acquisition channels
- Analog channels configurable as voltage or current
- IEC-61850 Goose Message Capture
- IEC-61850 Sampled Values
- Multiple triggers per channel
- Automatic creation of COMTRADE files
- Auto calling, polling, emailing
- Network, modem, DNP-3, FTP communications
- Digital channels configurable as DFR, SER, or both
- Integrated monitor and keyboard (APP-501 Computer Chassis)
- Superior analysis software (APP ClearView)
- AC or DC input power

Designed and manufactured by APP Engineering Inc.

1.4 Functions

Major recording functions of the APP-601 recorder include the following:

Transient Oscillography

Extended Oscillography

Extended RMS (Root Mean Square)

Continuous Oscillography

Continuous RMS

Continuous Frequency

Continuous Phasor

Trending RMS & Frequency

Sequence of Events (SOE)

PMU (Phasor Measurement Unit)

Real Time Local Monitoring or remote monitoring via RDP (Remote Desktop Protocol)

2. Specifications

2.1 Analog Inputs

2.1.1 Voltage

Max channels per chassis	30
Max input voltage	440VAC rms
True DC Coupling	Yes
Rin	100kΩ Min, Range Dependent
Burden	0.045VA@67V, 0.144VA@120V
Accuracy (un-calibrated)	Typical 0.15% of Reading, Max 0.5%

2.1.2 Current

Internal shunt	2mΩ
Burden	0.05VA@5A, 0.45VA@15A
Max Continuous current	15A
Max amp-seconds (not to exceed)	140A RMS for 2 seconds, 250A RMS for 0.5 seconds
Max current (not to exceed)	250A
Accuracy (un-calibrated)	Typical 0.61% of Reading, Max 1.0%

2.1.3 General

Ch to Ch phase angle error	≤ 0.004 degrees
Cut-off frequency	(-3db) 10kHz
Common mode rejection	80dB Min
Temperature Error	≤75ppm/ºC
Channel to channel isolation	≥ 3500VDC
Channel to ground isolation	≥ 3500VDC
Channels per card	3
Channel type	Each channel can be setup as voltage or current
Data alignment	With 1PPS rising edge
Data accuracy	1 µsec with unmodulated IRIG-B input
Connector type	#6 screw terminal double barrier
Max wire size	12AWG

2.2 Event Inputs

Max channels per chassis	80
Channels per card	8
Channel type	DFR, SER or Both
Standard input voltage range	45-250VDC
Optional input voltage	24VDC or internally wet
Contact configuration	Programmable normally open/normally closed
Configuration	Isolated or common return
Channel to channel isolation	≥ 3500VDC
Channel to ground isolation	≥ 3500VDC
Connector type	Pluggable, 16 poles
Max wire size	14AWG

2.3 Traveling Wave Inputs

Max channels per chassis	10
Channels per card	1
Channel type	Traveling Wave
Standard input voltage range	30A at CT, 10 VDC at the BNC
Connector type	2 x BNC (TW CT, IRIG-B) 1 Ethernet

2.4 APP-618 Controller

Operating system	Linux Ubuntu
Processor	Atom E3845 Quad Core
RAM	8GB DDR3L-1600
BIOS	American Megatrends Inc. BIOS
Chipset	System-on-Chip integrated, Intel HD Graphics, Shared System memory
Power Input	86-125Vac (50Hz/60Hz) or 86-350Vdc Computer auto power AC/DC power
Power Requirements	25W (using 3 X 2.5" Hard Drives
Internal HDD	3 X 1TB STD Western Digital Red, SSD Optional
RAID	RAID 1 + Hot Spare (2 – 1TB HDDs in RAID 1 configuration with 1TB as hot spare automatic substitute failed HDD
Ports	2x RS232 (Com1 & 2)
	3x Ethernet 10/100/1000 MB
	3x USB2, 1x USB 3
	3x SATA 300
	1 HDMI, 1 VGA
	1x line-out, 1x Mic-in
Temperature	-20°C ~ 70°C (-4°F ~ 158°F)
Relative Humidity	10% ~ 95% relative humidity, non-condensing
LED Indicators	FRONT: 5 LEDs - 12V + 5V Power, Computer + RAID 1 power, RAID Error REAR: 6 LEDs - 1 activity + 1 error indicator for each hard drive

2.5 Power Supply

AC Range	88-264Vac (50/60Hz)
DC Range	86VDC to 373VDC (48VDC Option)
Power draw @ 125VDC	90W, 54 analog channels & 96 event channels
Input to ground isolation	≥ 3500VDC

2.6 Status Relays

Cards per system	1 standard (more optional)
Outputs per card	8
Contact ratings	12A Cont., Break is 0.5A @ 125VDC 12A Cont., Break is 0.35A @ 250VDC
Dielectric coil to contacts	5kVac
Contact Configuration	Board jumper normally open/normally closed
Physical Alarm outputs	8
Alarms, (Mappable to any physical alarm output). An alarm can be assigned to multiple physical outputs. A physical output can have 1 or more alarms assigned to it. It is recommended not to map multiple alarms to Power, Online, Continuous Record, and Cross Trigger.	Power Online Offline Clock sync loss Disk Full Master Communication error Chassis Communication error Transient Record Disturbance Record SOE Record DSP Board Temperature Continuous Record PC Health Analog Channel Fail Cross Trigger TW Fail
Connector type	Pluggable, 16 poles
Max wire size	14AWG

2.7 Time Synchronization

Modulated IRIG-B Input	Yes
Unmodulated IRIB-B Input	Yes
Precision Time Protocol (PTP)	Yes (DSP 6.4 or after)
Selection method	Board jumper & Software
Connector type	BNC, Ethernet
Chassis to chassis signal	1PPS – BNC connector, 100ns chassis to chassis latency if signal is daisy chained. 1PPS signal can be paralleled with a “T” connector.

For more information, see *Time Quality* on page 10-2.

2.8 Communications

Recorder to master station	Ethernet 10/100Mbit, TCP/IP (Fiber optional) Modem 56K
Chassis to chassis	Ethernet 100Mbit, UDP (Fiber optional)
DNP-3	Ethernet 10/100Mbit, TCP/IP (Fiber optional) RS232 (9-Pin Connector)
PMU	Ethernet 10/100Mbit, UDP or RS232 (9-Pin Conn)

2.9 System Computer

2.9.1 Choice #1 APP-601 Computer Chassis

Operating system	Windows 10, Linux Ubuntu
Processor	Atom E3845 Quad Core
RAM	8GB DDR3L-1600
BIOS	American Megatrends Inc. BIOS
Chipset	System-on-Chip integrated, Intel HD Graphics, Shared System memory
Power Input	86-125Vac (50Hz/60Hz) or 86-350Vdc Computer auto power AC/DC power
Power Requirements	25W (using 3 X 2.5” Hard Drives
Internal HDD	3 X 1TB STD Western Digital Red, SSD Optional
RAID	RAID 1 + Hot Spare (2 – 1TB HDDs in RAID 1 configuration with 1TB as hot spare automatic substitute failed HDD
External HDD, CDRW, DVDRW	Option
Ports	2x RS232 (Com1 & 2)
	3x Ethernet 10/100/1000 MB
	3x USB2, 1x USB 3
	3x SATA 300
	1 HDMI, 1 VGA
	1x line-out, 1x Mic-in
Display	Option, APP-904 Mon./Keyboard Chassis
Keyboard	Option, APP-904 Mon./Keyboard Chassis
Touchpad	Option, APP-904 Mon./Keyboard Chassis
Temperature	-20°C ~ 70°C (-4°F ~ 158°F)
Relative Humidity	10% ~ 95% relative humidity, non-condensing

LED Indicators	FRONT: 5 LEDs - 12V + 5V Power, Computer + RAID 1 power, RAID Error REAR: 6 LEDs - 1 activity + 1 error indicator for each hard drive

2.9.2 Choice #2 APP-501 Computer Chassis

Operating system	Windows 10, Linux Ubuntu
Processor	Intel Duo Core Minimum
RAM	4GB DDR Minimum
Internal HDD	500GB IDE Min.
External HDD (option)	250GB IDE Minimum
Ports	1-RS232
	1-Ethernet (1 for DSP)
	1-External Ethernet to USB for LAN
	4-USB
Display	Integrated Flip Up
Keyboard	Integrated
Touchpad	Integrated
Temperature	5 to 55° C
Modem	Yes, External 56K
Solid State Drive	Optional (SLC Recommended)

2.10 Ethernet Switch

Data rate	10Base-T/100Base-TX
Ports	5 (8, 16, 24 port optional, fiber optional)
Power	10-36Vdc or 8-24Vac
Input frequency	47-63 Hz
Port connectors	RJ-45
LED indicators	Activity, Link, Data Rate, Power

2.11 Enclosures

APP-601 Computer Chassis	19” W x 5.25” H x 9.8” D (Rack Mount)
APP-501 Computer Chassis	19” W x 5.25” H x 16” D (Rack Mount)
APP-601 Data Chassis	19” W x 5.25” H x 9.8” D (Rack Mount)
APP-618 Controller	19” W x 5.25” H x 9.8” D (Rack Mount)
Ethernet Switch	1” W x 4.75” H x 3” D (Din Rail Mount)

2.12 Environment

Operating temperature	5 to 55º C Standard -25 to 70° with 601 Computer Chassis and Extended Range HDD or SSD
Storage temperature	-40 to 70º C
Operating relative humidity	0 to 95% non-condensing
Storage relative humidity	0 to 95% non-condensing
Operating altitude	10,000 ft maximum

2.13 Approvals

Standard	ANSI/IEEE C37.90.1-2002
Standard	ANSI/IEEE C37.90.2-2004
Standard	ANSI/IEEE C37.90.3-2001 (Electrostatic Disch)
Standard	IEC 60255-22-1:2005 Cat III (Osc)
Standard	IEC 60255-22-2 Electrostatic Discharge Contact & air 6KV (APP 601 Data Chassis)
Standard	IEC 60255-22-3 Radiated Electromagnetic Field Disturbance (APP 601 Data Chassis)
Standard	IEC 60255-22-4 cat IV (EFT)
Standard	IEC 60255-22-5 :2000 Cat IV (Isolation)
Standard	IEC 60255-22-6 Surge Immunity
Option w/Extended Range HDD	IEC 60068-2-1 (Cold)
Option w/Extended Range HDD	IEC 60068-2-2 (Hot)
Option w/Extended Range HDD	IEC 60068-2-30 (Damp Heat)
Standard	IEC 61000-4-2;2008 (Electrostatic Disch, Class A)
Standard	IEC 61000-4-3;2006 (Immunity Radiated RF)
Standard	IEC 61000-4-6;2008 (Immunity Conducted RF)
Standard	ANSI/IEEE C37.111 (COMTRADE)
Standard	ANSI/IEEE C37.232-2007 (Com Names)
Standard	ANSI/IEEE 1613-2009 (100mm Free Fall) (APP 601 Computer Chassis)
Standard	IEC 60255-21-1:1988 (Vibration)
Standard	IEC 60255-21-2:1988 (Shock Response & Withstand) (APP 601 Data Chassis)
Standard	IEC 60255-21-3:1993 (Earthquake Test) (APP 601 Data Chassis)
Special Manufacturer Defined	Overload Test on Power Supply, Current Channels, and Voltage Channels

Kepco	Overload Test on Power Supply, Current Channels, and Voltage Channels
Standard	IEC 60255-26-2013 Voltage Dips, Interruptions, and variations Test
Standard	IEC 61000-4-5-2005 Surge Test
Standard	IEC 61000-4-5-2009 Power Frequency Magnetic Field Immunity Test
Standard	IEC 61000-4-10-2016 Damped Oscillatory Magnetic Field Immunity Test
Standard	IEC 61000-4-17-1999/2001/2008 Ripple on DC Input Power Port Test

3. Installation Overview

3.1 Installation Types

Three types of installations are possible:

Centralized

Distributed

Turn-key

Centralized Installation

A centralized installation is used when the recorder chassis are installed in the same panel/cabinet or near each other. Proximity would be within 40’ (even longer with special discussions with the factory). A centralized installation will generally consist of a computer control chassis and one or more data chassis. In this type of installation, there is typically only one satellite clock IRIG-B input. 1PPS signals are daisy chained from chassis to chassis.

Distributed Installation

A distributed installation is used when the recorder chassis are installed in panels/cabinets that are greater than 40’ apart or even in separate buildings. A distributed installation will generally consist of a computer control chassis and several data chassis. All chassis must connect back to the system Ethernet switch. The chassis should not be greater than 100 meters from the Ethernet switch if straight Ethernet is used. Longer distance can be achieved with Ethernet boosters or by using fiber optic interfaces or using the company network. One or more IRIG-B or PTP signals can be used.

Turn-Key Installation

The most common installation type is a turn-key installation. APP Engineering, Inc. mounts and wires the chassis, and other associated components, in a customer specified panel/cabinet. All work is completed at the APP factory and a complete turn-key cabinet is delivered to the customer.

WARNING

Only qualified, service-trained personnel who are aware of the hazards involved should install, open any doors, remove any covers, or disconnect the instrument (APP-601 Recorder). Disconnect power before attempting any installation, service or maintenance.

See *Safety Notices* on page v for more very important, must read, safety information.

Please call APP Engineering, Inc. at 317-536-5300 with any installation or service questions. Installation service is available by APP Engineering, Inc. Please call the number above for additional information.

3.2 Completing a Centralized Installation

When a chassis only (loose gear) system is purchased, the minimum number of chassis in the system will be two (Computer Control Chassis & Data Chassis). Chassis front views are provided for reference.

Figure 1: APP-601 Computer Control Chassis Front View (Fanless)

Figure 2: APP-501 Computer Control Chassis Front View

Figure 3: APP-601 Data Chassis Front View

Figure 4 APP-618 Controller Front View

Chassis can be located in the same panel or distributed in 2 or more panels. The installation steps discussed below do not include software setup steps. Most of the time, the factory will have obtained a point assignment list, satellite clock information, event input information, and other information that allowed them to configure the software and set up the hardware jumpers. Software settings and windows are discussed in later sections of this manual.

➢ To Complete a Centralized Installation

1. Inspect the shipping cartons to see if any obvious shipping damage has occurred. If the items have been damaged, contact the carrier immediately and file a damage claim. Take pictures of the damaged cartons.

2. Unpack the instruments and keep the cartons. If you filed a claim with the freight company, their inspector may want to see the boxes. Inspect the instruments and associated peripherals. If damaged, take pictures and file a claim with the freight company if you feel they are at fault. Contact APP Engineering, Inc. if any kind of damage has occurred.

3. Carefully review the print set that was provided with the recorder.

4. Remove any power from the panels that you will be installing equipment into or working in.

5. Install the rack mount Computer Control chassis and Data chassis into your desired panel. Each chassis should be installed with (4) fasteners. Since panels utilize various size screws for rack mount instruments, fasteners have not been provided (unless special arrangements have been made).

6. Install the din rail mount Ethernet switch. It is preferred that the Ethernet switch be mounted in the same panel as the Computer Control chassis and Data chassis. A small piece of din rail has been provided. At the request of the customer, APP Engineering can mount the Ethernet switch to the back of a 3U rack mount panel.

7. In a centralized installation, data chassis are usually installed in the same panel as the computer chassis. However, some data chassis can be mounted in other panels. A shielded straight Ethernet cable and 1PPS co-axial cable will need to be pulled from the Ethernet switch and last data chassis in the centralized panel, respectively, to the data chassis.

8. If you are using an APP-618 Controller for Sampled Values, connect the DSP Port to the DSP LAN switch. Connect the ENET LAN port of the APP-618 to the process bus network. If the APP-601 Data Chassis is using an IRIG-B clock, the 618 will need to get PTP clock source from the process bus.

9. Ensure that all circuit board cards are seated properly, and the holding screws are tight. Open the front panel doors on each chassis and ensure that internal power supplies, connectors, and computer are in proper position and secured in place. Ensure that no foreign objects are lying in the chassis.

10. Ground all chassis to your panel grounding bars. The distance from any chassis to a panel grounding bar(s) should not exceed 16 ft. Grounding braid has been provided. Ensure that your panel ground bars are properly earth grounded.

WARNING **Proper grounding procedures must be followed to prevent serious injury or death to people who may come in contact with this recording equipment.**

11. Review the Point Assignment Record that your company provided to APP Engineering, Inc. APP strives to get these records prior to shipment so the instrument internal settings are complete. Prior to connecting signals to the analog channels, the user must know if a particular channel has been designated as a voltage channel or current channel. Each analog channel has **two jumpers** that configure it for a voltage or current input. If the Point Assignment Record was received prior to shipment, the factory has already made the correct jumper settings.

12. Wire the recorder analog channels. The analog channels will accept a maximum wire size of 12AWG. The terminal block screws are #6. The maximum input to a voltage channel is 440VAC. The maximum continuous current thru a current channel is 15Amps.

13. Wire the recorder event (digital) channels. The event channels utilize a pluggable 16 position connector. The maximum wire size for this connector is 14AWG. The standard input voltage range is 45-250Vdc. Event Boards setup for 24Vdc are available as an option. Reference the print set for any notes designating event channels that require 24Vdc or event boards that are **Internally Wetted** as opposed to our typical board that needs external wetting. If the events have a common return and the customer provided that information to the factory, they will have jumpers between the (-) event terminals.

CAUTION **APP Engineering manufactures an event circuit board that is internally wetted and is setup for dry contact connection only. Do not connect an external voltage to this internally wetted event circuit board!**

The board will have labeling indicating that it is for Dry Input. Again, reference the print set for electrical drawings and important notes.

14. Wire the recorder alarm outputs. The alarm outputs utilize a pluggable 16 position connector. The maximum wire size for this connector is 14AWG. The alarm output contact is dry. The contacts can break 0.5Amps @ 125VDC or 0.35A @ 250VDC.

15. Connect your IRIG-B signal to the back of the DSP/IRIG circuit board. The IRIG-B connector is labeled and is a standard BNC type connector. This board can accept a modulated or un-modulated IRIG-B signal. However, a board jumper must be set to reflect the input type and software setting in the Point Assignment Record must be made. Unless a satellite controlled clock was purchased with the system, an IRIG-B coax cable is not provided.

16. Connect the 1PPS signal from chassis to chassis. Connect the 1PPS out signal from the 1st Data chassis to the 1PPS input of the 2nd Data chassis. Keep daisy chaining until the remaining data chassis are connected. The 1PPS connector is a standard BNC connector. 1PPS interconnecting cables have been provided with the system. The 1PPS signal can also be paralleled by using a BNC "T" to reduce 1PPS latency.

17. Ethernet cables have been provided with the system. Each chassis has one Ethernet RJ45 connector. On the Data chassis this connector is located on the DSP/IRIG circuit board. On the Computer Control chassis it is simply located on the back panel and labeled DSP Enet. A cable should be connected to each chassis and routed back to the system Ethernet switch. If a system only consists of a Computer Control chassis and a single Data chassis, a switch is not required and may not have been provided. Simply make a peer-to-peer connection between the two chassis.

18. Connect power cables to the Ethernet switch. A power cable has been provided. It should be connected from the Data Chassis power supply circuit board (terminals 3&4) to the input terminal block of the Ethernet switch. The voltage is 12Vdc.

CAUTION **It is possible that a specially requested Ethernet switch was used and it may connect directly to 125VDC.**

Reference the print set for electrical drawings and important notes.

19. Main input power to the system connects to the 1st Data chassis. Input voltage can be 88-264Vac or 86-373 Vdc or 125Vdc. Other voltage input options are available. All chassis have power connected to terminals 1 & 2 of the power circuit board. It is likely that wires have been provided for paralleling power from Data chassis to Main Data Chassis (usually the 1st Data Chassis). Power to the Computer Control chassis should come from the Data chassis. Terminals 5 & 6 on the Data chassis power supply circuit board should be used to power the Computer Control chassis. It is likely wires have been provided for connecting output power from the Main Data chassis to the power input of the Computer Control chassis.

WARNING **All #6 ring terminals connecting to the power circuit board should be <u>insulated</u> ring terminals.**

20. Ensure that all chassis power switches are in the OFF position.

WARNING **Ensure that your power source wires are not live (turned off or disconnected). Follow OSHA power safety lock out procedures. Ensure that your source can provide sufficient current to the recording system. Ensure that your power source is fused and properly earth grounded.**

21. Connect power from your source to the main or 1st Data chassis power supply board (terminals 1&2). **Use insulated #6 ring terminals.**

WARNING **Reference the drawings provided with the system.**

22. If using an APP-501 Computer Control chassis, open the hinged front door, pull out the computer, and flip up the monitor. If you purchased the optional APP-904 Monitor and Keyboard chassis (for the APP-601 Computer Control Chassis), open the hinged front panel door and pull out the monitor and keyboard.
23. Carefully and with great prior inspection and thought, turn on your power source.
24. Carefully turn on the power switches located at the rear of the Data chassis.
25. If a proper turn on occurs, you should see the following:
    - Computer startup
    - APP Recorder program begins
    - All Data chassis front panel POWER LED illuminate green, the ONLINE LED illuminate green, the 1PPS LED illuminate green, and only if the continuous recording is enabled the CONT RECORD LED illuminate amber (yellow).
26. If the system has not powered up correctly, please recheck your wiring and review the wiring prints that shipped with the recorder.
27. Please call the factory for any required assistance (317) 536-5300.

3.3 Completing a Distributed Installation

➢ **To Complete a Distributed Installation Steps**

1. Inspect the cartons to see if any obvious shipping damage has occurred. If the items have been damaged, contact the carrier immediately and file a damage claim. Take pictures of the damaged cartons.

2. Unpack the instruments and keep the cartons. If you filed a claim with the freight company, their inspector may want to see the boxes. Inspect the instruments and associated peripherals. If damaged, take pictures and file a claim with the freight company if you feel they are at fault. Contact APP Engineering, Inc. if any kind of damage has occurred.

3. Carefully review the print set that was provided with the recorder.

4. Remove any power from the panels that you will be installing equipment into or working in.

5. Install the rack mount Computer Control chassis and Data chassis into your desired panels. Each chassis should be installed with (4) fasteners. Since panels utilize various size screws for rack mount instruments, fasteners have not been provided (unless special arrangements have been made).

6. Install the din rail mount Ethernet switch. It is preferred that the switch be mounted in the same panel as the Computer Control chassis. A small piece of din rail has been provided. At the request of the customer, APP Engineering can mount the Ethernet switch to the back of a 3U rack mount panel.

   Note: Unless fiber optic converters or Ethernet extenders were purchased with the instruments, all Data chassis should be installed within 100 meters (328 feet) of the Ethernet switch.

7. Ensure that all circuit board cards are seated properly, and the holding screws are tight. Open the front panel doors on each chassis and ensure that internal power supplies, connectors, and computer are in proper position and secured in place. Ensure that no foreign objects are lying in the chassis.

8. Ground all chassis to your panel grounding bars. The distance from any chassis to a panel grounding bar(s) should not exceed 16”. Grounding braid has been provided. Ensure that your panel ground bars are properly earth grounded.

WARNING **Proper grounding procedures must be followed to prevent serious injury or death to people who may come in contact with this recording equipment.**

9. If you are using an APP-618 Controller for Sampled Values, connect the DSP Port to the DSP LAN switch. Connect the ENET LAN port of the APP-618 to the process bus network. If the APP-601 Data Chassis is using an IRIG-B clock, the 618 will need to get PTP clock source from the process bus.

10. Review the Point Assignment Record that your company provided to APP Engineering, Inc. APP strives to get these records prior to shipment so the instrument internal settings are complete. Prior to connecting signals to the analog channels, the user must know if a particular channel has been designated as a voltage channel or current channel. Each analog channel has two jumpers that configure it for a voltage or current input. If the Point Assignment Record was received prior to shipment, the factory has already made the correct jumper settings.

11. Wire the recorder analog channels. The analog channels will accept a maximum wire size of 12AWG. The terminal block screws are #6. The maximum input to a voltage channel is 440VAC. The maximum continuous current thru a current channel is 15Amps.

12. Wire the recorder event (digital) channels. The event channels utilize a pluggable 16 position connector. The maximum wire size for this connector is 14AWG. The standard input voltage range is 45-250Vdc. Event Boards setup for 24Vdc are available as an option. Reference the print set for any notes designating event channels that require 24Vdc or event boards that are **Internally Wetted** as opposed to our typical board that needs external wetting. If the events have a common return and the customer provided that information to the factory, they will have jumpers between the (-) event terminals.

CAUTION **APP Engineering manufactures an event circuit board that is internally wetted and is setup for dry contact connection only. Do not connect an external voltage to this internally wetted event circuit board!**

The board will have labeling indicating that it is for dry input. Again, reference the print set for electrical drawings and important notes.

13. Wire the recorder alarm outputs. The alarm outputs utilize a pluggable 16 position connector. The maximum wire size for this connector is 14AWG. The alarm output contact is dry. The contacts can break 0.5Amps @ 125VDC or 0.35A @ 250VDC.

14. Connect IRIG-B or 1PPS signal to the back of each DSP/IRIG circuit board (one board per chassis) according to Point Assignment Record. The IRIG-B or 1PPS-IN/OUT connectors are labeled and are standard BNC type connectors. This board can accept a modulated or un-modulated IRIG-B signal, or 1PPS-IN signal. It also can output 1PPS signal. However, a board jumper and software setting in the Point Assignment Record must be set to reflect the input type. Unless a satellite-controlled clock is purchased with the system, an IRIG-B coax cable is not provided.

    The Chassis to chassis 1PPS signal can also be paralleled by using a BNC “T” to reduce latency.

    SNTP can be used for the clock input via LAN Enet port to an internet SNTP clock source or through an external SNTP clock.

15. Each chassis has one Ethernet RJ45 connector. On the Data Chassis, this connector is located on the DSP/IRIG circuit boards. On the Computer Control chassis, it is simply located on the back panel and labeled DSP Enet. A shielded straight cable should be connected to each chassis and routed back to the system Ethernet switch. If a system only consists of a Computer Control chassis and a single Data chassis, an Ethernet switch may not have been provided. Simply make a peer-to-peer connection between the two chassis. Typically, Ethernet cables are not provided with distributed system.

16. Connect power cables to the Ethernet switch. A power cable has been provided. It should be connected from Data chassis power supply circuit board (terminals 3&4) to the input terminal block of the switch. The voltage is 12Vdc.

CAUTION **It is possible that a specially requested Ethernet switch is used, and it may connect directly to 125VDC.**

Reference the print set for electrical drawings and important notes.

17. In a distributed architecture, each Data chassis receives its own power input from your power source (station battery or AC Input). Input voltage can be 86-373 Vdc or 88-264 Vac. Other voltage input options are available. Power to the Computer Chassis should come from the main

data chassis. Terminals 5 & 6 on the data chassis power supply circuit board should be used to power the computer control chassis.

WARNING **All #6 ring terminals connecting to the power circuit board should be <u>insulated</u> ring terminals.**

18. Ensure that the power switches, located on the back of each chassis, are in the OFF position.

WARNING **Ensure that your power source wires are not live (turned off or disconnected). Follow OSHA power safety lock out procedures. Ensure that your source can provide sufficient current to each Data chassis. Ensure that your power source is fused and properly earth grounded.**

19. Connect power from your source to all the Data chassis power supply boards (terminals 1&2). Connect power to the computer chassis per the drawings. Use installed #6 ring terminals.
20. Open the hinged front door of the Computer Control chassis, pull out the computer, and flip up the monitor.
21. If the factory does <u>not</u> know the chassis arrangement prior to shipping, the Ethernet and IP addresses of each Data chassis must be set before powering up the system as a whole.

    If this is the case, complete the following

    Unplug all Ethernet cables from the Data chassis. Connect the provided programming cable from a DSP circuit board to the computer chassis RS232 connector or to your laptop running APP ClearView. With caution, power up the Data Chassis and Computer chassis. The APP Recorder program should automatically start. Via the Tools menu click “DSP Board Ethernet Settings” to display the settings window. The preferred Ethernet address is 2-35-69-86-203-X where X is 1, 2, 3 etc. according to the chassis number. The preferred IP address is 192.168.203.X where X is 1, 2, 3 etc. according to the chassis number. The preferred default gateway is 192.168.203.220. After setting the Ethernet address and IP Address in each Data chassis, power down all chassis and plug in all the Ethernet cables.

    If you are using an **APP-618 Controller**, address those chassis IP addresses by using the process described below in **section 4.9 Networking**.

22. Carefully and with great prior inspection and thought, turn on power to all chassis.
23. If a proper turn on occurs, you should see the following:
    - Computer startup
    - APP Recorder service program begins.
    - On each Data chassis, the front panel POWER LED illuminate green, the ONLINE LED illuminate green, the 1PPS LED illuminate green, and only if the continuous recording is enabled the CONT RECORD LED illuminate amber (yellow).
24. If the system has not powered up correctly, please recheck your wiring and reference the wiring prints that came with the recorder.
25. Please call the factory for any required assistance (317) 536-5300.

3.4 Completing a Turn-Key Installation

➢ To Complete a Turn-Key Installation

1. Inspect the cabinet to see if any obvious shipping damage has occurred. If the cabinet or any smaller auxiliary boxes have been damaged contact the carrier immediately and file a damage claim. Take pictures of the damaged cabinet or boxes. Keep damaged boxes to show the freight company inspector.
2. Unpack any auxiliary boxes. Inspect the contents and if damaged, take pictures and file a claim with the freight company. Contact APP Engineering, Inc. if any kind of damage has occurred.
3. Carefully review the print set that was provided with the recorder.
4. Ensure that all circuit board cards are seated properly, and the holding screws are tight. Open the front panel doors on each chassis and ensure that internal power supplies, connectors, and computer are in proper position and secured in place. Ensure that no foreign objects are lying in the chassis.
5. Earth ground the cabinet.

WARNING **Proper grounding procedures must be followed to prevent serious injury or death to people who may come in contact with this recorder equipment.**

6. Review the Point Assignment Record that your company provided to APP Engineering, Inc. APP strives to get these records prior to shipment so the recorder internal settings are complete. Prior to connecting signals to the field side of the analog terminal blocks, the user should know if a particular channel has been designated as a voltage channel or current channel. Each analog channel contains two jumpers per channel that configures it for voltage or current input. If the Point Assignment Record was received prior to shipment, the factory has already made the correct jumper settings.
7. Wire the analog channel terminal blocks (field side). The maximum input to a voltage channel is 440VAC. The maximum continuous current thru a current channel is 15Amps.
8. Wire the recorder event (digital) channels. The event channels utilize a pluggable 16 position connector. The maximum wire size for this connector is 14AWG. The standard input voltage range is 45-250Vdc. Event Boards setup for 24Vdc are available as an option. Reference the print set for any notes designating event channels that require 24Vdc or event boards that are **Internally Wetted** as opposed to our typical board that needs external wetting. If the events have a common return and the customer provided that information to the factory, they will have jumpers between the (-) event terminals. Again, reference the print set for electrical drawings.

WARNING **All #6 ring terminals connecting to the power circuit board should be insulated ring terminals.**

9. Wire the recorder alarm output terminal block(s) (field side). The alarm output contact is dry. The contacts can break 0.5Amps @ 125VDC or 0.35A @ 250VDC.
10. Connect your IRIG-B signal to the back of the DSP/IRIG circuit board. The IRIG-B connector is labeled and is a standard BNC type connector. This board can accept a modulated or un-modulated IRIG-B signal. However, a board jumper must be set to reflect the input type. This information should have been provided to the factory and the jumper should already be set in the appropriate position. If a satellite-controlled clock is installed in the system, the antenna must be installed on the building roof and the antenna connected to the back of the satellite controlled clock.

11. If you are using an APP-618 Controller for Sampled Values, connect the DSP Port to the DSP LAN switch. Connect the ENET LAN port of the APP-618 to the process bus network. If the APP-601 Data Chassis is using an IRIG-B clock, the 618 will need to get PTP clock source from the process bus.

12. Ensure that the power switch, located on the back of the Data chassis, is in the OFF position.

WARNING **Ensure that your power source wires are not live (turned off or disconnected). Follow OSHA power safety lock out procedures. Ensure that your source can provide sufficient current to the recording system. Ensure that your power source is fused and properly earth grounded.**

13. Connect power from your source to the cabinet power terminal block(s) (field side). You must reference the print set for additional details.

14. If using an APP-501 Computer Control chassis, open the hinged front door, pull out the computer, and flip up the monitor. If you purchased the optional APP-904 Monitor and Keyboard chassis (for the APP-601 Computer Control Chassis) open the hinged front panel door and pull out the monitor and keyboard.

15. Carefully and with great prior inspection and thought, turn on your power source(s).

16. Turn on the power switch located at the rear of the Data chassis.

17. If a proper turn on occurs, you should see the following:

    - Computer startup
    - APP Recorder service program begin.
    - On the Data chassis front panels, the POWER LED illuminate green, the ONLINE LED illuminate green, the 1PPS LED illuminate green, and only if the continuous recording is enabled the CONT RECORD LED illuminate amber.

18. If the system has not powered up correctly, please recheck your wiring and reference the wiring prints that came with the recorder.

19. Please call the factory for any required assistance (317) 536-5300.

3.5 Basic Connection Diagram

IMPORTANT **The following diagrams are to give you a general picture of chassis interconnections. They are NOT for wiring and installation purposes. You must use the detailed print set provided with each system for wiring and installation.**

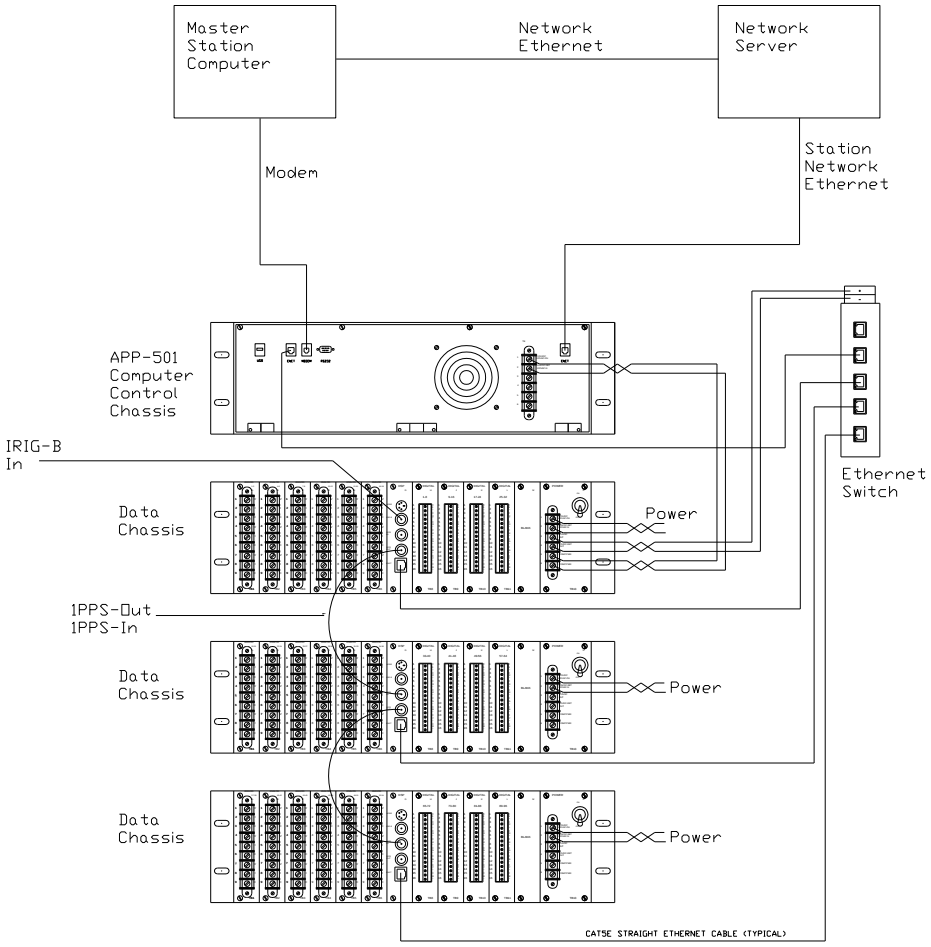


Figure 5: Chassis Interconnection Diagram (Reference) (with APP-501 Computer Control Chassis)

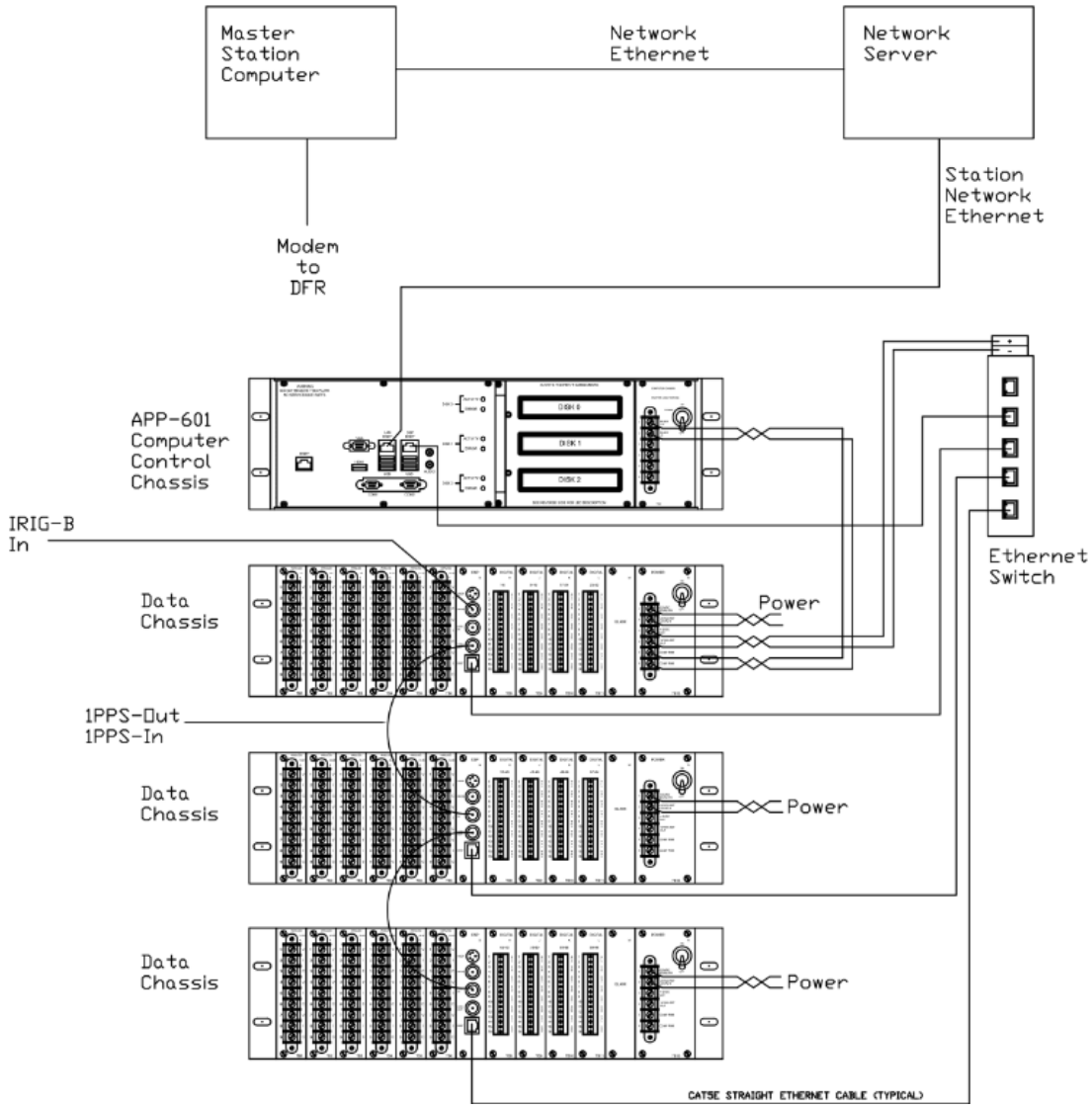


Figure 6: Chassis Interconnection Diagram (Reference) (with APP-601 Computer Control Chassis)

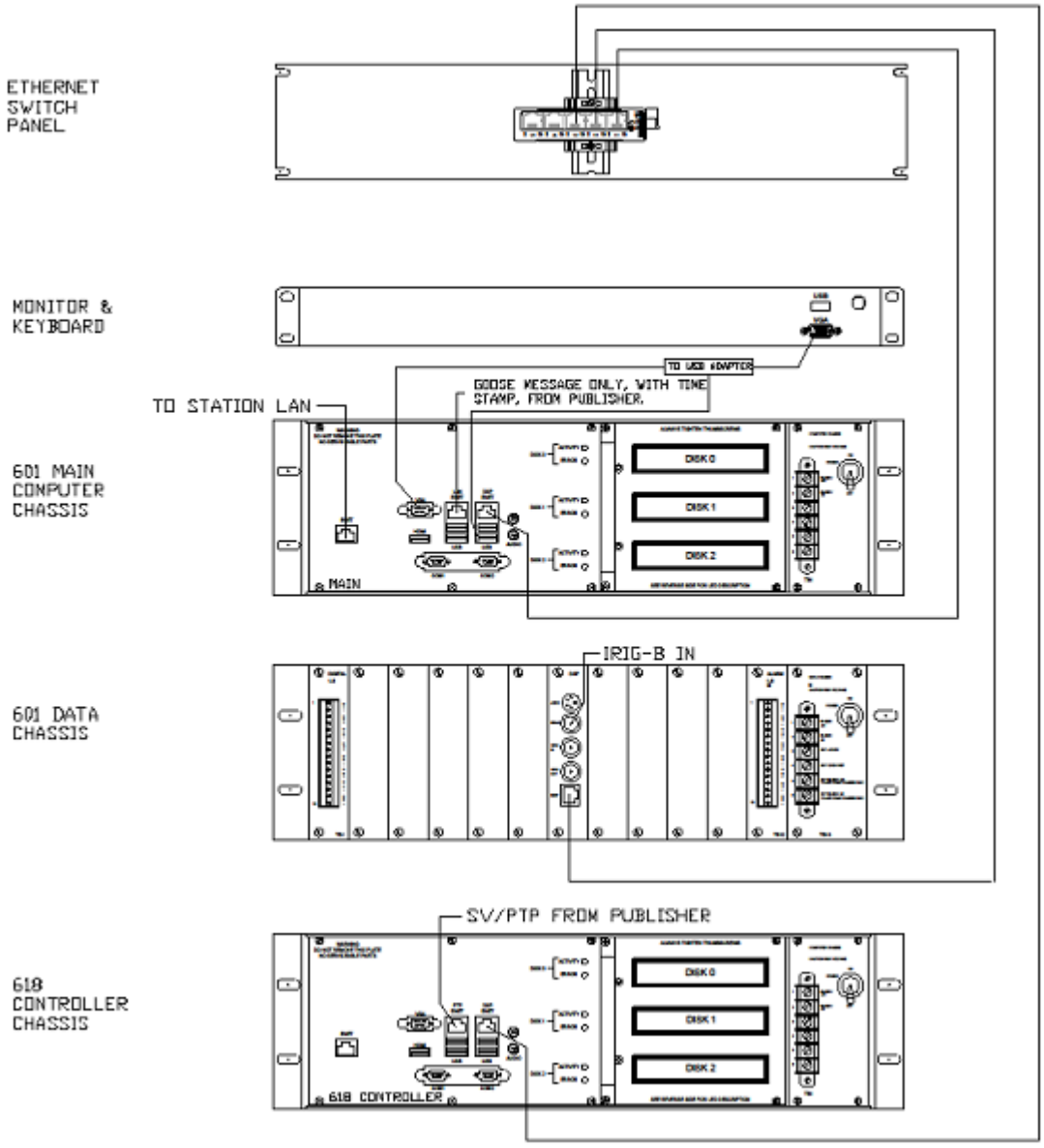


Figure 7 Chassis Interconnection diagram with APP-618 Controllers

4.Hardware

4.1 Available Computer Control Chassis

The APP-601 recorder can be purchased with either of the following Computer Control chassis:

1) APP-601 Computer Control Chassis (fanless)

2) APP-501 Computer Control Chassis (with fan & human interface)

4.2 Major Duties of the Computer Control Chassis

The major duties of the Computer Control chassis are:

Communicate with each DSP circuit board, 618 Controllers, and Intelligent Electrical Devices (IEDs), carrying out functions such as collecting data, downloading settings, and downloading new software.

Receive, organize, and store raw data.

Convert raw data into COMTRADE C37.111-2013 format.

Calculate continuous frequency, RMS, and phase data.

Communicate with the APP ClearView master station software via modem, network, or directory.

Output data in DNP-3 format via RS232 or Ethernet to a remote terminal unit or similar.

Output PMU data.

Provide a means for a local user to look at settings, change settings, view real-time oscillograms, look at stored records, communicate with someone at a master station, or even call another recorder and download records for review and analysis.

4.3 APP-601 Computer Control Chassis

The APP-601 Computer Chassis Nano Series is constructed in a 3U, 19” rack mount chassis. The chassis depth is approximately 9.8.” Housed inside the chassis are an industrial and fanless computer board, RAID controller board, Gigabit Ethernet adapter board, 3 hard drive bays (2.5” or 3.5”), 12V 100W power supply, 5V 100W power supply, and rear slide in power supply circuit board.

The computer chassis can be powered from an 86-373Vdc or 88-264Vac source. Ideally it should be powered from a data chassis via its power supply terminal block (terminals 5 & 6). In this manner, the data chassis can control power to the computer chassis. This gives a remote user, local user, or the system watchdog a means of rebooting the computer chassis.

The 12V power supply and 5V power supply are mounted to the chassis front panel. This allows for maintenance access and heat sinking.

WARNING **Always turn OFF chassis power before opening the chassis front panel. The input sides of the power supplies have 125V or 250V wired to them. This voltage can be deadly! Only trained experienced electrical personnel should open the chassis front panel and only with the power OFF.**

The rear slide in power supply circuit board contains a 2A fuse, components for surge protection, a power switch, and a 6-position terminal block. Power is connected to terminals 1 & 2 and passes through the board via connector X3 to the 12V power supplies discussed above.

WARNING **Only trained experienced electrical personnel should service this power supply circuit board and only after the unit has been turned off and power has been carefully removed from terminals 1 and 2. Ensure power has been removed from terminals 1 & 2 by measuring the voltage across terminals 1 & 2 (it should read zero volts).**

The computer board is powered from the 12V, 100W power supply. The computer is designed to support applications where high reliability and long-term availability are required. The computer features the Intel Atom E3845 fanless processor, which offers fast performance. This highly integrated processor along with its companion chip provides the majority of the board I/O, including USB support, serial ports, audio, and video.

The computer has two Ethernet ports for connecting to the data chassis and to connect to Process Bus for IEC 61850 GOOSE Capture. This computer chassis also has a Gigabit Ethernet adapter for locally remoting into the system (if a monitor and keyboard are not included) or for any other auxiliary purposes. This Port could also be used to connect to the Station LAN if the ENET LAN port is used for connecting the Process Bus.

The Basic Input/Output System (BIOS) is a program that provides a basic level of communication between the processor and peripherals. In addition, the BIOS also contains codes and various advanced features applied to the serial controller. The BIOS setup program includes menus for configuring settings and enabling computer board features. To enter the BIOS press the “delete” key a few seconds after powering up the computer chassis. Changing the BIOS settings is not recommended and may lead to incorrect controller behavior and possible inability to reboot.

In our standard configuration, the computer chassis is setup with RAID 1 + hot spare. Two 1TB hard drives are in RAID 1 configuration with the 3rd 1TB hard drive acting as a hot spare. The RAID hard drives will contain both the operating system and the Setup and Data folders for the Recorder program.

Typically, the Setup folder contains the Point Assignment Record, Line Group Record, Calibration File, and Trace Files. The Data folder contains the triggered transient records, triggered extended records, and various continuous recording folders such as continuous RMS, continuous frequency, continuous phase, and continuous oscillography.

The standard 1TB hard drive has a maximum temperature rating of 65° C. APP offers an extended temperature range 80GB hard drive with a temperature range to 85° C, allowing the Computer Control chassis to operate in a 70° C environment.

4.3.1 APP-601 Computer Control Chassis Specifications

APP-601 Computer Control chassis specifications are listed in the following table.

Table 1: APP-601 Computer Control Chassis Specifications

Item	Description
Operating system	Windows 10, Linux Ubuntu
Processor	Atom E3845 Quad Core
RAM	8GB DDR3-1600
BIOS	American Megatrends Inc. BIOS
Chipset	System-on-Chip integrated, Intel HD Graphics, Shared System memory
Power Input	86-125Vac (50Hz/60Hz) or 86-350Vdc Computer auto power AC/DC power
Power Requirements	25W (using 3 X 2.5” Hard Drives)
Internal HDD	3 X 1TB STD Western Digital Red, SSD Optional
RAID	RAID 1 + Hot Spare (2 – 1TB HDDs in RAID 1 configuration with 1TB as hot spare automatic substitute failed HDD
External HDD, CDRW, DVDRW	Option
Ports Notes: 1) Use the ENET marked “DSP ENET” to connect the computer chassis to the Ethernet switch provided with the system. 2) If not connecting the computer to the Process Bus, use the ENET “LAN ENET” to connect your substation LAN. Otherwise connect LAN ENET to the Process Bus network 3) If ENET LAN Port is connected to the Process Bus, Connect “ENET” port to the Station LAN.	2x RS232 (Com1 & 2)
	3x Ethernet 10/100/1000 MB
	3x USB2, 1x USB 3
	3x SATA 300
	1 HDMI, 1 VGA
	1x line-out, 1x Mic-in
Display	Option, APP-904 Mon./Keyboard Chassis
Keyboard	Option, APP-904 Mon./Keyboard Chassis
Touchpad	Option, APP-904 Mon./Keyboard Chassis
Temperature	-20°C ~ 70°C (-4°F ~ 158°F)
Relative Humidity	10% ~ 95% relative humidity, non-condensing
LED Indicators	FRONT: 5 LEDs: 12V + 5V Power, Computer + RAID 1 power, RAID Error REAR: 6 LEDs: 1 activity + 1 error indicator for each hard drive

Figure 8: APP-601 Computer Control Chassis Front View

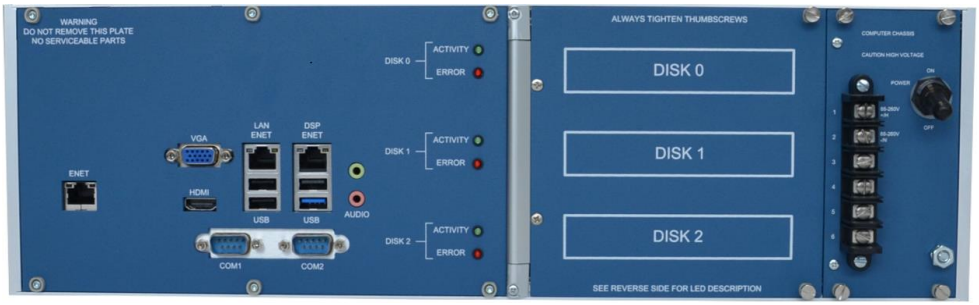


Figure 9: APP-601 Computer Control Chassis Rear View

4.4 APP-904 Rack Mount Monitor and Keyboard Console

The APP-904 monitor and Keyboard is an optional rack mount console for use with the APP-601 Computer Chassis.

APP-904 Industrial Rack Mount Monitor & Keyboard Console consist of: 1RU, 19” Rack Mount, 13” deep. Three Mounting Depths for Rack Mount Ears allows the console to be mounted flush, or 2” or 3.5”, out from the front of the rack or panel for greater monitor tilt angle.

Table 2: APP-904 Monitor and Keyboard Specifications

Item	Description
Power Input	86-370Vdc, or 88-264Vac, 17W @ 125VDC
Power Input Frequency	Range 47Hz to 63Hz
Ports	USB Type A
	1 - DVI-D
	1 - VGA
	1 – Three Pos Power Terminal Block
Display	Pull out drawer with 12.1” flip up Industrial TFT, High Brightness, cont’d XGA Monitor, 1024 x 768 Res
Keyboard Touchpad	Waterproof, Washable Membrane, 104 Key US Layout, cont’d with Touchpad
Temperature	25C to 70C
Relative Humidity	0 to 85% non-Condensing

Figure 10 APP-904 Optional Monitor and Keyboard

4.5 APP-501 Computer Control Chassis

The major difference between the APP-601 Computer Control Chassis and APP-501 Computer Control Chassis is the incorporation of a slide out laptop computer. This approach was used in the APP-501 recorder with great success and satisfaction. Benefits include a computer solution that is economical, familiar, has a local built-in human interface (window & keyboard), and provides a high degree of processing power.

An Intel Core 2 Duo 2GHz or Core I5 2.6 GHz processor is used in the APP-501 chassis laptop. In applications using more than 200 analog channels the APP-501 Computer Control Chassis is recommended. The APP-501 computer chassis contains fans for processor and chassis cooling.

The APP-501 Computer Control chassis is constructed in a 3U 19” rack mount chassis. The chassis depth is approximately 15.5”. Housed inside the chassis are an electrically isolated laptop computer, laptop internal modem, laptop internal 2.5” Hard Drive, USB to Ethernet converter, and 24V 100 Watt power supply.

The laptop computer is mounted on a slide out shelf. The shelf and computer can be slid out of the enclosure by loosening the front panel thumb screws, opening the hinged panel, and carefully pulling the shelf forward.

The computer chassis can be powered from a 86-373Vdc or 88-264Vac source. Power is connected to the rear panel terminal block terminals 1 & 2. Ideally power should come from an APP-601 Data chassis via its power supply terminal block (terminals 5 & 6). In this manner, the Data chassis can control power to the Computer Control chassis. This gives a remote user, local user, or the system watchdog a means of rebooting the computer chassis.

The laptop computer battery is removed to allow for automatic power toggle during the automatic reboot processes. Also, the D-series laptops have their power buttons shorted and the E-series laptops have the BIOS configured to allow the computer to automatically startup with no human intervention.

The chassis power supply is used to take a universal incoming voltage (typical 125VDC, 250VDC, 120VAC, or 240VAC) and convert it to 24VDC. Manually, the 24VDC is reduced to approximately 21VDC via an easy access power supply pot. The 21VDC signal is used to power the laptop computer.

WARNING **When the chassis rear panel is open high voltage is exposed. This voltage can be deadly. Only trained experienced electrical personnel should service this power supply circuit and only after the unit has been turned off and power has been carefully removed from terminals 1 and 2. Ensure power has been removed from terminals 1 & 2 by measuring the voltage across terminals 1 & 2 (it should read zero volts).**

Since the laptop computer only has one Ethernet port, a second port is created by using a Trendnet USB to Ethernet converter. The laptop Ethernet port is used for the DSP network and the Ethernet connection from the Trendnet converter is used for customer LAN connection.

In our standard configuration, the 2.5" computer hard drive is set up as the "C-Drive" and holds the Windows operating system and the APP Recorder program. The APP ClearView program is also installed on the hard drive so a local person can view and analyze fault records or test runs.

The "C-Drive" also holds the *Setup* folder and *Data* folders. Typically, the *Setup* folder contains the all important Point Assignment Record, trace files, and calibration file. The *Data* folder contains the triggered transient records, triggered extended records, and various continuous recording folders such as continuous RMS, continuous frequency, continuous phase, continuous oscillography, and Power Quality (PQ).

4.5.1 APP-501 Computer Control Chassis Specifications

APP-501 Computer Control chassis specifications are listed in the following table.

Table 3: 501 Computer Control Chassis Specifications

Item	Description
Operating system	Windows 10, Linux Ubuntu
Processor	Intel Core i5 2.6GHz
RAM	2GB DDR Minimum
SSD	Option
Internal HDD	500GB Min.
External HDD	Option
DVDRW	Yes
Ports	1-RS232
Ports	2-Ethernet 10/100 (1 for DSP, 1 for LAN)
Ports	2-USB
Display	Yes, 14.1" LCD
Keyboard	Yes
Touchpad	Yes
Temperature	5 to 55° C with battery removed
Modem	Yes, External

Figure 11: APP-501 Computer Control Chassis 3D View

Figure 12: APP-501 Computer Control Chassis Front View

Figure 13: APP-501 Computer Control Chassis Rear view

4.6 APP-601 Data Chassis

The Data chassis is housed in a 19” rack mount enclosure with a hinged front panel. Circuitry contained in the Data chassis includes:

Power Supply Circuit Board With Fuse & Switch

5V 100 Watt Power Supply

12V 100 Watt Power Supply

Alarm Circuit Board

Event Circuit Boards

DSP/IRIG Circuit Board

Analog Circuit Boards

Traveling Wave Circuit Board

Front Panel with LED Indicators

A Data chassis has 13 card slots. Three slots are always reserved: (1) for the power supply board, (1) for the alarm board, and (1) for the DSP/IRIG board. The other 10 slots can be populated with analog or event circuits. Therefore, the maximum number of analog circuit boards in a Data chassis is ten (no event circuit boards). Or, the maximum number of event circuit boards is ten (no analog circuit boards). A mix of analog and event boards can be inserted in the chassis, so long as the sum total does not exceed ten.

Functions and features of the Data Chassis circuit boards are discussed below:

4.6.1 Power Supply Circuit Board

Fuses the input power (2Amp/250V, 3AG, Slo-Blo, Glass Cartridge)

Uses a six position black barrier terminal block for input & output power connections (#6 screws)

Accepts input voltages of 86-373Vdc (48vdc Option) or 88-264Vac (50/60Hz)

Input voltage is connected to terminals 1 & 2

Terminals 3 & 4 are used for a 12VDC output to power the system Ethernet switch

Terminals 5 & 6 are used for powering the Computer Control Chassis. The voltage that appears across terminals 5 & 6 will be the same as the input voltage.

This board contains a relay that drops power to the system, if it receives an appropriate command from a local user or the master station computer. After a momentary power interruption, used as a last resort to reboot the computer and reset the entire system, the relay automatically closes to restore system power.

WARNING **All #6 ring terminals connecting to the power circuit board should be <u>insulated</u> ring terminals.**

4.6.2 5VDC Power Supply Module

This module allows the system to have a wide range of input voltages of 86-373Vdc (48vdc Option) or 88-264Vac (50/60Hz)

The output of this module is 5VDC, 100W

The module includes over load, over voltage, and over temperature protection.

This unit is mounted on the back of the chassis front panel.

WARNING **Always turn OFF chassis power before opening the chassis front panel. The input sides of the power supplies have 125V or 250V wired to them. This voltage can be deadly! Only trained experienced electrical personnel should open the chassis front panel and only with the power OFF.**

5V provided by this power supply is connected to the mid plane circuit board via a 2 position green plug and receptacle, XP20 and X20 respectively. The 5V signal is routed to the power supply circuit board where it passes thru a normally closed relay contact, back to the mid plane circuit board, and on to various boards that plug into the mid plane.

4.6.3 12VDC Power Supply Module

The output of this module is 12VDC, 100W

The module includes overload, over voltage, and over temperature protection.

This unit is mounted on the back of the chassis front panel.

WARNING **Always turn OFF chassis power before opening the chassis front panel. The input sides of the power supplies have 125V or 250V wired to them. This voltage can be deadly! Only trained experienced electrical personnel should open the chassis front panel and only with the power OFF.**

12V provided by this power supply is connected to the mid plane circuit board via a 3 position green plug and receptacle, XP18 and X18 respectively. The 12V signal is routed to the power supply circuit board where it passes thru a normally closed relay contact and lands on power supply circuit board 6 position terminal block (terminals 3 & 4).

CAUTION **The 12V output should ONLY be used to power the system EISK series Ethernet switch (manufactured by Contemporary Controls), the N-Tron (by Red Lion) Ethernet Switch, or low power TTL to fiber media converter. Reference the system drawings for detail.**

4.6.4 Alarm Circuit Board

The alarm board contains (8) relay outputs. A selection of alarms can be mapped to the relay outputs. More than one alarm can be mapped to a relay, note exceptions below. Alarm mapping is done via software in the Point Assignment Record.

The relays are indirectly energized via a 5V signal coming from the DSP circuit board. See "Specifications" for relay contact ratings.

Each relay uses an on-board jumper that will allow the contact to be either normally open or normally closed. The board is labeled for easy jumper placement.

The relay board utilizes a 16 position pluggable connector. The plug will accept a maximum wire size of 14AWG.

Alarm selections include:

- **Power**
  Relay is energized when system power is applied. Most users will put contact in the normally closed position. We recommend Power be mapped to its own output, no other alarm should be mapped to those outputs.
- **Online**
  Relay is energized when the system program starts and the system is ready to record or is recording. Most users will put this contact in the normally closed position. We recommend Online be mapped to its own output, no other alarm should be mapped to those outputs.
- **Offline**
  Relay is energized when the system program, APP Recorder, is stopped. Most users will set this contact to the normally open position.
- **Clock Sync Loss**
  Relay is energized when the DSP/IRIG board has completely lost its IRIG-B input, such as disconnecting the cable, or the satellite clock sends a signal (4 bits per the IEEE standard) that an error greater than 1ms has occurred. The relay will stay energized until a synchronized condition is reestablished. Most users will set this contact as normally open.
- **Chassis to Chassis Communication Error**
  Relay will energize if any data acquisition chassis stops communicating with the computer control chassis for a period of 5 minutes or more. The relay will stay energized until the problem chassis begins proper communication. Most users will set this contact in the normally open position.
- **Chassis to Master Station Communication Error**
  Relay will energize if the recorder modem or network card stops communicating with the APP recorder software. The relay will remain energized until the problem is fixed. Most users will set this contact in a normally open position.
- **Disk Full**
  Relay will energize when the computer hard drive memory falls below a user programmable limit. The relay will remain energized until the hard drive free space goes above the user programmable limit. However, if the history overwrite feature is enabled, the alarm relay will not energize. Most users set this contact in the normally open position.
- **Trigger**
  Relay will energize when the recorder trips, records a transient record. The relay will remain energized for the duration set in Alarm Duration field. The default is 10 seconds. Most users will set this contact in the normally open position.
- **Disturbance Record**
  If a trigger has been defined as a disturbance trigger, in the Point Assignment Record, the relay will energize when the recorder trips. The relay will remain energized for the duration set in Alarm Duration field. The default is 10 seconds. Most users will set this contact in a normally open position.

- **SOE Record**
  If a digital point has been setup as sequence of event point, in the Point Assignment Record, the relay will energize when any SOE/SER point goes abnormal. The relay will remain energized for the duration set in Alarm Duration field. 10 seconds is default. Most users will set this contact in a normally open position.
  If a digital point has been set up as a **Perpetual** point in the Point Assignment Record, the relay will energize when any SOE/SER point goes abnormal. The relay will remain energized until the channel returns to Normal status.
- **DSP Temperature**
  If the DSP temperature sensor measures a temperature that exceeds the setting in the Point Assignment Record, the relay will energize and remain energized until the temperature drops below the user setting. The user selectable range is 65 to 85° C. The default setting is 70°C.
- **Continuous Record**
  If the continuous recording feature has been enabled in the Point Assignment Record, the relay will energize when the continuous recording begins. Most users will set this contact to the normally open position. We recommend Continuous Record be mapped to its own output, no other alarm should be mapped to those outputs.
- **PC Health**
  This alarm monitors the hard drive(s) and temperature and CPU Temperature. This relay will energize if the temperature of the hard drive exceeds 70° C. A program called HDSentinel must be installed on the recorder computer for this alarm to be functional.

  APP Recorder monitors HDSentinel for active drives, if there are fewer active drives in HDSentinel than the number entered in the "# of HD/SSD field, in the PAR General Settings Tab, this relay will energize. We recommend PC Health be mapped to its own output, no other alarm should be mapped to those outputs.

  CPU temperature is monitored by Speedfan and must be installed on the computer
- **Analog Fail**
  This alarm monitors each analog channel. The relay will energize if the measured value of the analog channel goes to maximum negative, indicating a failed channel.

Note: Even though this alarm is not mapped to an alarm output, if a failed channel is detected it will be logged to the trace file and diagnostic report (Status File).

- **Cross Trigger**

  This Alarm output is to trigger another DFR when a fault is encountered. This starts the recording in the second DFR, at nearly the same time as the first DFR to create a parallel fault record for the components monitored in the second DFR. The DFRs need to be connected to a network via the Ethernet switch and the IP address of the DFR Computers need to be entered into the Point Assignment Record/Event Channel assigned to receive the cross triggers see Figure 14 below. **OR** the DFRs need to be wired from the alarm output associated with the cross trigger in the first DFR to a digital event input, configured for **Cross Trigger in the PAR)** in the second DFR to receive the Cross Trigger see Figure 15 below.

Note: This Cross Trigger approach is not recommended, as it can be less accurate than the standard APP 601 configuration. The standard APP 601 DFR configuration has one Computer Unit with multiple Data Chassis in a centralized or distributed configuration. Cross triggering between the Data Chassis is automatic and time alignment is accurate (within 1 µs or better).

➢ Configuring and wiring for Cross Trigger using an IP Network

Follow these instructions to set up Cross Triggering between separate DFRs using an IP Network.

1. In the Point Assignment Record of the DFRs, map the Cross Trigger Alarm to an output contact of your choice (see **Configuring Point Assignment Record/Configuring General Settings** section in the Clearview Operating Manual).
2. In the Point Assignment Record of the DFRs, map an event channel of your choice to be a cross trigger input (see **Configuring Point Assignment Record/Configuring Event Channels** section in the Clearview Operating Manual).

Note: The assigned Event Channel for receiving a Cross Trigger over the IP network must NOT be wired, (i.e. must be left open.)

3. To connect the DFRs that will cross trigger, run an Ethernet cable between the switches connecting the DSP boards of each DFR, see Figure 14 below.
4. Typically, each DFR is assigned IP addresses as described in the section 4.9 Networking. If you have more than one DFR in a station, you could have the same IP addresses assigned to each. This is acceptable unless they are networked as in the Cross Trigger arrangement using an IP network. Assign unique IP addresses to the Computers and Data Chassis. An example involving three DFR computer IP addresses: 192.168.203.**220**, 192.168.203.**221**, 192.168.203.**222.** See below, sample unique addressing scheme.

CAUTION **If you are adding Cross Trigger to existing DFRs, you may have to re-address the Computer Unit and DSP IP addresses to eliminate any duplicates when connecting the Ethernet switches.**

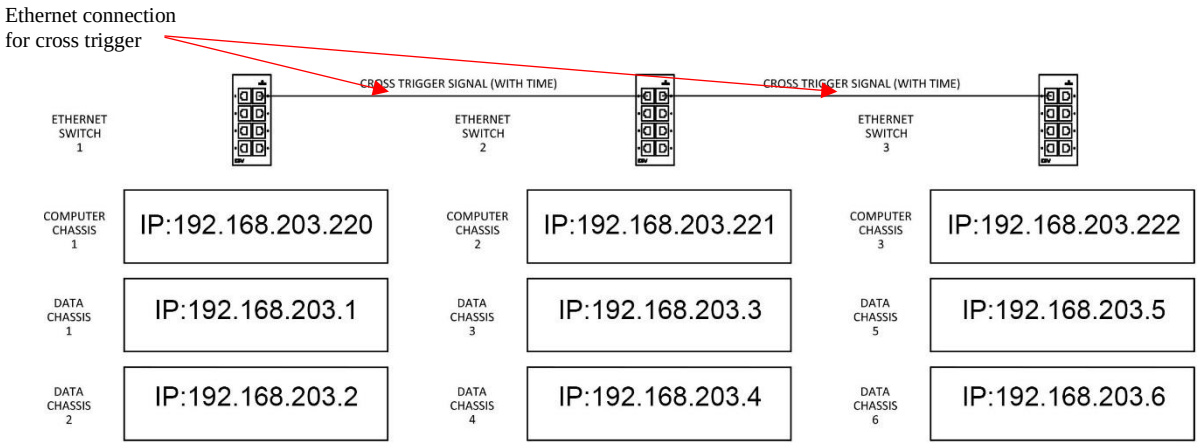


Figure 14: Cross Trigger over IP Network

➢ Configuring and wiring to Cross Trigger between multiple DFRs

Follow these instructions to set up Cross Triggering between separate DFRs using the Data Chassis Alarm output and Event Input physical connections.

1. In the Point Assignment Record of the DFRs, map the Cross Trigger Alarm to an output contact of your choice (see **Configuring Point Assignment Record/Configuring General Settings** section in the Clearview Operating Manual).
2. In the Point Assignment Record of the DFRs, map an Event Channel input of your choice to be a Cross Trigger input (see **Configuring Point Assignment Record/Configuring Event Channels** section in the Clearview Operating Manual).
3. Wire the output cross trigger contact of DFR#2 to an event channel input on DFR #1, DFR #3, to DFR #n

4. Repeat wiring for as many DFRs as you want. (See Figure 15: Cross Trigger Wiring, 3 DFR Example).
5. We recommend setting the prefault timer on all DFRs at least 750ms.

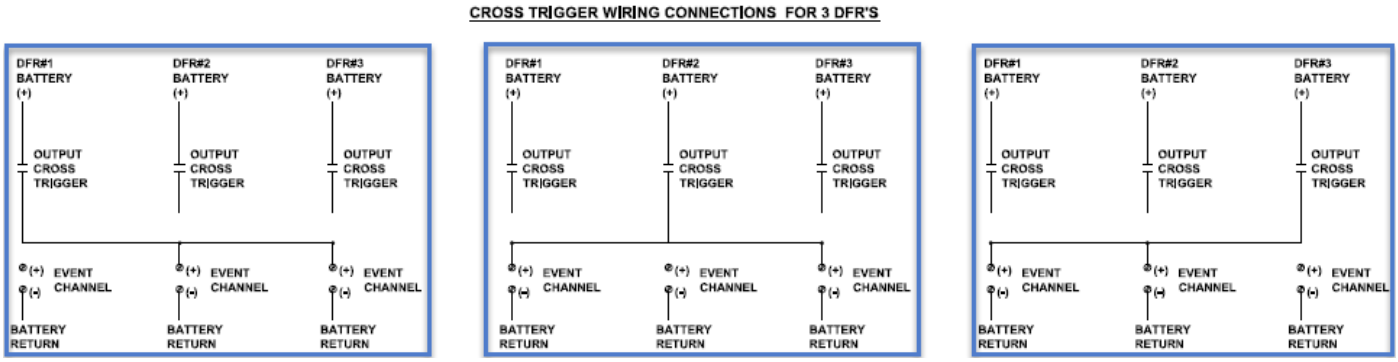
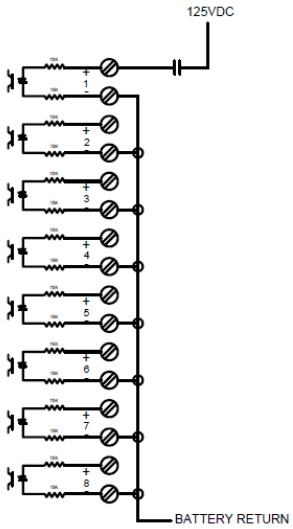


Figure 15: Cross Trigger Wiring, 3 DFR Example

- **TW Fail**
  The TW Fail alarm monitors communications with Traveling Wave boards. If you have Traveling Wave boards installed and configured in the Point Assignment Record, TW Fail Alarm will energize if the TW board(s) are not communicating with the Recorder Driver.

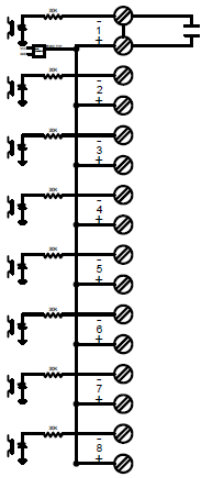
4.6.5 Event Circuit Board

- An event board contains 8 event inputs. The maximum number of event channels in a Data chassis is 80 (10 boards x 8 channels per board).
- The standard voltage range for an event input is 45-250VDC. Other input voltage ranges are available as an option.
- An event board utilizes a 16 position pluggable connector. The plug will accept a maximum wire size of 14AWG.
- Inputs are user programmable as either normally open or normally closed. See the Point Assignment Record.
- On our standard event circuit board, inputs need to be externally wetted. APP offers an internally wetted event circuit board upon request (see wiring diagrams Figures 14 and 15 below).
- For common return simply daisy chain the (-) negative terminals together and connect to station battery return (DC return).
- Event channels are scanned at the same rate as the analog channels. The scan rate is user programmable and includes choices of 1200Hz, 2400Hz, 4800Hz, 9600Hz, and 19,200Hz, and 24,000Hz.
- Event channels can be user programmed as DFR, SER, or BOTH. If a channel is setup as DFR, all channels on the recorder begin recording and a COMTRADE record is created when it goes abnormal. If a channel is setup as SER, it alone is recorded in the Sequence of Event Report when it goes abnormal. If a channel is setup as BOTH, then both DFR and SER recordings occur simultaneously.
- If an event channel is setup as a DFR channel, it can also be user programmed to trigger on a rising edge, falling edge, or both.
- To prevent nuisance event triggers, user programmable settings are available to automatically shut down and then restart event triggers.
- Event channels can be user programmed to include a de-bounce time. De-bounce time of 0.40 ms is typical.



EXTERNALLY WET DIGITAL CARD CONNECTION

Figure 16: Externally Wetted Event Board



INTERNALLY WET DIGITAL CARD CONNECTION

Figure 17: Internally Wetted Event Board

4.6.6 DSP/IRIG Circuit Board

The DSP/IRIG board is the heart of a Data chassis. The DSP IC contains the recorder driver program and is responsible for collecting data from the analog and event inputs. The DSP IC performs mathematical calculations on the data received from each analog and event channel and decides if a trigger condition exists. Prefault data is stored in a circular buffer. If a trigger condition does not exist, the oldest prefault data is overwritten by new incoming prefault data (FIFO). If a trigger condition is measured, the prefault data plus incoming data is routed to the Computer Control chassis via the Ethernet connection. If continuous recording is enabled, the above triggering process is carried out and incoming data from the analog channels are continuously routed to the Computer Control chassis (all with data sample time stamping.)

The DSP/IRIG board can accept a modulated or un-modulated IRIG-B input signal from a satellite-controlled clock. The top BNC connector, J6, is the IRIG-B input. Each data sample is time stamped to the microsecond. Data is aligned with the 1PPS rising edge and the accuracy of the time stamp is no better than the accuracy of the 1PPS signal coming from the satellite controlled clock.

Precision Time Protocol (PTP) input Option, PTP input is being developed as an option and requires DSP Card version 6.4 or higher.

Table 4: SyncMethod and Corresponding Hardware 3-PIN Jumper Position

SyncMethod	JP2 3-PIN Jumper (DSP/IRIG Circuit Board)
Un-modulated IRIG-B	Short middle pin & pin close to panel
Modulated IRIG-B	Short middle pin & pin away from panel
SNTP (External Clock)	N/A (LAN ENET interface)
PTP (E2E) Option	N/A (LAN ENET interface)
PTP (P2P) Option	N/A (LAN ENET interface)

Note: There are “un-mod” and “mod” labels on back of DSP board under the JP2.

If the DSP/IRIG board loses the 1PPS signal from the satellite-controlled clock, the DSP IC no longer receives a 1PPS interrupt signal. In this case, the DSP will rely on its own 1PPS signal that is generated from an onboard 25MHz crystal. The crystal has an accuracy of 100ppm which translates to an error of 0.1msec/1sec (8.6sec/day).

The system computer, located in the Computer Control chassis, is time synchronized with the satellite-controlled clock. If the recorder is powered up and the there is no satellite controlled clock present, the beginning time of day is obtained from the computer.

CAUTION **We recommend turning on the satellite controlled clocks extended IEEE C37.118 IRIGB format. If the clock does not have this feature, we recommend not turning off the computer’s Daylight Saving Time.**

If the recorder contains multiple Data chassis, the 1PPS signal is routed from the first Data chassis down to the next Data chassis via the 1PPS out/in connectors.

The DSP/IRIG circuit board is always located in the 7th board slot, from the left side of the chassis. There is one DSP/IRIG circuit board per Data chassis.

Major hardware/firmware items on this board include the following:

- High Performance Digital Signal Processing IC (100MHz, 32bit, 1MB On Chip Dual-Ported SRAM, Integrated I/O Processor with Multiprocessing Support and Multiple Internal Buses to Prevent I/O Bottlenecks, 15x15 BGA style package)
- 256MB High Speed SDRAM IC
- Microcontroller with Ethernet Media Access Controller 10/100
- 2MB Serial Flash Memory IC
- IRIG Isolation IC & Isolation Transformer
- IRIG-B Demodulating Circuit
- BNC Connectors for IRIG-B Input, 1PPS Output & 1PPS Input
- RJ45 Connector (Ethernet Connection)
- Mini Din Connector (Used by the factory for initial IP address and board setup)

Jumper Settings

- JP1 – Jumper On =Normal Operating State

  Jumper Off =Factory Debug Position

- JP2 – Jumper Pins 1 to 2 =Modulated IRIG-B Input

  Jumper Pins 2 to 3 =Un-Modulated IRIG-B Input

- JP3

  JP3 has a new pin layout on DSP board 6.4 and higher. JP3 changed from a 3 PIN to a 6 PIN jumper. The following describes JP3 settings for V6.3 and below, then V6.4 and higher.

JP3 Pin layout DSP V6.4	3	2	1
	6	5	4

  - JP3 – **DSP V6.3 and lower (3 PIN)**
    - JP3 – Jumper Pins 1 to 2 = External 1PPS

      Jumper Pins 2 to 3 = Internal 1PPS

      PTP not available with DSP 6.3 or below
  - JP3 – **DSP V6.4 and higher (6 PIN)**
    - JP3 – Jumper Pins 5 to 6 = External 1PPS

      Jumper Pins 4 to 5 = Internal 1PPS

      Jumper Pins 2 to 5 = PTP

Note: Internal 1PPS indicates that an IRIG-B signal has been connected to the DSP circuit board (the 1PPS signal is part of the IRIG-B signal).

External 1PPS indicates the DSP circuit board is receiving a 1PPS signal from another DSP circuit board or possibly from a clock 1PPS output.

- J1 is used to connect an emulator. Under normal operating conditions. J1 must have four jumpers in the following positions:

5 to 6

7 to 8

9 to 10

11 to 12

Pin layout	13	11	9	7	5	3	1
	14	12	10	8	6	4	2

- J2 is used by the factory to download a program to the microprocessor/Ethernet IC. During normal operation J2 has no jumpers.
- If the 1PPS signal is daisy chained from chassis to chassis via the input and output BNCs the latency is 100ns per jump. Latency can be nearly eliminated by using a BNC "T" connector and paralleling the 1PPS signal from input to input.

4.6.7 Analog Circuit Board

An analog board contains 3 channels. The maximum number of analog channels in a Data chassis is 30 (10 boards x 3 channels per board).

A channel can be setup as a voltage channel or current channel. To make this selection, software settings must be made and two hardware jumpers per channel must be set. Software settings are made in the Point Assignment Record and are discussed in a later section. The hardware setting is made via two jumpers on each channel (JP1 & JP2 on the 1st board channel, JP3 & JP4 on the 2nd board channel, and JP5 & JP6 on the 3rd board channel). These are 3 pin headers.

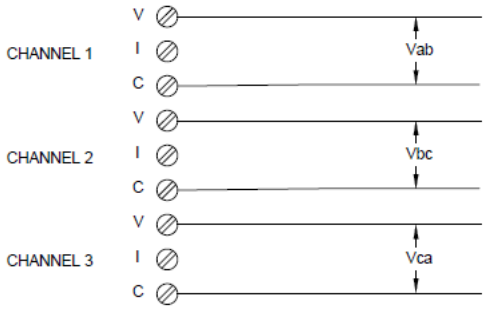
To set up a channel for voltage input, place the shorting jumper on the middle pin and the pin towards the middle of the circuit board.

To set up a channel for current input, place the shorting jumper on the middle pin and the pin towards the 9 position black analog terminal block and blue rear panel.

CAUTION **Ensure that the voltage/current jumper is set properly before wiring to the circuit board terminal block.**

For a voltage channel, the input should be wired between V & C (voltage and common).

The following diagrams show wiring for 3-phase Voltage channels using WYE and Delta connections.



DELTA CONNECTION (VOLTAGE)

Figure 18: 3-Phase Delta Connection (Voltage)

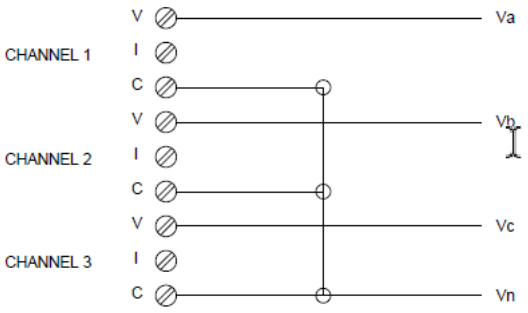


Figure 19: 3-Phase WYE Connection (Voltage)

For a current channel, the input should be wired between I & C (current and common).

The following diagrams show wiring for 3-Phase Current connections using Analog Channels.

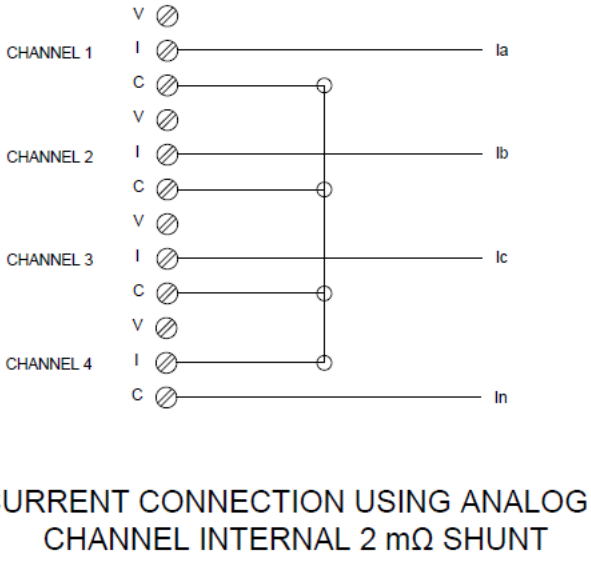
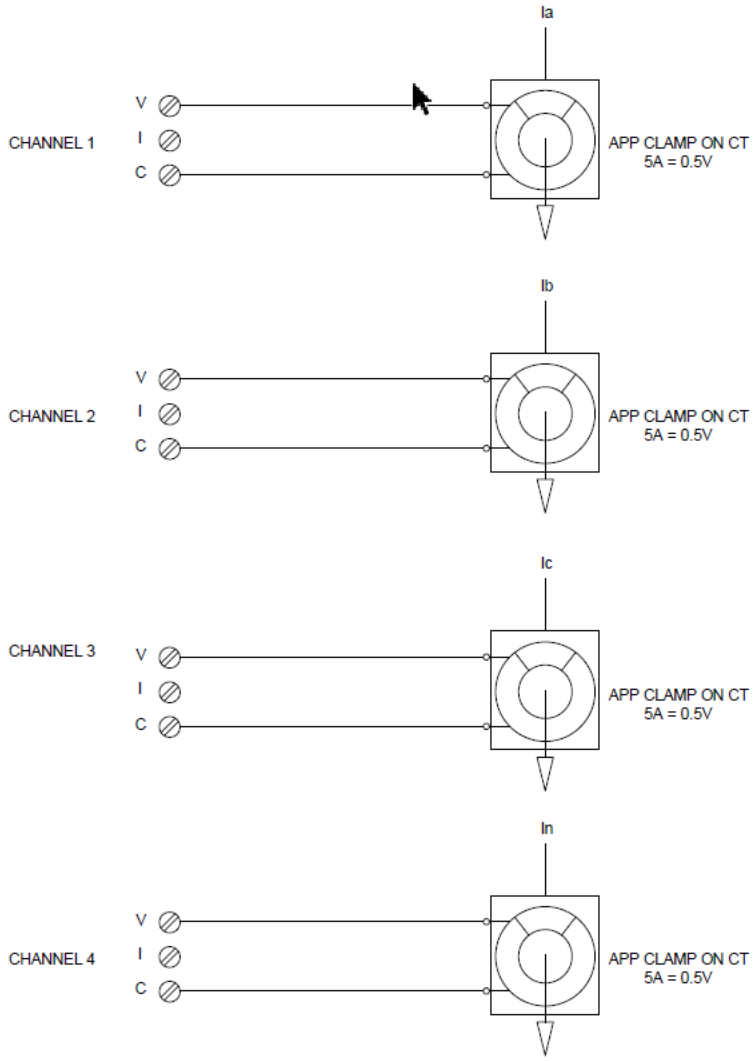


Figure 20: 3-Phase Current connection - Internal Shunt



CURRENT CONNECTION USING APP CLAMP ON CT
5A = 0.5V

Figure 21: 3-Phase current connection - Clamp on CT

WARNING **The maximum input voltage for a voltage channel is 440VAC.**

The maximum continuous current for a current channel is 15Amps.

The maximum current into a current channel for 0.5 seconds is 250Amps RMS or 140 Amps RMS for 2 Seconds

The maximum wire size for an analog terminal block is 12AWG

4.6.8 Traveling Wave Circuit Board

A Traveling Wave board contains one channel.

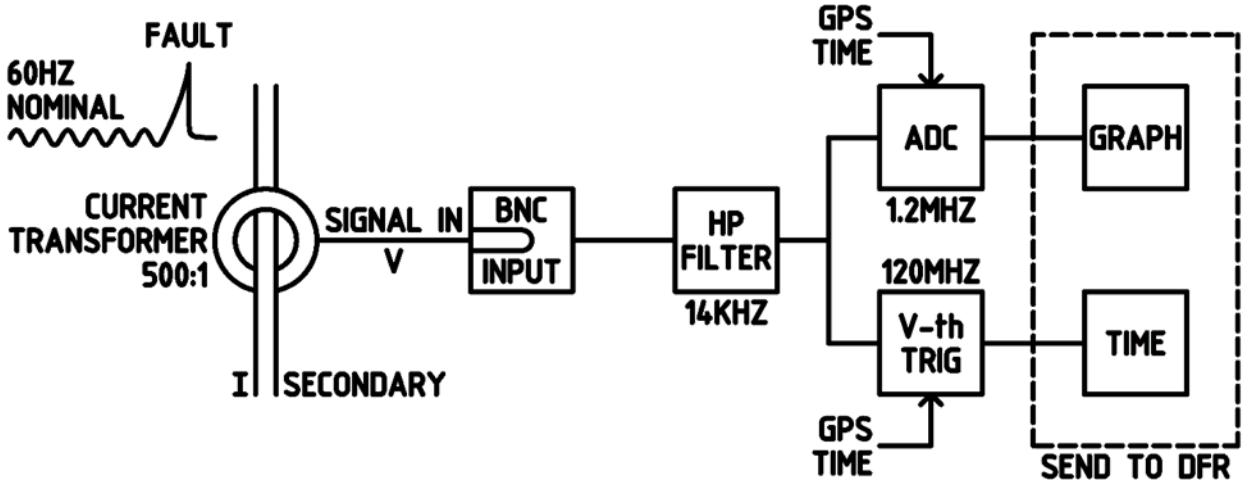


Figure 22: Diagram of Traveling Wave circuit board

The block diagram above represents the hardware of the traveling wave (TW) board and included high bandwidth current transformer (CT) that must be installed on the APP-601 data chassis to record traveling wave data for the TWFL feature to function.

The input signal is a secondary current signal which passes through the CT with a 500:1 ratio. The bandwidth of the CT has been tested to operate in the range of 60Hz to 1MHz. The CT outputs a voltage signal.

The CT connects to the TW board via BNC connector. The input signal will generally be a 60Hz nominal signal. The signal then passes through a high-pass filter (HP FILTER) with a corner frequency of 14kHz which refines the presence of the fault.

The filtered signal is then split between an analog-digital converter (ADC) and voltage-threshold trigger (V-th TRIG). Both are receiving GPS time signals and assign time-marks according to the GPS time.

The ADC has a sampling frequency of 1.2MHz and outputs data points to form a graph in a fault record.

The V-th TRIG has a trigger frequency of 120MHz and records the time-mark of the fault at a nanosecond precision and records it in an INF file of the fault record. This information can be found in the fault summary of the fault record. The over-under voltage of the V-th TRIG is the trigger ratio R_T multiplied by the peak noise I_{NPk}, which can be positive or negative. The peak noise is generally around 1A at the secondary.

$$|V_{th}| = R_T I_{NPk}$$

The absolute peak range of the V-th TRIG is 120A.

4.6.9 Front Panel LED's

The Data Chassis uses front panel LED's to give a quick indication of system status.

Green LED's will illuminate when the recorder is operating properly. Red LED's will illuminate if a recorder problem exists. Yellow LED's will illuminate when the system is recording data. An explanation of each LED is listed in the following table.

Table 5: Description of LEDs

LED	Color	Description
POWER	Green	Illuminates when the system power is switched on and is normal.
ONLINE	Green	Illuminates after the APP Recorder Program/Service is running and normal system operation has started.
1PPS	Green	Illuminates if the 1PPS signal is present from an external satellite controlled clock. If no satellite controlled clock is connected, this LED will illuminate if the internally generated 1PPS signal is present and normal.
OFFLINE	Red	Illuminates if the system is not ready to record.
CLK SYNCLOSS	Red	Illuminates if an IRIG-B signal is not connected to the recorder or the satellite controlled clock has sent a lost Syncsignal. The LED will remain illuminated until synchronization occurs. Error information will appear in the Trace file.
DISK FULL	Red	Illuminates if the hard drive free space has reached a user programmed minimum free space amount. This LED will remain illuminated until the hard drive free space exceeds the minimum limit.
MASTER COMM ERROR	Red	Illuminates if the recorder software is not able to communicate with the system modem or network card. The LED will remain illuminated until the problem has been fixed.
CHASSIS – CHASSIS COMM ERROR	Red	Illuminates if any data acquisition chassis stops communicating with the computer control chassis for a period of 5 minutes or more. The LED will remain illuminated until the problem chassis begins proper communication. Error information will appear in the Trace file.
TRANS RECORD	Yellow	This LED will illuminate after the recorder trips and creates a transient fault record. The LED will remain illuminated for the time set in the PAR, Fault/SER LED Alarm Duration. 10 seconds is the default.
CONT RECORD	Yellow	This LED will illuminate if the system is currently performing any continuous recording function.

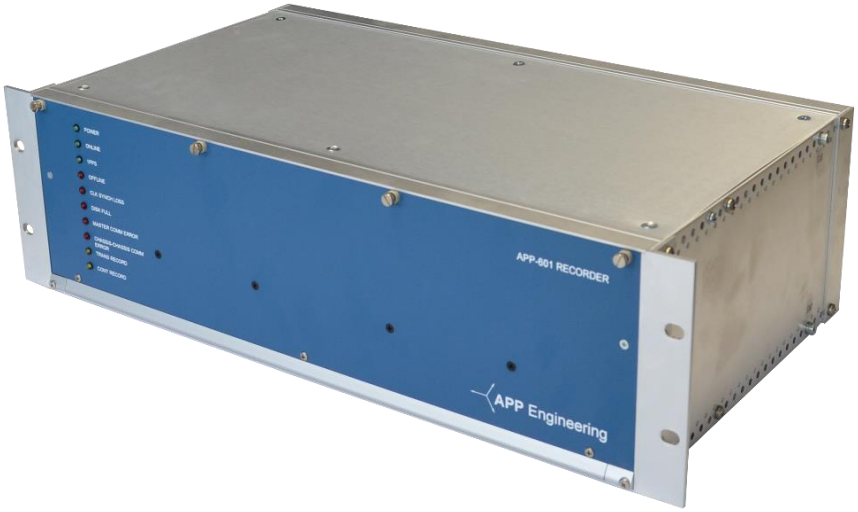


Figure 23: APP-601 Data Chassis 3D View

Figure 24: APP-601 Data Chassis Front View

Figure 25: APP-601 Data Chassis Rear View

(Blank Panels Shown in Slots 5 & 6, Analog or Event Board can be inserted)

4.7 APP-618 Controller

The APP-618 Controller is used to capture IEC-61850 Sampled Values data from Analog Channels from Intelligent Electrical Devices (IED) and Merging Units (MU) via the Process Bus. Event data is captured by IEEC-61850 Goose Capture. Goose data is captured by the APP Recorder Computer running APP Goose Capture software and is discussed in a separate section.

The APP-618 Controller Chassis is constructed in a 3U, 19" rack mount chassis. The chassis depth is approximately 9.8." Housed inside the chassis are an industrial and fanless computer board, RAID controller board, Gigabit Ethernet adapter board, 3 hard drive bays (2.5" or 3.5"), 12V 100W power supply, 5V 100W power supply, and rear slide in power supply circuit board.

The controller chassis can be powered from an 86-373Vdc or 88-264Vac source. Ideally it should be powered from a data chassis via its power supply terminal block (terminals 5 & 6). In this manner, the data chassis can control power to the computer chassis. This gives a remote user, local user, or the system watchdog a means of rebooting the controller chassis.

The 12V power supply and 5V power supply are mounted to the chassis front panel. This allows for maintenance access and heat sinking.

WARNING **Always turn OFF chassis power before opening the chassis front panel. The input sides of the power supplies have 125V or 250V wired to them. This voltage can be deadly! Only trained experienced electrical personnel should open the chassis front panel and only with the power OFF.**

The rear slide-in power supply circuit board contains a 2A fuse, components for surge protection, a power switch, and a 6-position terminal block. Power is connected to terminals 1 & 2 and passes through the board via connector X3 to the 12V power supplies discussed above.

WARNING **Only trained experienced electrical personnel should service this power supply circuit board and only after the unit has been turned off and power has been carefully removed from terminals 1 and 2. Ensure power has been removed from terminals 1 & 2 by measuring the voltage across terminals 1 & 2 (it should read zero volts).**

The computer board is powered from the 12V, 100W power supply. The computer is designed to support applications where high reliability and long-term availability are required. The controller features the Intel Atom E3845 fanless processor, which offers fast performance. This highly integrated processor along with its companion chip provide the majority of the board I/O, including USB support, serial ports, audio, and video.

The controller has two Ethernet ports for connecting to the DSP Network and to connect to the Process Bus to receive Sampled Values stream from IEDs or Merging Units (MUs) as well as a PTP clock source.

The Basic Input/Output System (BIOS) is a program that provides a basic level of communication between the processor and peripherals. In addition, the BIOS also contains codes and various advanced features applied to the serial controller. The BIOS setup program includes menus for configuring settings and enabling computer board features. To enter the BIOS press the "delete" key a few seconds after powering up the computer chassis. Changing the BIOS settings is not recommended and may lead to incorrect controller behavior and possible inability to reboot.

In our standard configuration, the computer chassis is set up with RAID 1 + hot spare. Two 1TB hard drives are in RAID 1 configuration with the 3rd 1TB hard drive acting as a hot spare. ~~The RAID hard drives will contain both the operating system and the Setup and Data folders for the Recorder program.~~

The standard 1TB hard drive has a maximum temperature rating of 65° C. APP offers an extended temperature range of 80GB hard drive with a temperature range to 85° C, allowing the Computer Control chassis to operate in a 70° C environment.

APP-618 Controller chassis specifications are listed in the following table.

Table 6: APP-618 Controller Chassis Specifications

Item	Description
Operating system	Linux Ubuntu
Processor	Atom E3845 Quad Core
RAM	8GB DDR3-1600
BIOS	American Megatrends Inc. BIOS
Chipset	System-on-Chip integrated, Intel HD Graphics, Shared System memory
Power Input	86-125Vac (50Hz/60Hz) or 86-350Vdc Computer auto power AC/DC power
Power Requirements	25W (using 3 X 2.5” Hard Drives)
Internal HDD	3 X 1TB STD Western Digital Red, SSD Optional
RAID	RAID 1 + Hot Spare (2 – 1TB HDDs in RAID 1 configuration with 1TB as hot spare automatic substitute failed HDD
External HDD, CDRW, DVDRW	Option
Ports Notes: 1) Use the ENET marked “DSP ENET” to connect the controller chassis to the Ethernet switch provided with the system. 2) Use the ENET marked “LAN ENET” to connect your Process Bus LAN. 3) Use ENET labeled port to connect to your substation LAN	2x RS232 (Com1 & 2)
	3x Ethernet 10/100/1000 MB
	3x USB2, 1x USB 3
	3x SATA 300
	1 HDMI, 1 VGA
	1x line-out, 1x Mic-in
Display	Option, APP-904 Mon./Keyboard Chassis
Keyboard	Option, APP-904 Mon./Keyboard Chassis
Touchpad	Option, APP-904 Mon./Keyboard Chassis
Temperature	-20°C ~ 70°C (-4°F ~ 158°F)
Relative Humidity	10% ~ 95% relative humidity, non-condensing
LED Indicators	FRONT: 5 LEDs: 12V + 5V Power, Computer + RAID 1 power, RAID Error REAR: 6 LEDs: 1 activity + 1 error indicator for each hard drive

Figure 26 APP-618 Controller Chassis front view

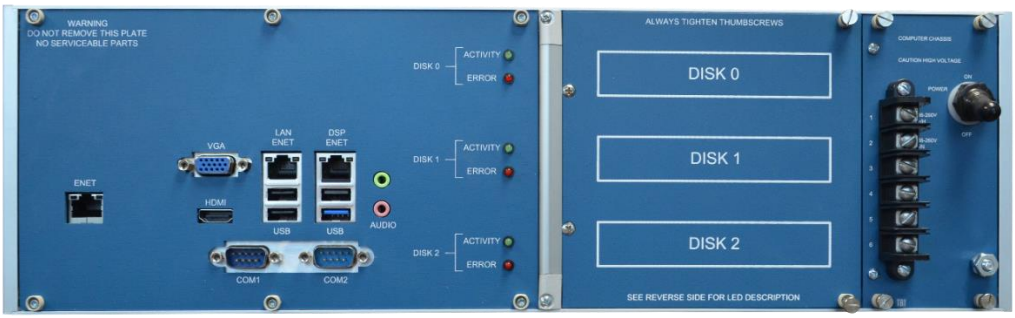


Figure 27 APP-618 Controller rear view

4.8 Ethernet Switch

The Ethernet switch allows the flow of information between the Computer Control chassis, the Data chassis, and 618 Controller chassis. The standard Ethernet switch, included with the recorder, is a five or eight port EISK series or N-Tron unmanaged plug and play switch. The EISK and N-Tron switches are intended for commercial and industrial applications. They have a wide temperature and operating range and comply with electromagnetic compatibility and EFT/Surge standards.

The auto-negotiate protocol allows it to link with any compatible 10BASE-T or 100BASE-TX device. It will allow function with any application layer that works with Ethernet, including Modbus/TCP or Ethernet/IP. The switch has built-in broadcast storm control to prevent excess broadcasts from degrading network performance.

To aid in troubleshooting, each port LED is lit solid if a valid link exists to an attached device, flashes to show activity, and indicates data rate by color: green for 100Mbps and yellow for 10Mbps. A separate green LED indicates the device is powered.

In most cases, power for the switch comes from a Data chassis or Computer Control chassis. Both Chassis output 12VDC via the power supply circuit board terminal block. The 12VDC output is located on terminals 3 & 4.

The following table lists the switch specifications.

Table 7: Switch Specifications

Specification	Details
Input voltage	10-36VDC or 8-24VAC
Power	5 Watts
AC Input Frequency	47-63Hz
Operating Temperature	0 to 60º C
Relative Humidity	0 to 95% non-condensing
Data Rate	10/100 Mbps
Protection	IP30
Signaling	10Base-T/100Base-TX
Port Connectors	Shielded RJ-45

Table 8: Pin Out

RJ-45	Usage
1	TD+
2	TD-
3	RD+
4	Not Used
5	Not Used
6	RD-
7	Not Used
8	Not Used

(Ports normally assume the internal crossover function but will automatically adapt to connected devices. Straight instead of crossover cable is preferred. When daisy chaining switches, straight cable is a must.)

CAUTION **The Ethernet Switch is used for the DSP network only. The users company LAN/WAN connects to a RJ45 connector labeled "LAN Enet" on the computer chassis rear panel.**

CAUTION **From time-to-time the user specifies an Ethernet Switch other than our standard Contemporary Controls EISK series or N-Tron. In this case, it is likely that the switch powers from substation 125VDC, not the 12V output from the recorder. Also, the DSP circuit board may need to be reprogrammed from Auto Negotiate to 100Mbit and Full Duplex**

4.9 Networking

The Computer Control Chassis uses two or three separate network setups. One is for recorder functionality (chassis- to-chassis communication & data transfer) and the second or third is for communication between the recorder (APP Recorder Software) and the master station (APP ClearView Software). The third connection is used in the case where the ENET LAN (2nd) port is connected to the Process Bus Network for IEC-6185 Goose Capture. If not, the third or ENET is typically used when connecting a laptop for remote access.

The first network connection will be called **"Local Area Connection (To DSP)"** or similar. If a complete system was purchased, the TCP/IP settings will have already been set up at the factory.

The following table lists the standard Ethernet and IP addresses for the DSP network.

Table 9: Ethernet and IP Addresses for the DSP Network

Chassis	Address	Value
Computer Control Chassis (Typical)	IP Address	192.168.203.220
	Subnet Mask	255.255.255.0
1st Data Chassis (Typical)	Ethernet Address	2-35-69-86-203-1
	IP Address	192.168.203.1
	Subnet Mask	255.255.255.0
	Default Gateway	Leave Blank
2nd Data Chassis (Typical)	Ethernet Address	2-35-69-86-203-2
	IP Address	192.168.203.2
	Subnet Mask	255.255.255.0
	Default Gateway	Leave Blank
3rd 618 Controller (Typical)	Ethernet Address	N/A
	IP Address	192.168.203.3
	Subnet Mask	255.255.255.0
	Default Gateway	Leave Blank

Note: The pattern continues for additional Data or 618 chassis.

Note: The IP addresses and Ethernet addresses can be different depending on customer requirements

The second connection using LAN ENET port will be called **"Local Area Connection (To LAN**)" or similar. Under TCP/IP properties the user can enter their static IP Address, Subnet Mask, and Default Gateway to enable the recorder to communicate with the master station program over the corporate LAN/WAN. If the LAN ENET is being used for connection to the Process Bus, the ENET port can be addressed and used for the LAN connection for communicating with the Master.

APP-618 Controller Network Addressing

Connect the DSP ENET port of the 618 chassis to the DSP network of the rack or cabinet. Connect the LAN ENET port to the SV/PTP source (note that both signals must be on the same line). This will likely be a switch specifically configured for this purpose.

Connect a monitor and keyboard to the 618 chassis. Right click on the desktop and select 'Open Desktop in Files'. Select 'Home' in the sidebar, then enter the 'APP-GPU' folder and open up the file named 'default.cfg'. In the file, change the RECORDER_IP field to match the IP address of the 601 computer and change the UDP_PORT field to the port number the chassis should use. Save and close the file.

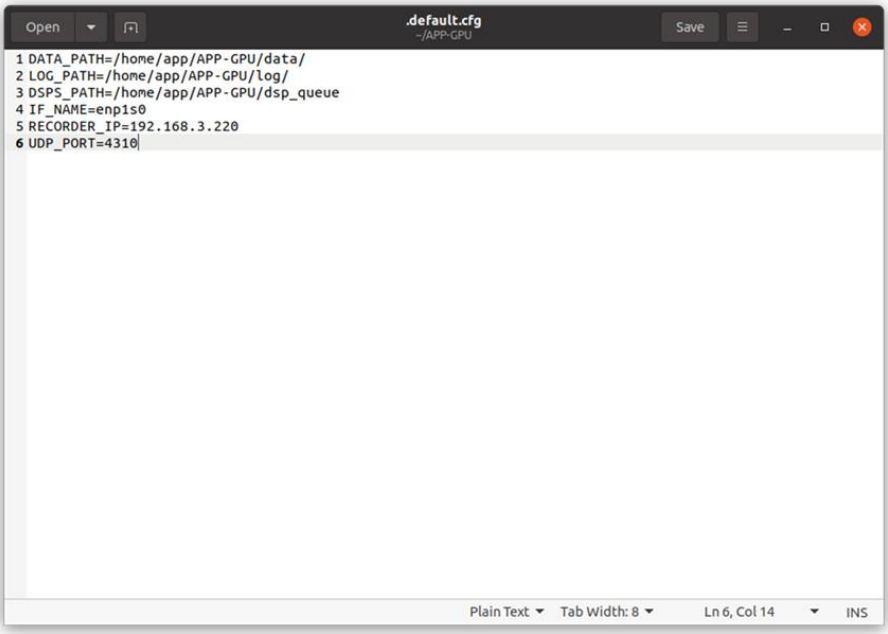


Figure 28 APP-618 Edit default.cfg

To set the Chassis IP for the **DSP Port**, right click on the desktop again and select ‘Settings’. Select ‘Network’ in the sidebar, then click the **gear icon** for the adapter named **‘enp1s0’**.

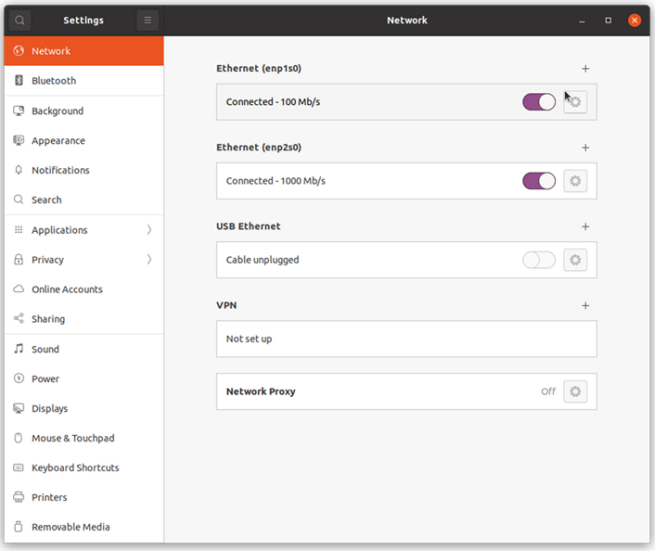


Figure 29 APP-618 Network Settings

Go to the ‘IPv4’ tab Click Manual for IPv4 Method and change the IP address to the address the chassis is to use. Click apply,

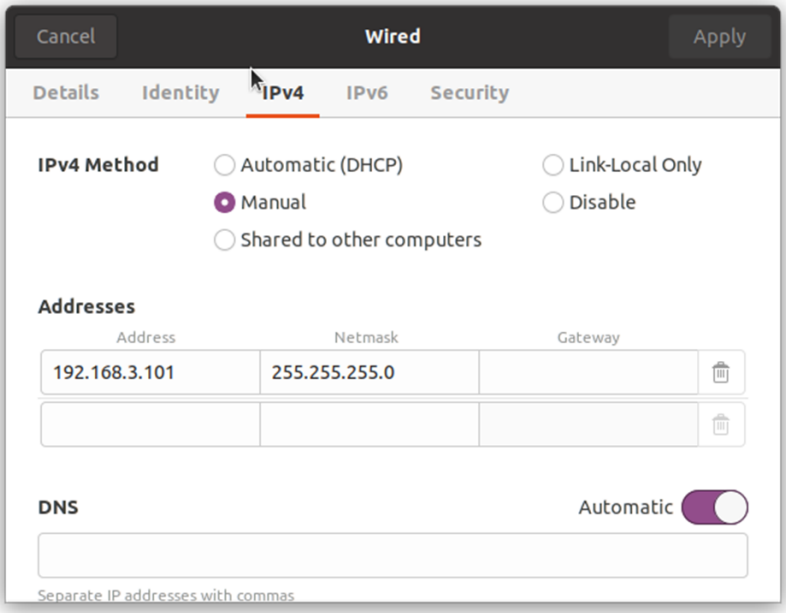


Figure 30 APP-618 Edit IPv4 TAB config

Repeat the Settings and IPv4 TAB steps for **Enp2s0** which will be the **LAN ENET Port** connecting to the Process Bus.

Close all windows, then reboot the chassis.

Note: If PTP is being sent over UDP, the IP of enp2s0 must be on the same subnet as the PTP source.

Repeat this process for each APP-618 chassis in the system.

5. Installing the Recorder Software

5.1 Introduction

APP Recorder program must be running for the recorder to be functional. When APP Recorder starts properly, and correct recorder settings have been entered the system will go online.

In most cases, APP Engineering, Inc. will have obtained information from the customer that allowed the factory to make the necessary hardware and software settings to your APP-601 Recorder prior to shipment. However, in some cases, the information is not available before the system ships, or only partial information was available, and it will be necessary for the user to enter information or enter certain settings.

This chapter will cover program installation and quick start settings and then a detailed description of all the menu choices. If your system was ordered with Linux see the Linux Manual for instructions.

5.2 Program Installation and Quick Start Settings

Note: Installation of the APP Recorder Program should not be necessary. It will be installed and setup at the factory. The following installation steps are provided in the event a future software load is required.

To Install the Program

1. Insert the Thumb Drive in a USB Port.
2. Browse to the APP Recorder.exe file and double click it to start the installation process.
3. After agreeing to the terms and conditions of the software license allow the wizard to install the program in C:**APP Recorder.**
4. Create a folder in the APP Recorder Folder called “Data”, **C**:\APP Recorder\Data.
5. Create a folder in the APP Recorder folder called “Setup”, **C**:\APP Recorder\Setup.
6. Start the APP Recorder Program by double clicking on the “APPRecorder.exe” file.
7. After the program starts, click **Edit** and then **Configuration**. The window shown in Figure 31 will be displayed.

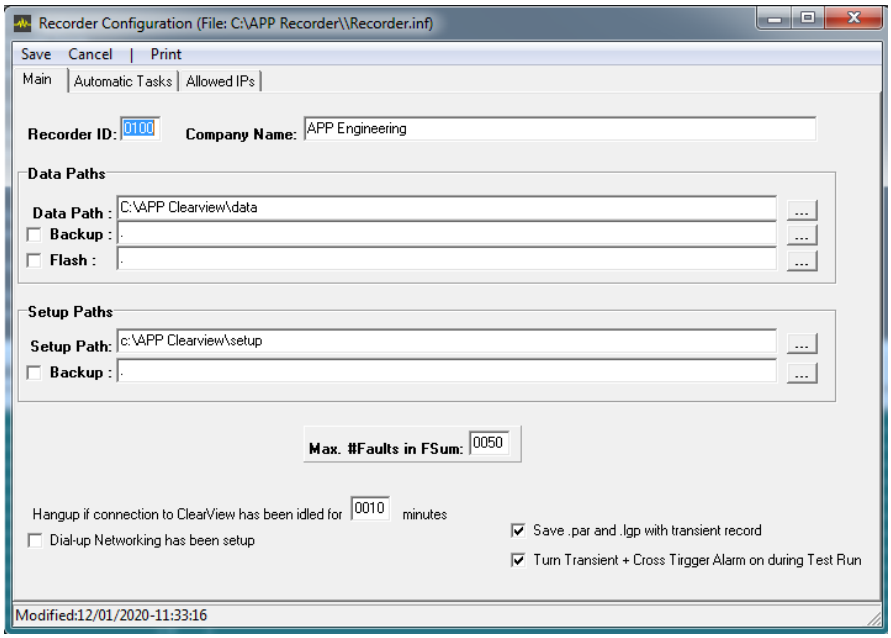


Figure 31: Recorder Configuration Window

8. Enter the system “Recorder ID” and the “Company Name.” Each recorder has a unique Recorder ID. This allows the master station program (APP ClearView) to identify which recorder it is communicating with.

CAUTION **Do not duplicate Recorder IDs.**

9. Enter the “Data Path” by clicking the browse button and browsing to the Data Folder created in step 4. **C:\APP Recorder\Data.**
10. Enter the “Setup Path” in the same manner C:**APP Recorder\Setup**
11. If you want the Data (data means transient records, extended records, and SER information) written to a backup folder then place a check mark next to “Backup” and enter the path.
12. Towards the bottom of the window, you can enter the number of fault record IDs to appear in the “FSum” file (fault summary file). The fault summary file is retrieved by the master station program, APP ClearView, and displayed in its Fault Summary Table. Settings under the “Automatic Tasks” or “Allowed IPs” tab are not required for recorder startup and will be discussed in a later section.
13. Click **Save** in the upper left-hand corner of the window. The basic configuration is set.
14. In the **APP Recorder** window, from the **Edit** menu, point to **Point Assignment Record (PAR)**, and then click **Edit Record**. If the Edit Point Assignment Record screen does not appear (Figure 32), and a message that the record does not exist appears, a PAR will need to be established. If the Point Assignment Record was not created by the factory, it may have been created by someone in your company. If this is the case, the point assignment file can be copied into the “Setup” folder (C:**APP Recorder\Setup**). PA Records are established in APP Clearview, if none exists in APP Recorder, please see APP Clearview Manual - Managing Point Assignment (PA) Records for instructions to create PAR.
15. Next, the Point Assignment Record must be verified/updated. As mentioned above, the factory usually obtains point assignment information from the customer and creates a Point Assignment Record/file in advance.

16. At the bottom of the **Point Assignment** window, click the **Chassis Config**. tab. At the top of the page, enter the name of the station or location of the recorder. Next to "#chassis", enter the total of Data chassis. Include aggregate number of 601 Data Chassis and 618 Controllers.

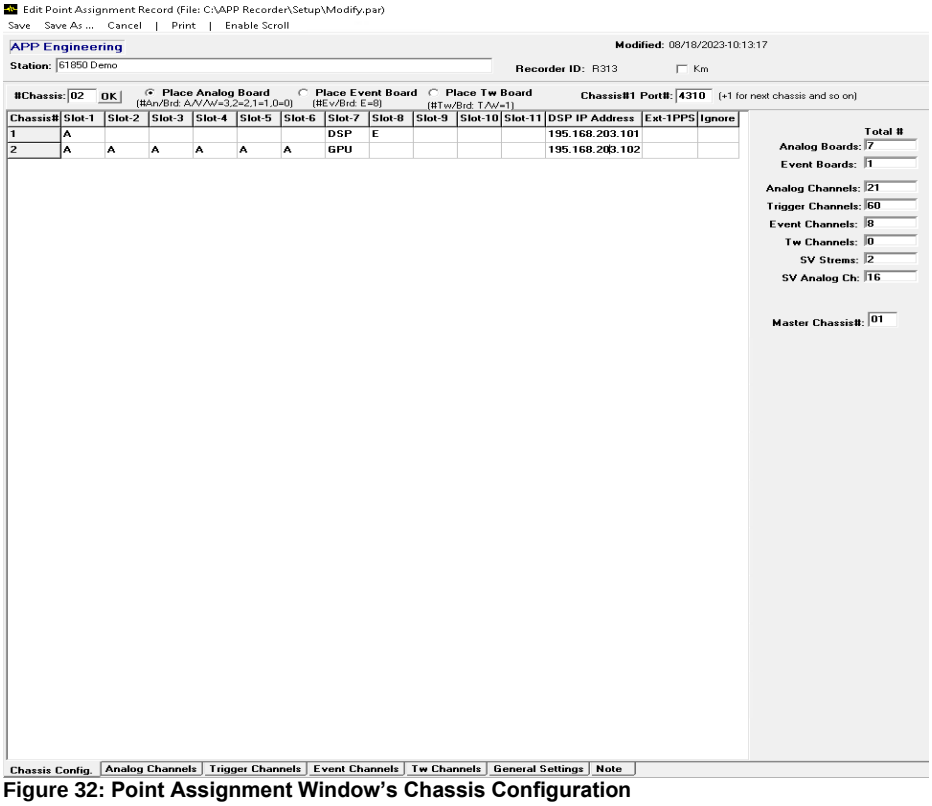


Figure 32: Point Assignment Window's Chassis Configuration

17. For each chassis, enter the type of circuit board inserted into slots 1, 2, 3, 4, 5, 6, 8, 9, 10, and 11. For example, if slot-1 contains an analog board then click **Place Analog Board** then click in the Chassis 1/Slot-1 box. An **A** will appear in the box. An **A** can also be placed in the box by simply selecting the box and typing the letter **A.**

    If slot-1 contains an event board, then click on **Place Event Board** then click in the Chassis 1/Slot-1 box. An **E** will appear in the box. An **E** can also be placed in the box by simply selecting the box and typing the letter **E**.

    Note: Slot-7 is always reserved for the DSP circuit board or GPU for a 618 Controller when capturing Sampled Values. Slot-12 is always reserved for the alarm output circuit board and slot-13 is always reserved for the chassis power supply board.

18. Each DSP circuit board and 618 Controller (GPU), one per chassis, is assigned an IP address. The IP address must be entered in the "IP Address" column for each chassis/DSP board. The default IP address is 192.168.203.X where X is the chassis number such as 1, 2, 3 etc.

19. If you have 618 Controller chassis for Sampled Values, you will need to follow the PAR setup process Configuring IEEE-61850 Sampled Values described in the **Clearview Instruction Manual Section 6**

20. Towards the upper right-hand portion of the page is a "Chassis #1 Port#." A port number is automatically selected for each chassis. This number can be changed if any conflict arises.

21. After the chassis and slot information are entered, the number of Analog Boards, Event Boards, Analog Channels, Event Channels, TW channels, SV Streams and SV channels will appear at the far right-hand side of the page.

Click on the tab at the bottom of the page labeled General Settings. The window shown below should appear.

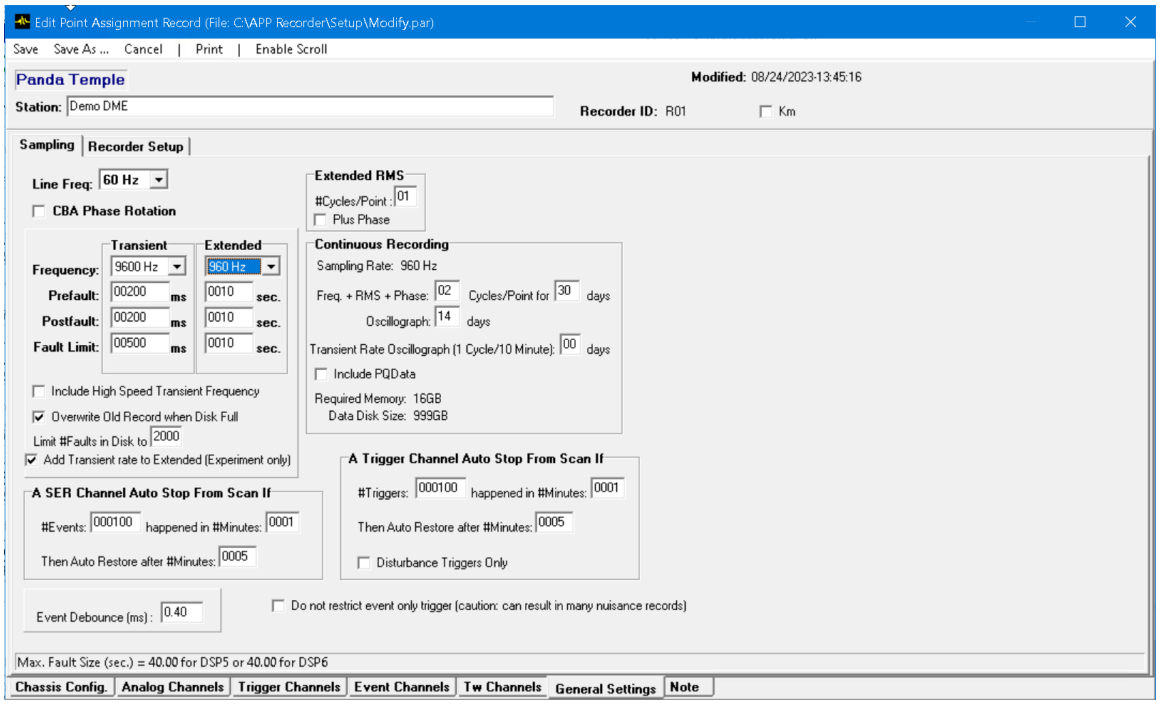


Figure 33: Point Assignment Window: General Settings Tab

22. Default values of 60Hz and a sampling rate of 4800Hz should be shown.

Note: If you are using APP-618 controllers for Sampled Values, the Transient sampling rate must be 4800 at this time.

23. With these default settings the system is ready to create transient records only.

24. From the menu bar, click **Save**.
    You should see the "APP Recorder Driver" pop-up momentarily and then the system should go On-Line. When the system goes online you should hear the On-Line output relay click. If the system is not synchronized with a satellite controlled clock you will hear the "CLK SYNC LOSS" relay click after approximately 1½ minutes.

    The system is now operational and the complete Point Assignment Record can be downloaded from the master station or completed at your convenience.

5.3 Startup and Running the APP Monitor

APP Recorder can be setup to automatically start when the computer restarts and using APP Monitor to automatically start if APP Recorder is shutdown. When Monitor is running, APP Recorder will restart within 60 seconds of being closed. This is important to ensure no manual intervention is required to maintain APP Recorder operation.

➢ Configuring APP Recorder and APP Monitor

In the **APP Recorder** window, from the **Tools** menu, click **Windows Logon & Startup** the following window appears.

Figure 34: Windows Logon & Setup Window

1. In the **User** box, type the username for the Windows logon of the APP Recorder.
2. In the **Password** box and the **Confirm Password** box, type the password for the Windows logon of the APP Recorder. If no Windows password is set, leave this password blank.

   Note: The username and password must match the Windows account settings.

3. Do you want the APP Recorder to automatically logon to windows when the computer starts?

   If **yes**, then select the **Auto Logon** check box.

   If **no**, then skip to the next step.

4. Do you want the **APP Monitor** to automatically start when you run the APP Recorder?

   If **yes**, then select the APP Monitor check box.

   If **no**, then skip to the next step.

   Note: If APP Monitor is **shut down** using Task Manager for example, when APP Recorder is started, APP Monitor will **NOT automatically start**. The best way to ensure APP monitor is re-initiated properly is to restart the computer (Windows Restart). This will cause APP Monitor to start if the APP Monitor option was selected.

5. Do you want the **SpeedFan** to automatically start when you run the APP Recorder as an application?

   Note: Speedfan is required for the PC Health Alarm to function due to CPU Temperature and is required for monitoring.

   If **yes**, then select the **Speedfan** check box.

   If **no**, then skip to the next step.

6. Do you want the **HDSentinel** to automatically start when you run the APP Recorder as an application?

   Note: HDSentinal is required for the PC Health Alarm to function due to Hard Drive Temperature and is required for monitoring Drives with a RAID drive configuration.

   If **yes**, then select the **HDSentinel** check box.

   If **no**, then skip to the next step.

7. Click **OK**.

8. Shutdown and restart Windows

9. Ensure APP Recorder automatically starts when Windows comes back up

5.4 IEC 61850 Goose Capture

APP Engineering has enabled APP Recorder to capture messages from Intelligent Electrical Devices (IED) in a substation via the Process Bus using Generic Object Oriented Substation Event (GOOSE) Protocol as defined in IEC 61850. This enables APP Recorder to aggregate status data from devices not connected to an APP Recorder with data from devices connected to an APP Recorder.

Note: APP GOOSE Capture is provided on a case-by-case basis by request only. A company requesting this capability will be provided the downloadable software by APP Engineering and is not available on the APP Engineering website.

APP 601 Recorder captures relevant messages from configured IEDs and writes them to the Sequence of Event Report (SER) file.

There are two programs required to configure and run GOOSE Capture. The first is WinPCap 4.3.1 which is the driver enabling GooseCap to retrieve messages from the Process Bus. GooseCap is the application that allows the user to define IEDs in the substation to capture status messages that are passed on the Process Bus and save them to the Sequence of Events Report (SER) file. As of APP Recorder version 3.2.0 GOOSE Capture software is incorporated into Recorder and is not installed separately. When enabled, you will see GOOSE Capture running separately.

Status messages are sent from IEDs regularly regardless of the State of a device. Goose Capture captures messages that indicate a change of state from IEDs that match IEDs configured in GooseCap and stored in the GOOSE Point Assignment Record or R*xx*.gpar file.

Note: The messages received in the SER are low resolution and will not arrive at the same rate as Event Channel records.

The following instructions will guide you through installation and setup of the software needed to run GOOSE Capture as part of APP Recorder. This section provides basic information to complete setup and assumes the APP Recorder has been delivered with all the APP Recorder software loaded and file structure established.

Note: This manual assumes the user is familiar with GOOSE capture architecture and capabilities and knows the identifiers required from connected IEDs from which messages will be collected.

What will typically need to be done at this point is to download WinPcap_4_3_1 application software to the APP Recorder directory on the APP Recorder Computer.

5.5 Downloading WinPCap applications

A company will receive WinPCap application files directly from APP Engineering. You can then download these files to the APP Recorder computer in the APP Recorder master directory.

C:\APP Recorder

5.6 Install WinPcap

You will need to install WinPcap and allow automatic start at Boot for GooseCap to receive packets from the Process Bus.

WinPCap 4.1.3 provided by Riverbed Technology is the API that allows Windows applications to capture and transmit packets on a network.

1. To install WinPcap double click on WinPcap_4_1_3 executable file.
2. When asked, click OK to allow WinPcap to make changes to the computer
3. Click Agree when asked if you agree to the License Terms
4. Be sure the Automatically start the WinPcap driver at boot time check box is clicked

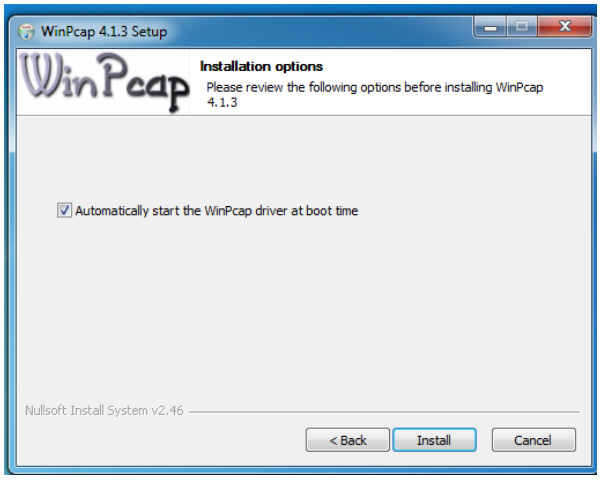


Figure 35 WinPCap Setup - Restart at Boot

5. Then click Install
6. Reboot the computer

5.7 Activating GOOSE Capture in APP Recorder

To run GOOSE Capture you check the GOOSE Capture checkbox in the APP Recorder Point Assignment record General Settings TAB/Recorder Setup TAB.

In APP Recorder main screen

1. Click Edit, hover over Point Assignment Record then click Edit
2. Click the General Settings TAB at the bottom of the window
3. The Recorder Setup window should appear

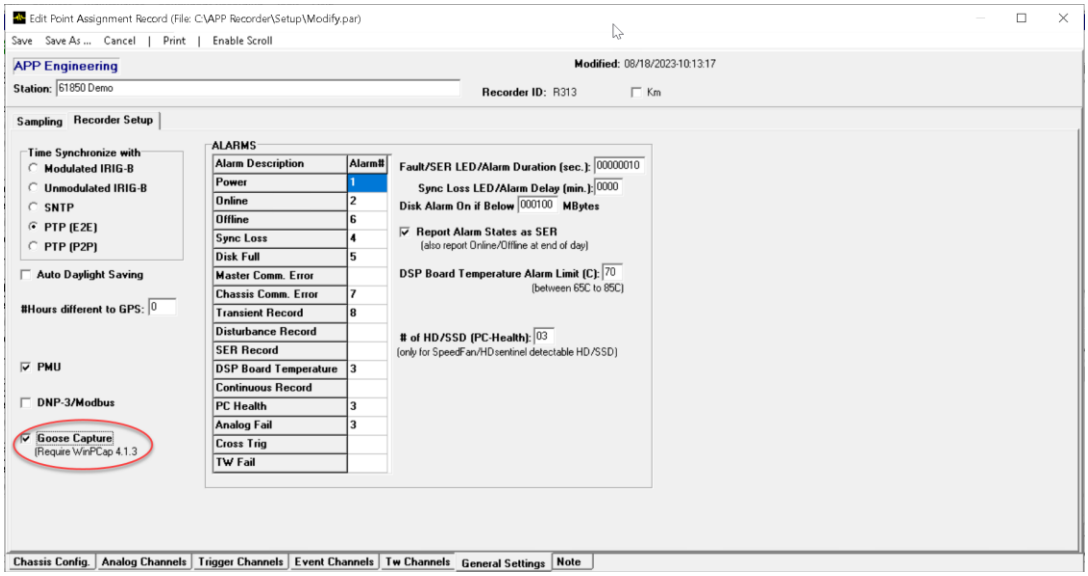


Figure 36 Edit PA Record - GOOSE Capture check box

4. Click Goose Capture check box
5. Click Save
6. The Recorder will reinitialize, and Goose Capture software will begin to run.

See APP Clearview User Manual for more information on Editing the PA Record

Note: Goose Capture will not start capturing messages until it is configured, and capture started. See the following sections for configuration and startup instructions.

5.8 Configuring GooseCap

The user must set up Goose Capture to identify the IEDs from which messages are to be captured and received by the APP Recorder Sequence of Events Report (SER) file. The following steps describe how to add IEDs and define the type of messages to be captured and saved.

From the main screen, Select the APP Recorder Ethernet port being used to connect to the LAN network where the IEDs being monitored are connected by clicking the network device, usually LAN ENET.

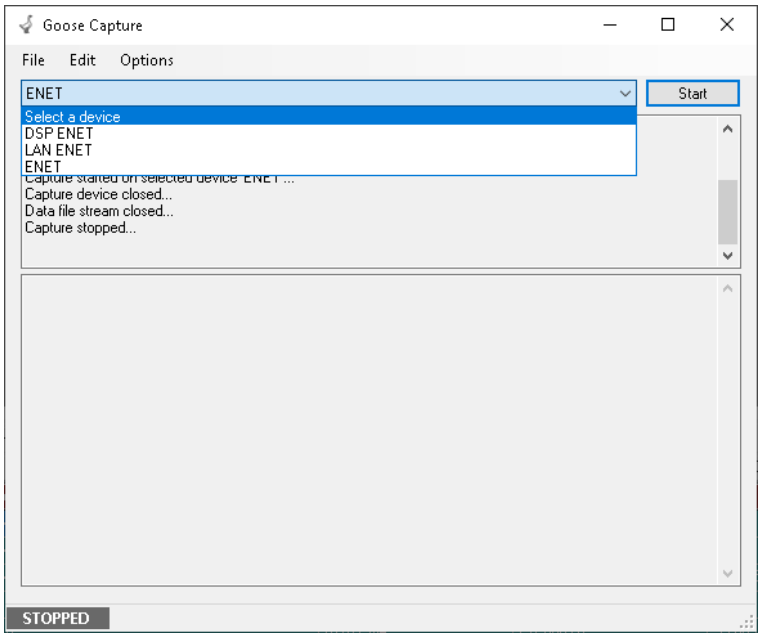


Figure 37 GooseCap setup - Select Network Port

5.8.1 Edit GOOSE Points

GOOSE Points define the components from which you want GOOSE Messages to be captured and saved. This is similar in concept to defining the Point Assignment Record in APP Recorder.

Click the Edit menu and select Edit GOOSE Points.

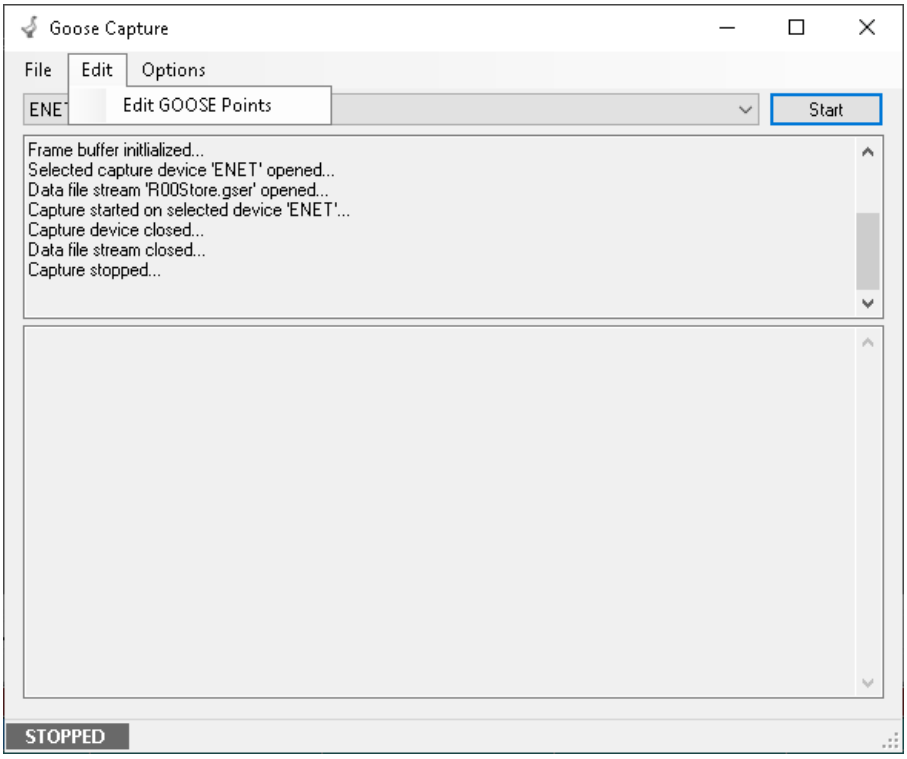


Figure 38 GooseCap Setup - Edit Goose Points

The Device Screen will appear. If no devices have been defined, the screen will be blank.

Begin filling in the form by entering information about the device. The fields must match the identifiers of the connected device from which messages will be captured. The Identifiers are case sensitive.

Enter:

- Control Block Reference
- GOOSE ID
- Data Set Reference
- Number of Data Set Entries

Note: The identifiers are case sensitive and must match the field entries.

Enter a number or use the up and down arrows to set the **Number of Data Set Entries** associated with this device. This will create blank fields below where you describe the GOOSE Entries and Status type to be captured.

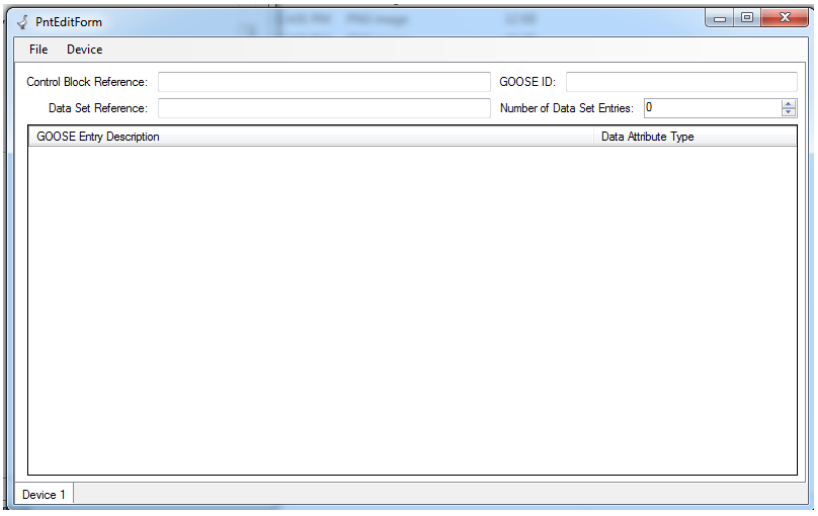


Figure 39 GooseCap setup - Goose Point Form

Then begin entering the GOOSE Entry Descriptions. This field is free form for the user to identify the component.

Triggering the Recorder

You can set up a GOOSE Point to trigger the DFR by including a Tag at the beginning of the description. The Tag would be <TA> for Trigger Abnormal. For Example, a description might be "<TA> Circuit Breaker 1"

Then click on the **Data Attribute Type** field and select from the options:

- Status Value
- Quality
- Timestamp

As of this writing, **Status Value** only is being captured at this time.

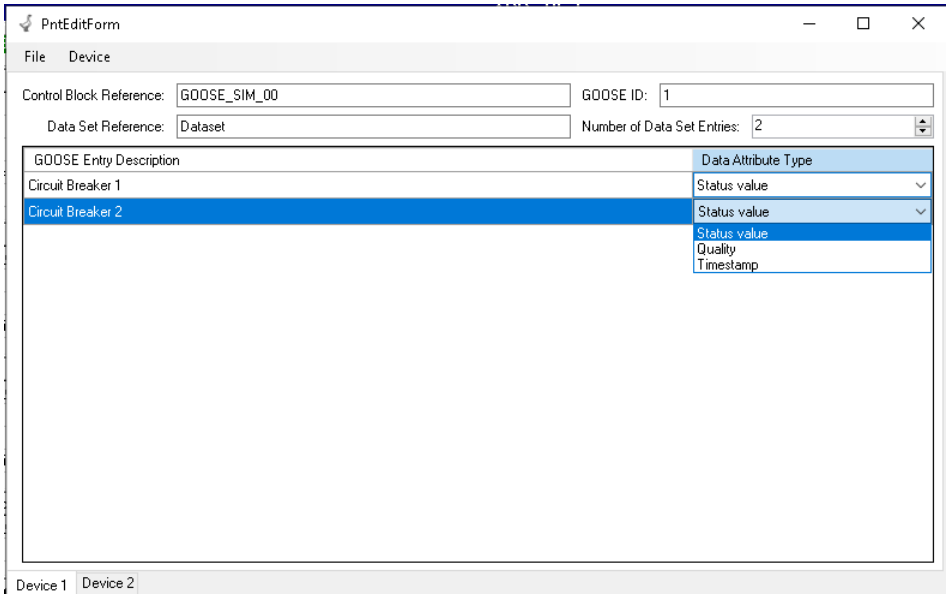


Figure 40 GooseCap Setup - Dataset entries - Description and Attribute Type

Once you have entered all the components associated with the device you can save the GOOSE Point record, or you can add more devices.

5.8.2 Adding Additional Devices

To add devices, click the **Device** menu and select **Add Device**. A blank entry screen will appear, and a new Device TAB will appear at the bottom of the window.

Duplicate Device - to simplify and reduce entries use **Duplicate Device**. Click **Device** and select **Duplicate** Device then modify entry as needed.

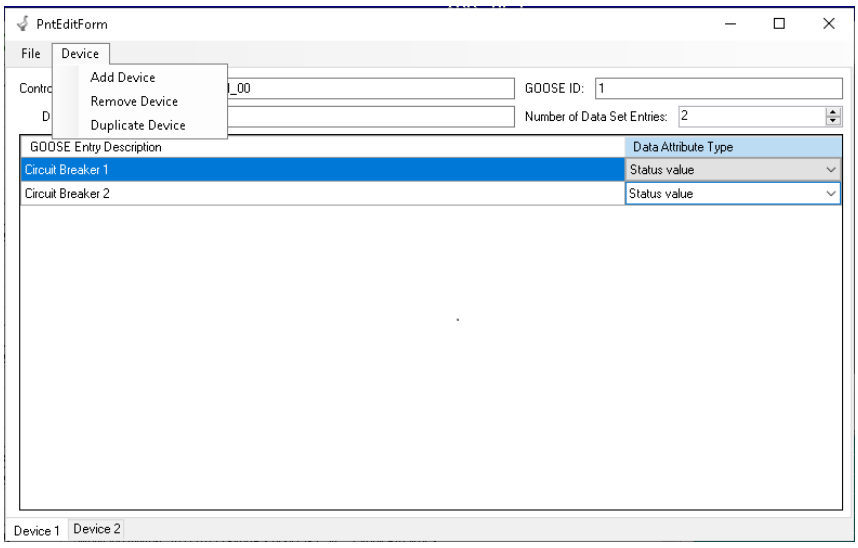


Figure 41 GooseCap Setup - Adding and Duplicating Devices

5.8.3 Remove a Device

To **Remove a Device,** click the **Device Menu** and select **Remove Device**. This will remove the current selected device TAB shown at the bottom of the GOOSE Point window.

Note: If you mistakenly remove a Device, you can retain the old information by Canceling all updates since the last Save. See the next section below.

5.8.4 Saving GOOSE Point Record or Cancel

Once you have defined or updated GOOSE Point devices, you need to save the record. Click **File** and select **Save**.

To retain the record before changes, click **File** and select **Cancel**.

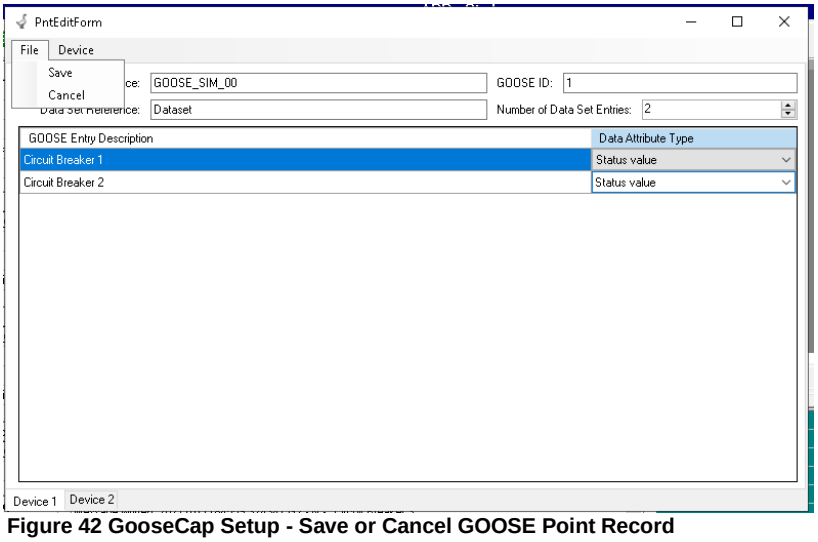


Figure 42 GooseCap Setup - Save or Cancel GOOSE Point Record

When you save the GOOSE Point Record, it is saved in the recorder setup folder using the recorder ID in this format:

C://APP Recorder/setup/R*xx*.gpar where xx is the recorder ID.

A backup file is also automatically saved:

C://APP Recorder/setup/R*xx*.gpar.bak where xx is the recorder ID.

The backup file is updated when the .gpar file is saved and holds the most recent previous version of the .gpar.

Note: You can change the configuration while GooseCap is running. When you save, GooseCap will recognize the change and use the new version without needing to restart.

5.9 Options Menu

Record Initial Frame is a debugging tool which will cause Goose Capture to record the initial status message from the EIDs being monitored at startup of Goose Capture. Under normal circumstances Goose Capture will capture a change in state only. When trouble shooting it may be helpful to include the initial status.

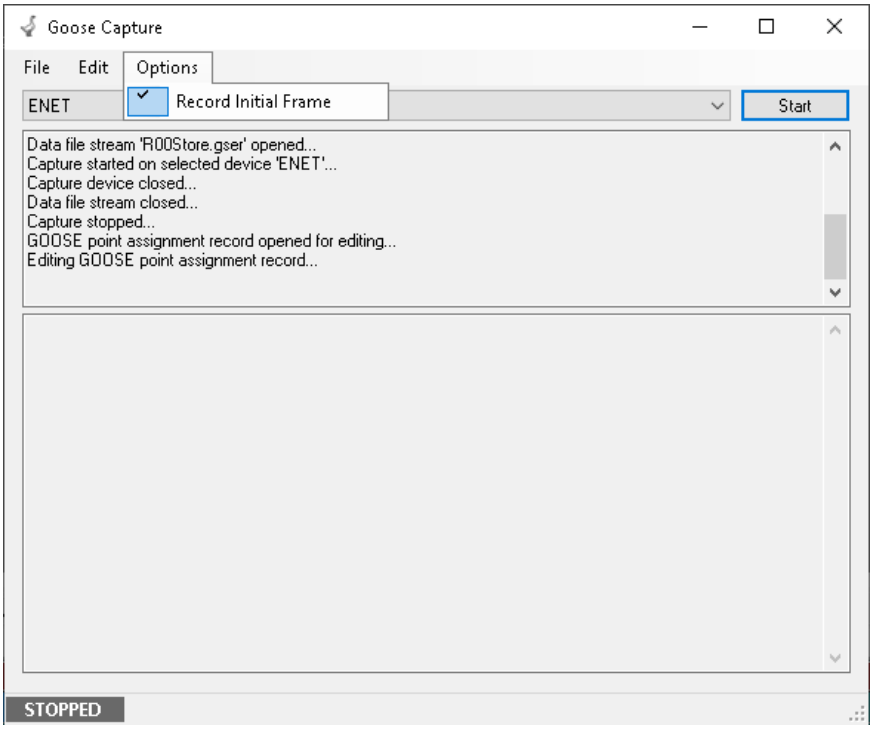


Figure 43 Record Initial Status option

To **Record Initial Frame**, click on the options menu then click **Record Initial Frame**. A check mark will appear next to the item to show it is active.

To stop recording the Initial Frame, click the option menu then click the **Record Initial Frame** to turn off the check mark.

For further assistance please call APP Engineering at (317) 536-5300.

6.Using the APP Recorder

6.1 Introduction

The APP Recorder Program must be running for the APP Recorder hardware to operate. The APP Recorder Program contains information and settings that contribute to the Recorder's versatile, user-friendly, state-of-the-art functionality.

6.2 APP Recorder Program Functions

The APP Recorder Program carries out the following major functions:

Receives transient and extended data from the DSP circuit boards and 618 Controllers and stores the data in path location C:**APP Recorder\Data**. Before storing the transient and extended data in this directory, the program automatically converts the files to the COMTRADE C37.111 – 2013 format. If the extended recording feature is enabled in the Point Assignment Record (**General Settings** tab: **Sampling** tab), the APP Recorder program creates the following three records each time the recorder trips:

- Transient oscillography
- Extended oscillography
- Extended RMS

Note: The APP Recorder program automatically names the transient and extended records as per the IEEE C37.232-2007 COMNAMES requirement.

Receives continuous streaming data from the DSP circuit boards and writes that data in path location of C:**APP Recorder\Data\OsclgrData**. This data is used when the analysis software is requesting a time slice of continuous oscillography information.

From the continuous streaming data, the APP Recorder Program calculates the following quantities and writes that information to the path indicated:

Continuous RMS Data ……..… C:**APP Recorder\Data\RMSData**

Continuous Frequency Data……... C:**APP Recorder\Data\FreqData**

Continuous Phase Data……C:**APP recorder\Data\PhaseData**

Receives Sequence of Event Records from the DSP circuit boards and writes that information in the path location C:**APP Recorder\Data\SerData.**

Displays near real-time analog RMS values, frequency, phase, event status, trigger status, and sequence of event log on its main window.

Displays real time analog channel oscillograms via its OScope feature.

Coordinates communication with the master station program, APP ClearView, via Ethernet or modem.

Outputs DNP-3 analog RMS values and event status via RS-232 or Ethernet.

Outputs PMU information via Ethernet.

6.3 The APP Recorder Program Main Window

When you start the APP Recorder program, the **APP Recorder** window automatically appears.

The following figure illustrates the sections of the **APP Recorder** window.

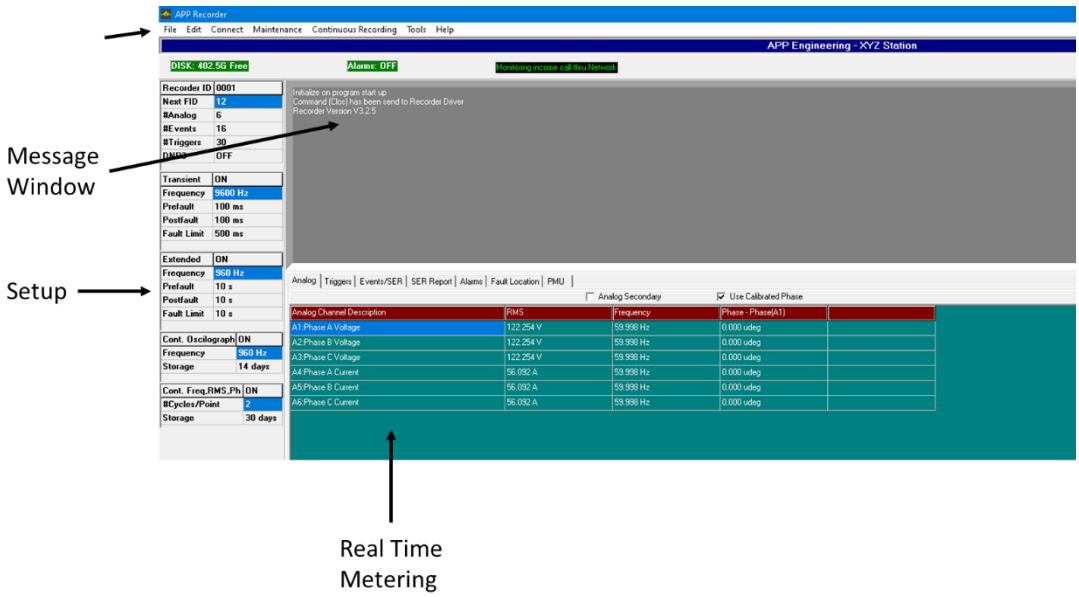


Figure 44: APP Recorder Program Main Window

The Setup area displays the major parameters that are set up or selected from the menu choices.

The **Message** window displays information related to program startup, program re-initialization, information sent to the APP Recorder Driver, and error messages. In addition, it can display messages sent during a chat session with someone at the master station.

The near Real-time Metering section provides a quick look at RMS values for all the analog channels, event status, trigger status, and the sequence of event logs. You can use the tabs in this section to view different types of information.

Analog Tab

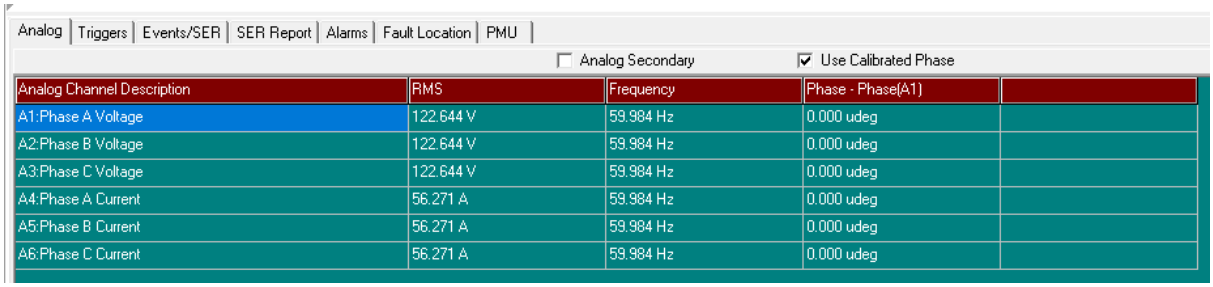


Figure 45: Analog Tab

This tab appears only if there are analog channels configured in the Point Assignment Record and if continuous recording is turned on. If the **Analog Secondary** check box is not selected (this is the default setting), this tab shows primary values. If the **Analog Secondary** check box is selected, then the tab shows secondary values. The data will update continuously for an interval of about 10 to 15 seconds.

Export Analog Tab Meter to a CSV file

You can export the Meter to a CSV file. Right click meter screen and a pop-up will appear.

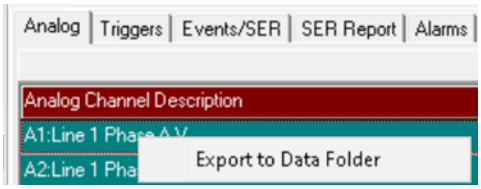


Figure 46 Export Analog Meter screen

Click export and a file will be saved in the /APP Recorder/Data/folder with the filename format of YYYYMMDDHHMMSSSSSSSSS-AnalogMeters.csv.

Triggers Tab

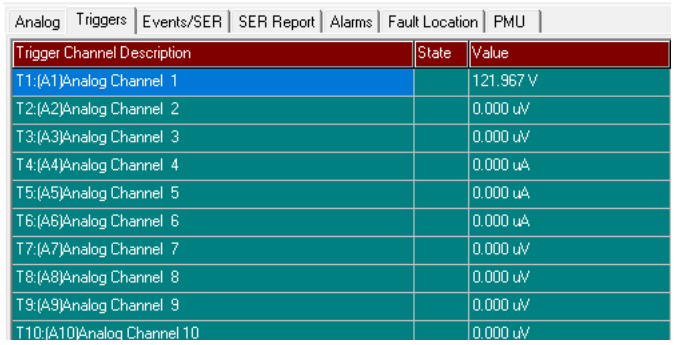


Figure 47: Triggers Tab

The Triggers tab appears if there are Analog channels, however, unlike the **Analog Channel** tab, this tab does not require continuous recording to be turned on. The **Triggers** tab shows the value of the processed trigger value in the DSP(s). It is a useful troubleshooting tool.

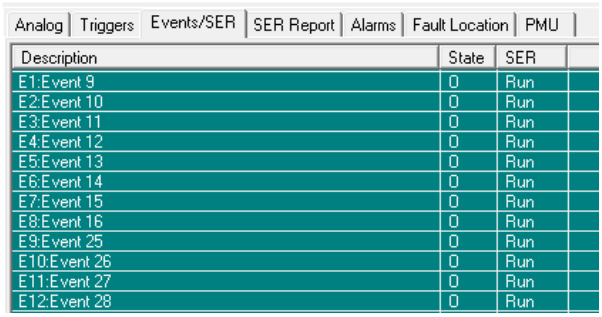
Export Trigger Tab Meter to a CSV file

You can export the Meter to a CSV file. Right click meter screen and a pop-up will appear.

Figure 48 Export Trigger s Tab to a .csv file

Click export and a file will be saved in the /APP Recorder/Data/folder with the filename format of YYYYMMDDHHMMSSSSSSSSS-TriggerMeters.csv.

Events/SER Tab



Description	State	SER
E1:Event 9	0	Run
E2:Event 10	0	Run
E3:Event 11	0	Run
E4:Event 12	0	Run
E5:Event 13	0	Run
E6:Event 14	0	Run
E7:Event 15	0	Run
E8:Event 16	0	Run
E9:Event 25	0	Run
E10:Event 26	0	Run
E11:Event 27	0	Run
E12:Event 28	0	Run

Figure 49: Events/SER Tab

The Events/SER tab shows the configuration of the event/SER. If you highlight any of the row(s) and then right click, a pop-up menu will display the options, **Run SER** and **Stop SER**. You can run or stop a particular event channel SER without re-initializing the APP Recorder.

Export Events/SER Tab Meter to a CSV file

You can export the Meter to a CSV file. Right click meter screen and a pop-up will appear.

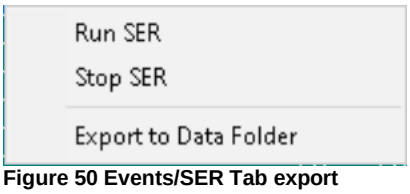
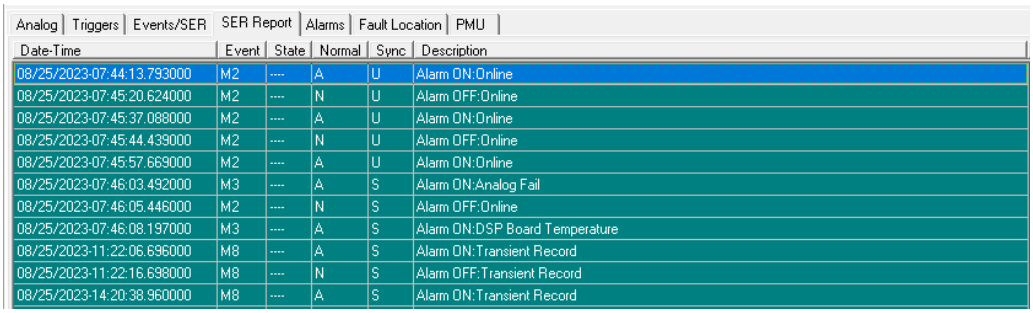


Figure 50 Events/SER Tab export

Click export and a file will be saved in the /APP Recorder/Data/folder with the filename format of YYYYMMDDHHMMSSSSSSSSSS-EvMeters.csv.

SER Report Tab



Date-Time	Event	State	Normal	Sync	Description
08/25/2023-07:44:13.793000	M2	----	A	U	Alarm ON:Online
08/25/2023-07:45:20.624000	M2	----	N	U	Alarm OFF:Online
08/25/2023-07:45:37.088000	M2	----	A	U	Alarm ON:Online
08/25/2023-07:45:44.439000	M2	----	N	U	Alarm OFF:Online
08/25/2023-07:45:57.669000	M2	----	A	U	Alarm ON:Online
08/25/2023-07:46:03.492000	M3	----	A	S	Alarm ON:Analog Fail
08/25/2023-07:46:05.446000	M2	----	N	S	Alarm OFF:Online
08/25/2023-07:46:08.197000	M3	----	A	S	Alarm ON:DSP Board Temperature
08/25/2023-11:22:06.696000	M8	----	A	S	Alarm ON:Transient Record
08/25/2023-11:22:16.698000	M8	----	N	S	Alarm OFF:Transient Record
08/25/2023-14:20:38.960000	M8	----	A	S	Alarm ON:Transient Record

Figure 51: SER Report Tab

The **SER Report** tab displays channels that are in a stopped or abnormal state. These will include channels reporting via GOOSE Capture. The following table explains the letters that appear on this tab.

Table 10: Values on the SER Report Tab

In this column…	This letter…	Means this…
State	O	There is an open contact.
	C	There is a closed contact.
Normal	A	The channel is currently in an abnormal state.
	N	The channel is currently in a normal state.
Sync	U	There is an unsynchronized time.
	S	There is a synchronized time.

If an SER channel is stopped, the word "Stopped" appears at the beginning of the channel description. The letter "M" or "A" also appears with the stop message:

- "M" indicates that the channel has been stopped manually via the Point Assignment Record.
- "A" indicates that the channel stopped automatically.

The Sequence of Event Report includes the following information for **Goose messages**:

Date and time of the event

GOOSE ID = Gx where x is the id

State - is not used

Normal - is defined as (A = Abnormal= Closed, N = Normal= Open)

Sync - is not used

User-defined GOOSE Entry Description as entered in the GOOSE Points Record.

Note: **If an SER channel frequently changes its state, you can configure the Point Assignment Record to automatically address the issue. On the** General Settings **tab in the Point Assignment Record, you can specify the threshold of time for allowable state changes (in other words, the acceptable amount of time between state changes). If the SER channel changes its state more frequently than the acceptable amount, you can configure it to automatically shut down and then to restart itself after the period of time you define.**

Alarms Tab

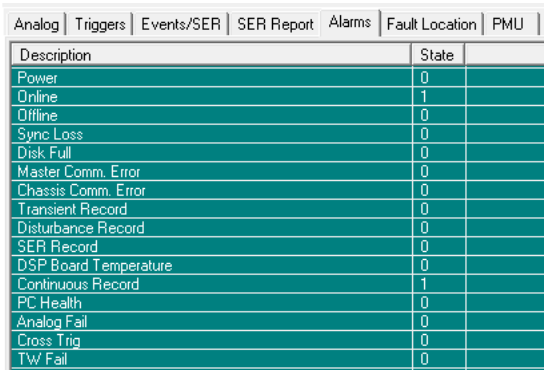


Figure 52: Alarms Report Tab

The **Alarms Report** tab displays the present state of all Alarms regardless of Alarm mapping defined in the Point Assignment Record/General Settings/Recorder Setup Tab. A state of 0 is not asserted (relay coil de-energized) and a state of 1 is asserted (relay coil energized).

The alarm board contains (8) relay outputs. A selection of alarms can be mapped to the relay outputs. More than one alarm can be mapped to a relay.

Each relay uses an on-board jumper that will allow the contact to be either normally open or normally closed. The board is labeled for easy jumper placement.

For more information see Section 4.6.4 Alarm Circuit Board

Export Alarm Tab Meter to a CSV file

You can export the Meter to a CSV file. Right click meter screen and a pop-up will appear.

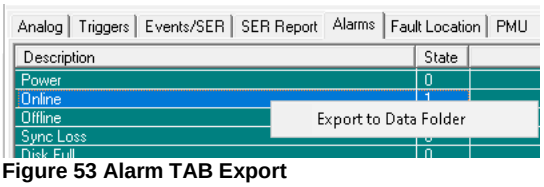


Figure 53 Alarm TAB Export

Click export and a file will be saved in the /APP Recorder/Data/folder with the filename format of YYYYMMDDHHMMSSSSSSSSSS-AlarmMeters.csv.

Fault Location Tab

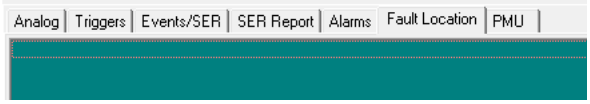


Figure 54: Fault Location Tab

This tab shows the fault location if any fault exists. Most of the time it will be empty since faults don't occur often.

PMU Tab

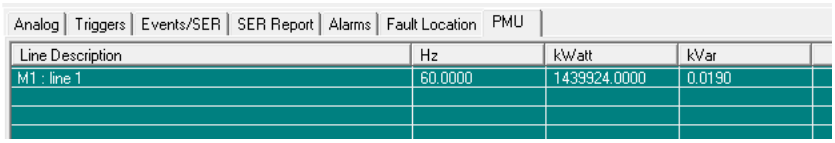


Figure 55 PMU TAB

The PMU Tab shows Frequency, Power and Reactive Power for any lines configured to send PMU data.

6.4 Setting the Administrator Password

You can optionally set an administrator password to restrict access to administrative features. If you set an administrator password, then only the people who know the password will be able to perform the following functions:

Changing passwords

Configuring the APP Recorder software

Modifying the Point Assignment Record

Modifying the Line Group Record

Exiting the APP Recorder software

➢ **To Set an Administrator Password**

1. From the **File** menu, select **Administrator**.
2. From the **File** menu, click **Change Administrator Password**.
   A **Change Administrator Password** box appears.
3. Enter the desired password and click **OK**.
   The Change Administrator Password box reappears.
4. Re-type your new password and click **OK**.
   The password is now set.

Note: If the **Password** box does not appear when you select an administrative feature, then you have not set an administrative password.

Also, if a check mark does not appear next to the **Administrator** menu item, and there *is* an administrative password, then the **Change Administrator Password** option will not appear on the **File** menu.

6.5 Printing

There are several types of information you can print from the APP Recorder:

Message window contents

Recent Fault Summary Report

Recent Fault Summary Report with Graph

6.5.1 Selecting and Configuring the Printer

Before you print, select, and configure the printer that you want to use.

➢ **To Select and Configure the Printer**

1. From the **File** menu, select **Printer Setup**.
   The standard Windows **Print Setup** dialog box appears.
2. From the **Name** list, select the printer that you want to use.
3. Complete the other fields in this dialog box and then click **OK**.

6.5.2 Printing the Contents of the Message Window

➢ **To Print the Contents of the Message Window**

In the **APP Recorder** window, from the **File** menu, click **Print Message Window**.
The contents of the **Message** window are immediately sent to the printer you selected in the procedure, *Selecting and Configuring the Printer*.

6.5.3 Printing the Recent Fault Summary

You can preview or print a fault summary report for the last recorded fault. If the APP Recorder Program is stopped, and restarted, this function will not work until a new fault record is generated: it does not read prior fault records.

➢ **To Print the Recent Fault Summary**

In the **APP Recorder** window, from the **File** menu, click **Print Recent Fault Summary**.
The report is sent immediately sent to the printer you selected in the procedure, *Selecting and Configuring the Printer*.

6.5.4 Printing the Recent Fault Summary with a Graph

You can preview or print a fault summary report that includes both analog and event graphs. You can specify parameters including the Y-scale, print channels, print range, channels per page, and event channel formatting.

➢ **To Print the Recent Fault Summary with a Graph**

1. In the **APP Recorder** window, from the **File** menu, click **Print Recent Fault Summary + Graph**.
   A window appears in which you can specify report configuration parameters.
2. Specify the report configuration parameters and then click **OK.**
   The report is sent immediately sent to the printer you selected in the procedure, *Selecting and Configuring the Printer*.

6.6 Exiting the APP Recorder

You can exit the APP Recorder for maintenance or troubleshooting purposes. When you exit the APP Recorder, the APP Driver is automatically exited as well.

If you have set an administrator password, then you must enter the password before exiting the APP Recorder. See *Setting the Administrator Password* for more information.

CAUTION **Stopping the APP Recorder Program takes the APP Recorder OFFLINE. No recording will be performed while the APP Recorder Program is stopped.**

Note: If the APP Monitor check box is checked in Tools/Windows logon and startup, APP Recorder will automatically restart itself in no more than 60 seconds.

➢ **To avoid auto restart, do the following prior to exiting**

1. Go to Windows Task Manager by pressing **CNTL-ALT-DEL**
2. Click Start Task Manager
3. In the Processes Tab, single click (Select)APP Monitor
4. Click End Process

➢ **To Exit the APP Recorder Program**

1. From the **APP Recorder** window **File** menu, click **Exit**.
2. Has an administrator password been set?
   a) If **yes**, then a message box appears. Enter the password and click **OK**. The program is stopped immediately.
   b) If **no**, then the program is stopped immediately.

➢ **To restart APP Recorder with APP Monitor activated**

1. Restart Computer (Windows Restart)
2. APP Recorder and APP Monitor will start automatically if APP Monitor was selected in the Tools/Windows logon & Startup previously.

6.7 Configuring the APP Recorder

6.7.1 Factory Settings

Some minimum configuration parameters must be setup for the APP-601 Recorder to operate. For example, it must know where to place the recorded data and where to find point assignment information. Before the recorder leaves the factory its "must have parameters" are already entered. You should not have to make changes to those settings.

Note: You should not alter the Recorder ID, Data Path, or the Setup Path without thoroughly understanding how the APP Recorder runs. Incorrectly changing these values can prevent the APP Recorder from running.

- The Recorder ID is needed for the recorder to read and save configuration and data files such as the Point Assignment Record, Line Group Record, COMTRADE data files, and so on.
- The Data Path has reserved memory in it.
- The Setup Path has all the configuration information.

6.7.2 Types of Configuration Settings

You can configure the following types of settings for the APP Recorder:

- Main configuration settings
- Automatic tasks
- Allowed IPs

6.7.3 Configuring the Main Configuration Settings

Main configuration settings are integral to the basic functioning of the APP Recorder.

APP Computer Chassis Data Storage Architecture:

The **APP 601** standard configuration, the computer chassis storage setup is C:\ drive with RAID 1 + hot spare. Two 1TB hard drives are in RAID 1 configuration with the 3rd 1TB hard drive acting as a hot spare. The RAID hard drives will contain both the operating system and the Setup and Data folders for the Recorder program.

Note: If you want to use the C: drive/Flash for storing fault records, please consult APP Engineering Inc. before configuring APP 601 Computer.

The **APP 501** Computer Chassis includes a single conventional hard drive for storing the OS and configuration files as well as the fault records. Remember you received a complete backup hard drive with the original factory settings along with your computer chassis.

➢ To Change Main Configuration Settings

1. In the **APP Recorder** window, from the **Edit** menu, click **Recorder Config.**
   The **Recorder Configuration** window appears. By default, the **Main** tab is selected.

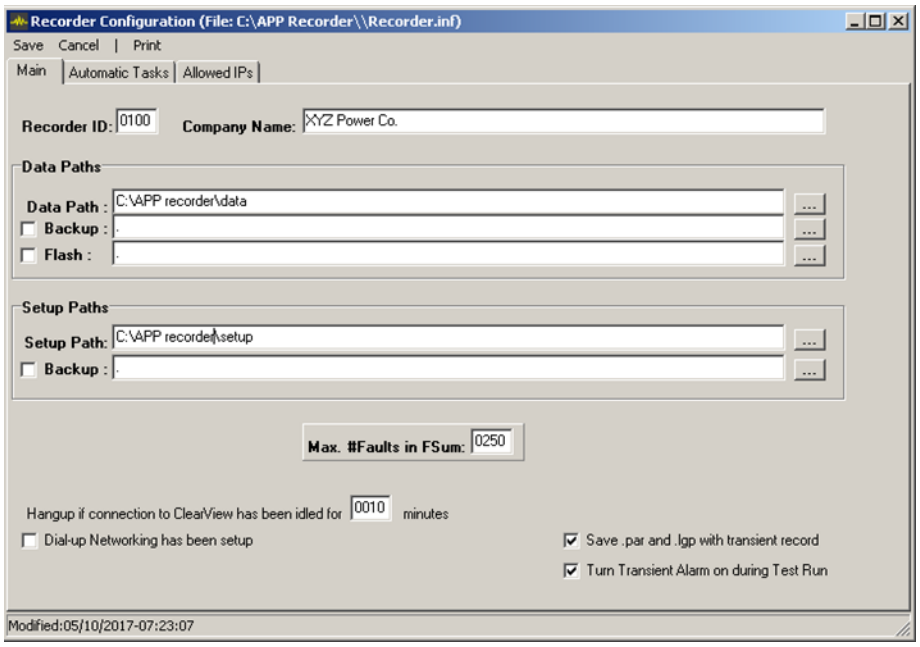


Figure 56: Example of APP 601 Recorder Configuration Window - Main Tab

2. *(Required)* **Recorder ID** field, specify a unique recorder ID. This allows the master station program (APP ClearView) to identify the recorder with which it is communicating.

CAUTION **Do not use duplicate Recorder IDs.**
Before shipping the Recorders, APP Engineering Inc. will assign Recorder IDs and configure each of your Recorders accordingly. Recorders will be numbered sequentially.

3. **Company Name** field, enter any name you would like. This name will appear at the top of the APP Recorder Program main page. At the factory, the name of the company who purchased the system is entered.

4. *(Required)* **Data Path** field, click ... and enter the location of the physical file where transient and extended recording information will be written. By default, the factory creates the path: **C:\APP Recorder\Data**

   You can change this value to any other path you want. However, you should not change the path without understanding how the APP Recorder runs. Incorrectly changing the path can prevent the APP Recorder from running.

5. Transient and extended recording information can be written to more than one path. To create a second location, next **Backup** click ... and enter the desired path.

6. **Flash:** Using Flash has a very limited application. If you would like to use Flash for Data, please consult APP Engineering Inc., before setting up the use of Flash.

7. *(Required)* Next to the **Setup Path** box, click the ... to specify the location of files such as the Point Assignment Record, calibration factors, Line Group Record, trace files, and diagnostic record. By default, the factory creates the path **C:\APP Recorder\Setup.** You can change this

value to any other path you want. However, you should not change the path without understanding how the APP Recorder runs. Incorrectly changing the path can prevent the APP Recorder from running.

8. In the **Max #Faults in FSum:** box, specify the number of Fault record IDs included in the Fault Summary upload to the master station (i.e. remote APP ClearView), when a Fault Summary file is created. The larger the number, the longer it takes to get the summary file. Typically, a reasonable number for this "fast" retrievable file is between 50 and 500.

Note: The APP Recorder Program AND APP Clearview Program should be configured to share the same Data folder (i.e. C:\APP Recorder\Data). All Fault records are available to APP Clearview with this configuration.

9. After normal communication has been established between the APP ClearView and the APP Recorder programs, the ideal disconnect situation is for someone at the master station or someone at the APP Recorder to initiate a disconnect or hang up command. When this is done, both programs are aware of the disconnect request and can properly close down communications.

   However, it is possible for a communication path to be cut without notice. This results in neither program receiving notice of disconnect. Therefore, a hang up timer is needed to ensure that both programs receive an automatic command to release the communications link.

   The default hang up timer for both the APP Recorder and APP ClearView programs is 10 minutes. However, the APP Recorder hang up timer has a delay that makes its effective default time 10 minutes and 30 seconds. Therefore, in the case of no communications activity, the APP ClearView program will be the first to initiate a hang up action.

   Do you want to make the APP Recorder the first program to initiate a hang up action in the event of an unexpected disconnect?

   If **yes**, then in the **Hang up if connection to ClearView has been idle for X minutes** box, type a value less than 10 minutes.

   If **no**, skip to the next step.

10. Have you already set up dial-up networking for the APP Recorder?

    If **yes**, then select the **Dial-up Networking** has been setup check box. See *Setting Up Dial-up Networking* for instructions on setting up dial-up networking.

    If **no**, skip to the next step.

11. If you want Point Assignment Record and Line Group Record saved with Transient Record, click the check box: **Save .par and .lgp with Transient Record**.

12. If you want the Transient Alarm triggered during a Test Run, click the check box: **Turn Transient Alarm on during Test Run**.

Note: The Transient Alarm has to be mapped in the Point Assignment, General Settings Tab for the alarm to be turned on.

13. From the menu bar, click **Save**.

6.7.4 Setting Up Dial-up Networking

Windows10

Dial-up Networking using Windows10, is supported on a case-by-case basis. To setup Dial-up networking with Windows 10 or above, please contact APP Engineering support at **(317) 536-5300.** If Windows 10 is running Dial-Up Networking will be set to Off and unable to be turned ON.

DialNet is for users who want to use Remote Desktop or a similar program to access the recorder using the same phone line as the recorder.

To establish dial-up networking, you must complete the setup procedures on both the APP Recorder (server) computer and on the ClearView (client) computer.

Things to Remember

The Dial-up network IP Address of the Recorder is (200.200.200.200)

The Dial-up network IP Address of the ClearView computer is (200.200.200.201)

Use IP:200.200.200.200 to call the Recorder when using Remote Desktop or UltraVNC or other remote access services.

The dial-up network can only be disconnected by the application that started it.

The dial-up network will stop the Internet connection and also could stop some local LAN.

The Internet will resume automatically after the dial-up network connection is disconnected.

6.7.5 Configuring Automatic Tasks

The APP Recorder can perform a variety of automatic tasks, which appear on the window that is shown in Figure 57. By configuring the automatic tasks, you can take full advantage of the APP Recorder's ability to become an integral part of your substation or plant automation.

There are several types of automatic tasks you can configure:

Automatic tasks that occur when a fault arrives, see Section 6.7.7 including:

- Whether or not the APP Recorder calls the master station, and what type of data it sends about the fault
- The format of printed reports
- The email settings for automated notifications
- The FTP settings for automated notifications

Automatic tasks that occur when a SER Event occurs see Section 6.7.14

Automatic tasks that occur when alarms occur see Section 6.7.15

Setting up the Master Phone List and the Passwords for login to the Master Station see Section 6.7.16

Note: The factory configures all of the settings for automatic tasks before shipping the APP Recorder to you. You can optionally change these settings as needed.

6.7.6 Accessing the Automatic Tasks Tab

You configure all of the automatic tasks on the **Automatic Tasks** tab of the **Recorder Configuration** window.

➢ **To Access the Automatic Tasks Tab of the Recorder Configuration Window**

1. In the **APP Recorder** window, from the **Edit** menu, click **Configuration**.
   The **Recorder Configuration** window appears. By default, the **Main** tab is selected.

2. Click the **Automatic Tasks** tab.
   The **Automatic Tasks** screen appears, as shown in the following figure.

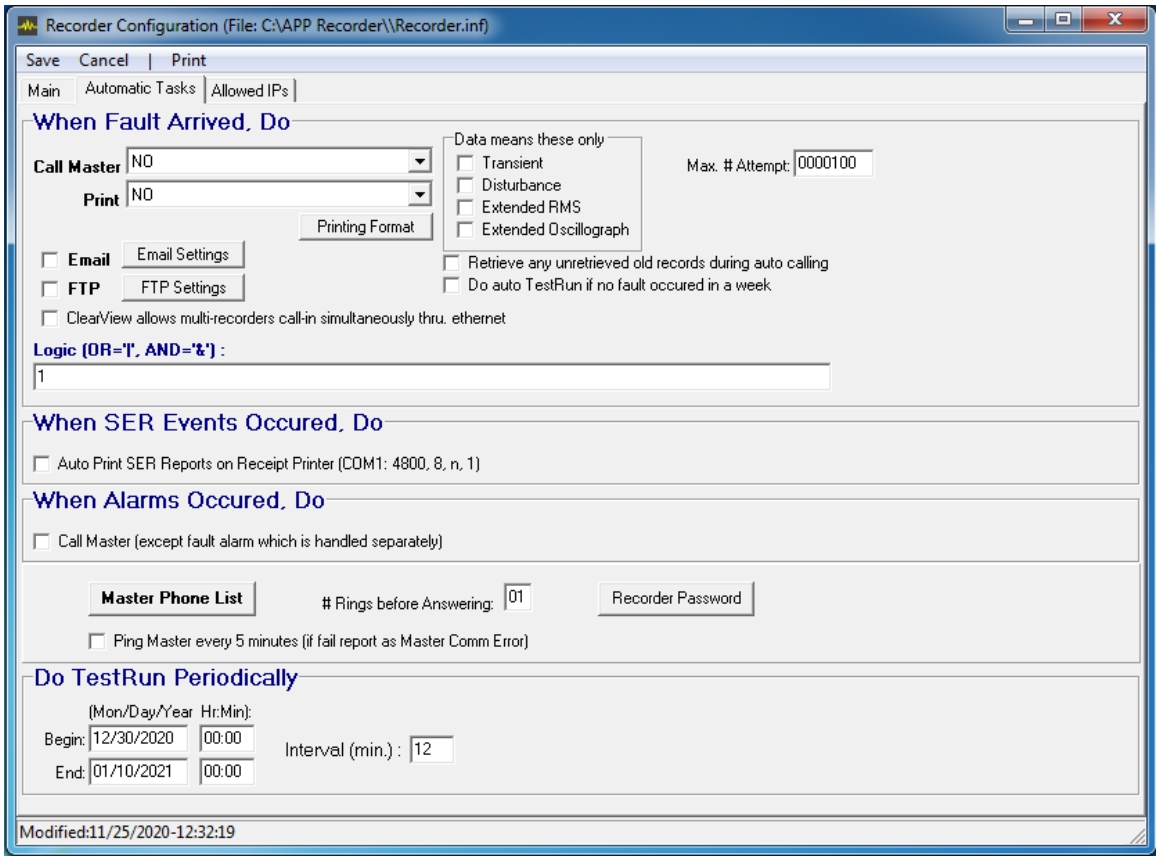


Figure 57: Recorder Configuration Window - Automatic Tasks Tab

6.7.7 Configuring Automatic Tasks that Occur when a Fault Arrives

Call Master, you can configure whether or not the APP Recorder calls the master station, and what type of data it sends about the fault.

> **Note:** In order for the APP Recorder Program to call the master station and transfer data, the master station must be running the APP ClearView Program. The APP ClearView Program must be set to monitor incoming calls

➢ **To Configure Whether or Not the APP Recorder Calls the Master Station**

1. Open the Automatic Tasks tab of the Recorder Configuration window.
2. In the Call Master drop down menu, select what you want the APP Recorder to do if a fault occurs. The following table describes the available options.

Table 11: Configuring Automatic Tasks—Options in the Call Master List

If a fault triggers the Recorder		Select this option	Also set the values of these fields
What should it upload?	**When?**		
A Fault Summary File	Always	**Yes– always (Send FSum Only)**	**Max #Faults in FSum** box on the Main tab This determines the number of fault files in the Fault Summary Record.
A Fault Summary File, and associated data	Always	**Yes – always (Send FSum and Data)**	**Data means these only** check boxes These determine the type of data sent. If all of the boxes are unchecked, then all of the types of data will be sent.
A Fault Summary File	Only when certain conditions occur	**Yes – if logic true (Send FSum Only)**	**Max #Faults in FSum** box on the **Main** tab **Logic (OR=1, AND =&)** box **Data means these only** check boxes
A Fault Summary File and associated data	Only when certain conditions occur	**Yes – if logic true (Send FSum and Data)**	**Logic (OR=1, AND =&)** box **Data means these only** check boxes
A Fault Summary File (always) and associated data (sometimes)	Always print a Fault Summary Report *but* Print all analog waveforms and all event graphs only when certain conditions occur	**Yes – always (FSum), if logic true (Data)**	**Max #Faults in FSum** box on the **Main** tab **Logic (OR=1, AND =&)** box **Data means these only** check boxes

3. In the **Max # Attempt** box, type the number of times the APP Recorder Program will attempt to call the master station, via modem or network, before stopping. The Recorder retries about every 2 minutes.
4. **Data Means These Only**, do you want to limit the type of data sent when a fault occurs?
   - If **yes**, then under Data means these only, select the appropriate check boxes. If you select none of the check boxes, then Transient, Disturbance, Extended RMS, and Extended Oscillography data are all sent.
   - If **no**, all data will be sent, skip to the next step.
5. **Retrieve any un-retrieved old records during auto Polling**, this function is to ensure all COMTRADE Records on the Recorder is retrieved into APP Clearview. Check the box if you want Clearview to pull any fault records during polling/auto polling existing in the Recorder and has not yet been retrieved.

Note: If the fault summary list (.lst file) is retrieved manually, then the Recorder is auto polled, Clearview may not retrieve any un-retrieved fault records until the next polling cycle.

6. **Do an Auto Test Run if no fault occurs in a week** will initiate a test run if there has been no faults recorded in the past week. This is to provide a way to ensure the recorder is functioning and can provide proof for audit purposes. Click the check box to have Auto Test Run turned on.
7. **Logic Box**, this box indicates the condition(s) that must be met in order for the Recorder to send the data to the master station. Do you want to set conditions for sending data to the Master?
   - If **yes**, then complete the **Logic** box. For more information, see **Defining a Boolean Logic Equation** on page 6-26.
   - If **no**, then skip to the next step.
8. From the menu, click **Save**.

6.7.8 Configuring Printing

You can preview/print a report of the APP Recorder configuration by clicking Print and selecting either Preview or Print.

Note: In order for the APP Recorder to print, there must be a local or network printer connected to the recorder.

➢ To Configure Printing

1. Open the **Automatic Tasks** tab of the **Recorder Configuration** window.
2. In the **Print** drop down menu, select the specific printing function that you want APP Recorder to perform. The following table describes the available options.

Table 12: Configuring Automatic Tasks—Options in the Print List

If a fault triggers the Recorder		Select this option	Also set the values of these fields
What should it upload?	**When?**		
Nothing **Note:** You can still manually activate printing.	n/a	**No**	n/a
A Fault Summary File	Always	**Yes– always (Print FSum Only)**	n/a
A Fault Summary File, and associated data	Always	**Yes – always (Print FSum and Data)**	**Data means these only** check boxes
A Fault Summary File	Only when certain conditions occur	**Yes – if logic true (Print FSum Only)**	**Logic (OR=1, AND =&)** box
A Fault Summary File, and associated data	Only when certain conditions occur	**Yes – if logic true (Print FSum and Data)**	**Logic (OR=1, AND =&)** box **Data means these only** check boxes
A Fault Summary File (always) and associated data (sometimes)	Always print a Fault Summary Report *but* Print all analog waveforms and all event graphs only when certain conditions occur	**Yes – always (FSum), if logic true (Data)**	**Logic (OR=1, AND =&)** box **Data means these only** check boxes

3. Do you need to complete the **Logic** box?
   This box indicates the condition(s) that must met in order for the Recorder to send the data to the master station.

   - If **yes**, then complete the **Logic** box. For more information, see **Defining a Boolean Logic Equation** on page 6-26.
   - If **no**, then skip to the next step.

4. Do you want to configure the format of printed reports?

   - If **yes**, continue with the procedure, *Configuring the Format of Printed Reports*.
   - If **no**, from the menu bar, click **Save**.

6.7.9 Configuring the Format of Printed Reports

➢ **To Configure the Format of Printed Reports**

1. Open the **Recorder Configuration** window and open the **Automatic Tasks** tab.
2. Click the **Printing Format** button.
   The **Format All Wave Printing** window appears.

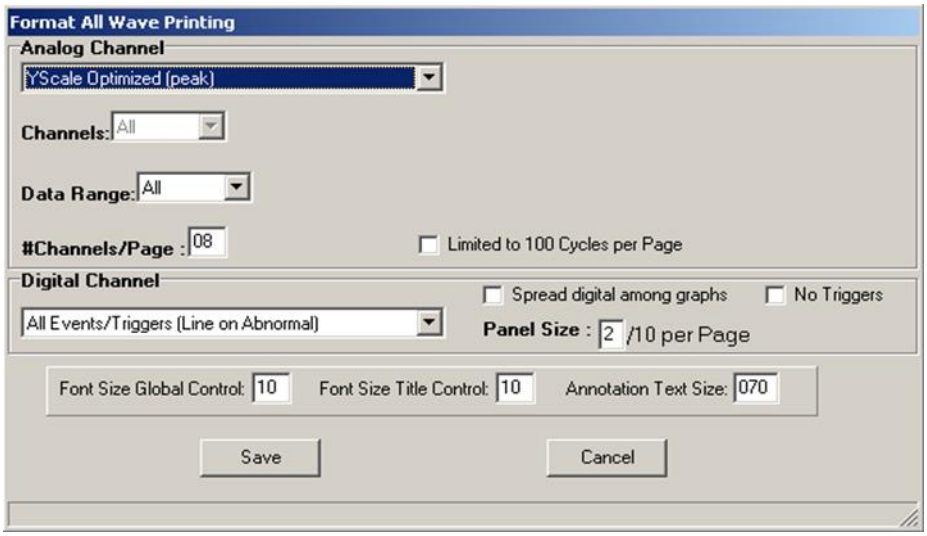
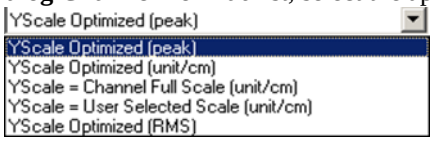


Figure 58: Printing Format Window

3. From the **Analog Channel Format** list, select the appropriate format:



- **YScale Optimized (peak)**
  Prints the highest peak value measured to the right-hand side of each oscillogram printed.
- **YScale Optimized (unit/cm)**
  Prints a volts/cm or amps/cm scale to the right-hand side of each oscillogram printed.
- **YScale = Channel Full Scale Optimized (unit/cm)**
  Prints a volts/cm or amps/cm scale to the right-hand side of each oscillogram printed. The value is based on the full scale setting in the Point Assignment Record and the number of oscillograms printed on the page.
- **Yscale = User Select Scale (unit/cm)**
  If selected, a user programmable Yscale field appears. The user can enter their desired volts/cm or amps/cm scale. Prints a volts/cm or amps/cm scale to the right-hand side of each oscillogram printed. The value is based on a user entered Yscale (unit/cm). If the scale is too small waveform clipping will occur.
- **Yscale Optomized (RMS)**
  This selection prints the RMS value to the right side of each oscillogram printed.

Note: Print fewer channels on a page to increase the resolution on the Yscale.

4. From the **Channels** list, select one of the following choices:

   - **All**
     Prints an oscillogram for each analog channel listed in the Point Assignment Record.
   - **Selected**
     After you select this, click the **Select Channels** button to select the specific channels to print.
   - **Group**
     Specific preset line groups can be printed.

5. From the **Print Data Range** list, select the range of records to print:

   - **All**
     Prints the entire length (X-axis) of all the oscillograms selected for printing.
   - **Selected**
     Each data point in an oscillogram has a number. The starting number is "0" which is usually the prefault portion of the waveform. The ending number depends on how long the fault or recording lasted. To print a partial record, X-axis length, enter the data range.

6. In the **#Channels/Page box,** enter the number of oscillograms you want to appear on each page of the printout.

Note: Print fewer oscillograms on a page to increase the resolution on the Yscale.

7. **Limit to 100 Cycles per Page** check box causes the report to limit to 100 Cycles per page for each channel displayed on a page.

8. There are two types of triggers, analog triggers and event triggers. You can print these triggers in conjunction with oscillograms. Triggers are represented by horizontal lines at the bottom of a printed or displayed page. In the **Digital Channel Format** list, select how the trigger line should appear, whether it is normal or abnormal:

   - **Sequence Of Events /Triggers (Line on Abnormal)**
     This selection only prints the event channels or analog triggers that caused the system to trigger and record. The state of other event channels is not printed. If a line is shown, it represents the period of time the event was abnormal.
   - **Sequence Of Events /Triggers (Line on Normal)**
     This selection only prints the event channels or analog triggers that caused the system to trigger and record. The state of other event channels is not printed. If a line is shown, it represents the period of time the event was normal.
   - **All Events/Triggers (Line on Abnormal)**
     This selection prints the analog triggers and event channels that were in an abnormal state when the record was created. If a line is shown, it represents the period of time the analog trigger or event channel was abnormal.
   - **All Events/Triggers (Line on Normal)**
     This selection prints the analog triggers and event channels that were in an abnormal state when the record was created. If a line is shown, it represents the period of time the analog trigger or event channel was normal.

9. **Spread digital among graphs**, if Spread digital check box is not checked, the Analog channels are printed, then the Event Channels, on each page (See Figure 59). With Spread digital check box checked the report shows the digital channels along with the Analog lines together (See Figure 60).

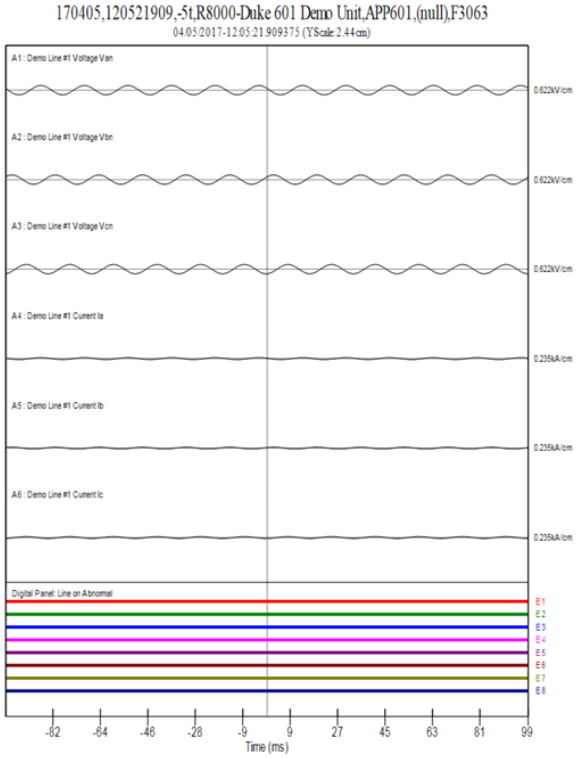


Figure 59: Default Report Format

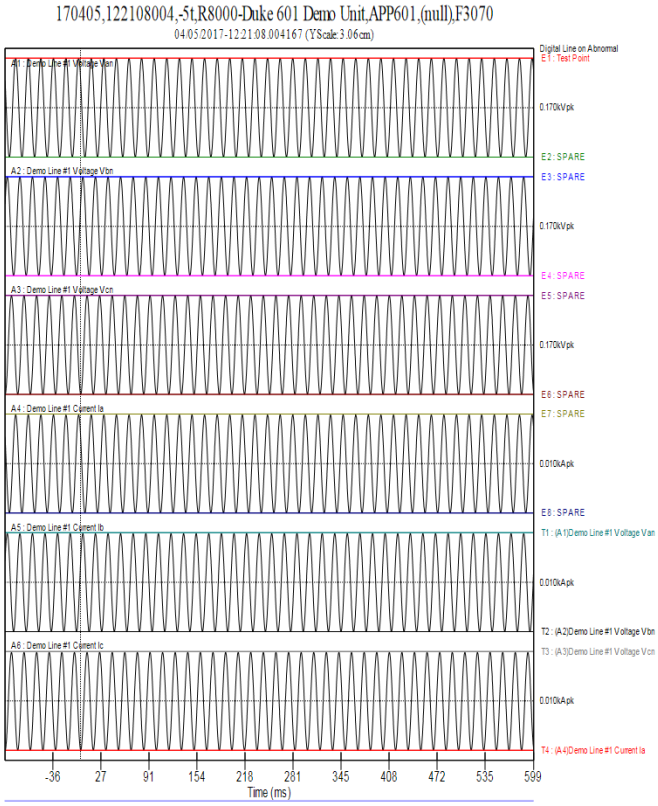


Figure 60: Report with Spread digital among graphs checked

10. **No Trigger** check box causes the report to exclude Analog Trigger faults from the report. An Event Trigger will still display if an Event Channel is set up, and an Event Channel caused the Trigger or an Event Channel changed state while the record was being created.
11. In the **Panel Size** box, enter the percentage of space the event and analog trigger lines will use at the bottom of a printed page.
12. In the **Font Size Global Control** box, enter the font size to be used for the title of the waveform pages and any annotations that may have been added. You cannot change the font on the **Fault Summary Report**.
13. In the **Font Size Title Control** box, enter the font size for the title that appears at the top of each waveform or oscillogram page.
14. In the **Annotation Text Size** box, enter the font size for any annotations that are added to a waveform or oscillogram page.
15. Click **OK**.

6.7.10 Configuring Email Settings

You can configure the APP Recorder to automatically email fault summary information to the master station. When the APP Recorder sends an email, it sends a plain text e-mail message containing a summary of a fault. The following information is included in the report:

Recorder ID

Fault ID number

Fault date and time

Fault duration

Fault location report (if calculable)

Note: The Recorder must have an SMTP/POP3 email account and connectivity in order for the Email feature to work properly.

➢ To Configure Email Settings

1. Open the **Recorder Configuration** window and open the **Automatic Tasks** tab. See Figure 57.
2. Select the **Email** check box.

Note: If the Email check box is not selected, the APP Recorder will not automatically send emails with fault summary information.

3. Click the **Email Settings** button.
   The **Main** tab of the **Email Settings** window appears.

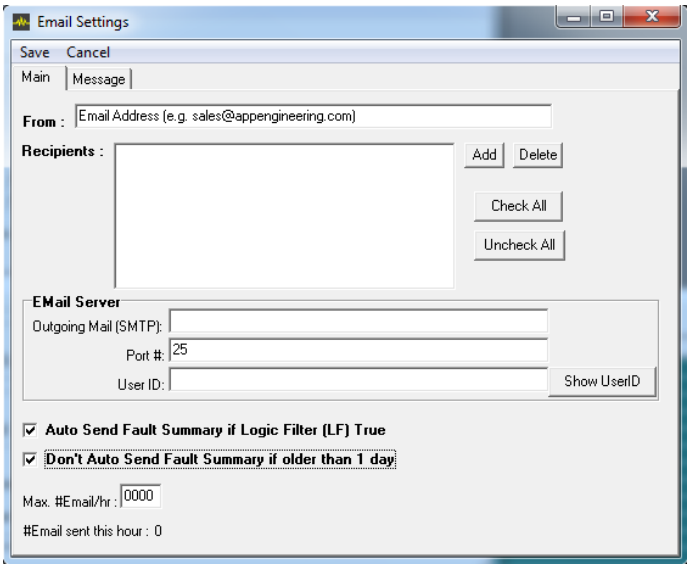


Figure 61: Auto Email Setup Window

4. In the **From** field, enter a valid email address.

5. In the **Recipients** list, add or delete recipients' email addresses. The e-mail message will be sent to all of the recipients in this list. If no recipients are listed, click **Add** and specify a valid email address.

   - Use the "Check All" button to select all recipients at once.
   - Use the "Uncheck All" button to unselect all recipients at once.

6. Contact your network administrator to obtain values for the **Outgoing Mail (SMTP)**, **Port#**, **User ID** and fields.

7. Do you want the APP Recorder to automatically email a summary of every fault each time the master station automatically retrieves a fault record or whenever a fault record is automatically called in?

   - If **yes**, then select the **Auto Send Fault Summary if Logic Filter (LF) True** check box. On the **Automatic Tasks** tab of the **Recorder Configuration** window, verify that the **Logic** box contains the appropriate value. For more information on completing the **Logic** box, see **Defining a Boolean Logic Equation**.
   - If **no**, skip to the next step.

8. **Limit faults automatically sent**. Do you want the Auto Send Fault Summary function to limit what is sent to the Master Station to any faults less than 1 day old?

   - If **yes**, then click the **Don't Auto Send Fault Summary if older than 1 day** check box.
   - If **no**, skip to the next step

   This function works only if Auto Send Fault Summary is also checked.

9. From the menu bar, click **Save**. At this point, you have completed configuring e-mail settings. It is a good idea to send a test e-mail to ensure that messages will be sent properly. To do this, complete the procedure, *To Test the Email Function*.

➢ To Test the Email Function

1. In the **Send Email** window, click the **Message** tab.
   The **Message** tab appears, as shown in the following figure. From here, you can type an email and manually send it to everyone in the **Recipient** list.

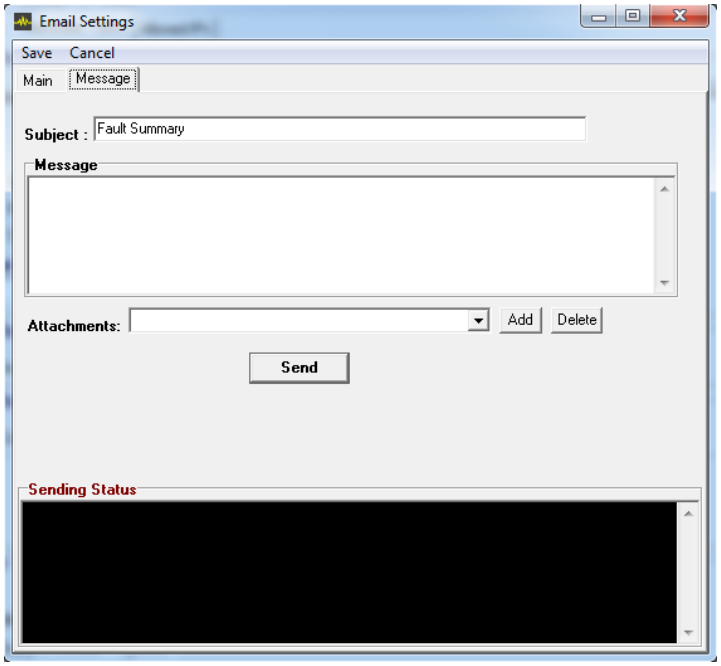


Figure 62: Manual Emailing Window

2. In the **Subject** box, type the subject line for the email.
3. In the **Message** box, type the message.
4. In the **Attachments** list, select an attachment to include. Use the **Add** and **Delete** buttons to select or remove additional files.

Note: Attachments will only be sent if the **Secure** check box is unchecked on the Main Tab

5. Click **Send**.

6.7.11 Configuring FTP Settings

You can configure the APP Recorder to automatically send the most recently generated transient fault record to a host directory.

➢ **To Configure FTP Settings**

1. Open the **Recorder Configuration** window and open the **Automatic Tasks** tab.
2. Select the **FTP** check box.

Note: You must set this up if you want the APP Recorder to send transient records through FTP.

3. Click the **FTP Settings** button.
   The FTP Settings dialog box appears, as shown in the following figure.

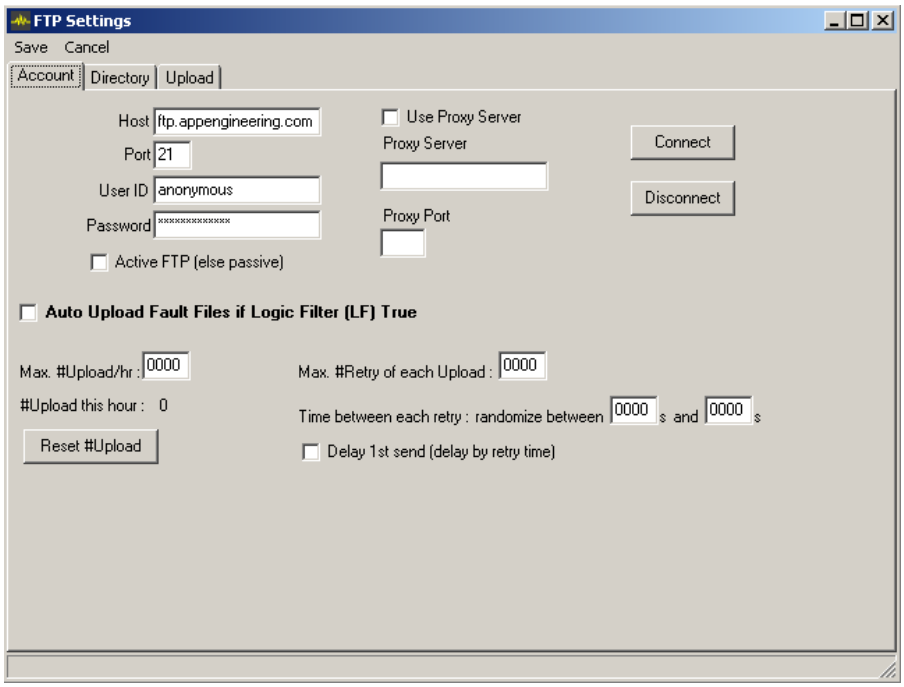


Figure 63: FTP Account Settings Window

4. *(Required)* In the **Host** field, type the URL for the host computer.
5. *(Required)* In the **Port** field, type the port for the host.

Note: A common port setting is 21.

6. *(Required)* In the **User ID** field, type the user ID to log in to the host.
7. *(Required) In the* **Password** field, type the password to log in to the host.
8. Do you want to use a proxy server?
   - If **yes**, then select the **Proxy Server** check box. In the Proxy Server box, type the name of the proxy server. In the **Proxy Port** box, type the port number for the proxy server.
   - If **no**, skip to the next step.

9. Do you want to create a logic filter to identify when the transient record should be sent to the host directory?

   - If **yes**, then select the **Auto Upload Fault Files if Logic Filter (LF) True** check box. On the **Automatic Tasks** tab of the **Recorder Configuration** window, verify that the **Logic** box contains the appropriate value. For more information on completing the **Logic** box, see **Defining a Boolean Logic Equation**.
   - If **no**, skip to the next step.

10. **Max #Upload/hr** box, enter the maximum number of fault records to be sent to the host directory per hour. Specify a limiter here to stop the host directory from being inundated with data in the event that the APP Recorder has an unexpected runaway tripping event.

    Note: You can reset the counter manually via the **Reset Upload** button. The **Reset Upload** button is for emergency purposes if the maximum upload number has been exceeded, but you still want other fault records to be sent.

11. **Max #Retry of each Upload** box, enter a limiter that determines how many times the software will try to send a new record to the host directory. If the limit is reached due to some connection or setting problem, a message will appear in the APP Recorder trace file.

12. **Time Between each Retry** : **Randomized Between**, enter the two times in seconds, between which FTP retries should occur. APP Recorder will attempt at random intervals between the range specified, to resend data.

13. **Delay 1st Send (by retry time)** check box. Check this to delay 1st send by the Retry time specified above.

14. From the menu bar, click **Save** and then click the **Directory** tab.
    The **Directory** tab appears, as shown in the following Figure 64: FTP Remote Directory Setup Window

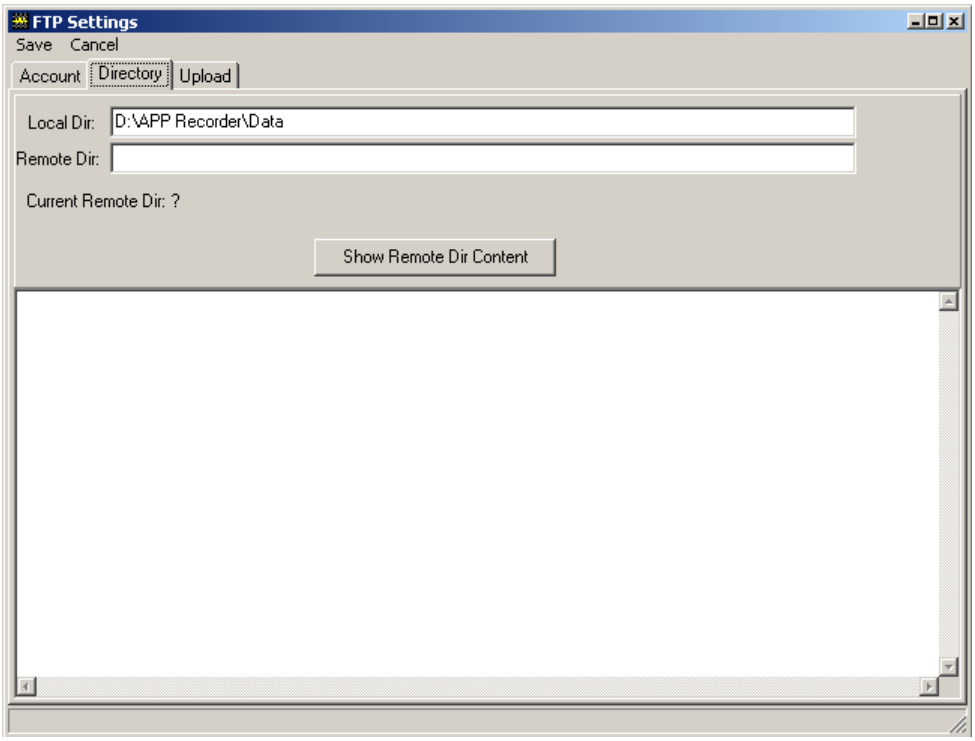


Figure 64: FTP Remote Directory Setup Window

15. The **Local Dir.** field automatically displays the value that was entered in the **Data Path** field on the **Main** tab of the **Recorder Configuration** window. This setting tells the FTP program from where to retrieve the new fault records that it will place in the host directory.

    Note: You can change the path while testing the FTP function

16. *(Required)* In the **Remote Dir.** field, type the path to the remote directory that is located on the host site to which the transient records will be sent (for example, **storage**).

    Note: The backward slash may need to be included in the path.

17. Do you want to test the connection to the remote directory?
    - If **yes**, click **Show Remote Dir Content**.
      If communication is established you will see the remote directory in the message window. If the FTP settings are incorrect, you will see nothing in the message window. In the tray below the message window you might see error messages.
    - If **no**, skip to the next step.
18. From the menu bar, click **Save**.

6.7.12 Defining a Boolean Logic Equation

You can define a Boolean Logic equation to automatically filter, or limit, when the APP Recorder does any or all of the following:

Calls the master system

Prints the Fault Summary File and fault-related data

Sends an email notification

Sends transient fault record via FTP

Note: You can define only one logic entry.

The following table lists the available equation variables and field entries.

Table 13: Defining a Boolean Logic Filter—Variables and Entries

Entry	Description
0	False, nothing will pass filter
1	True, everything passes filter
Blank (Nothing Entered)	True, everything passes filter
T1, T2, T3…..	Represents Trigger Channels
t1, t2, t3…..	Also Represents Trigger Channels
E1, E2, E3….	Represents Event Channels
e1, e2, e3….	Also Represents Event Channels

6.7.13 Performing a Test Upload

You can use the **Upload** tab to test the upload process. This tab allows the transfer of any file from the local directory to the remote directory. If the file is successfully transferred, an "Upload Succeed" message will appear in the FTP Status pane. If the file is not transferred, an "Upload Fail" message will appear instead.

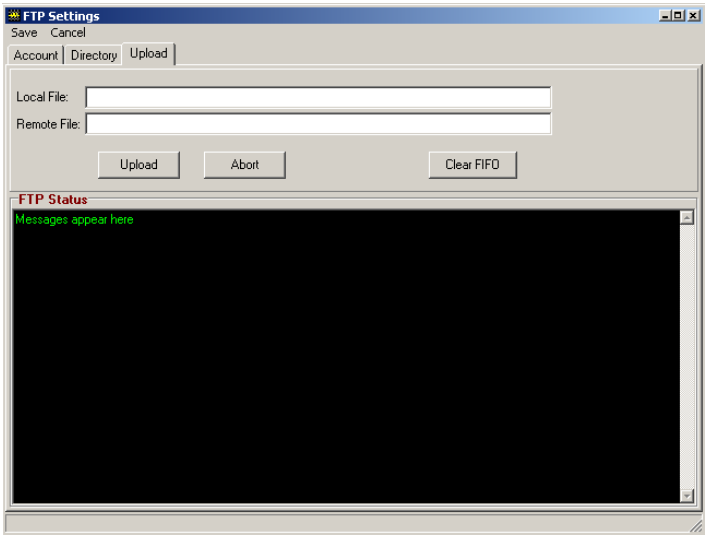


Figure 65: FTP Upload or Testing Window

➢ **To Perform a Test Upload**

1. In the **Local File** box, type the name of the file you wish to send to the remote file. This file must be located in the local directory that is defined on the **Directory** tab.
2. Do you want the file name to remain the same when it is placed in the remote directory?
   - If **yes**, then in the **Remote File** field enter the same file name that you entered in the **Local File** box.
   - If **no**, type a different file name.
3. Click **Upload**.
   The test file transfer process begins.
4. After the transfer is successful, click the **Show Remote Dir Content** button. The file appears in the remote directory that you specified on the **Directory** tab.

➢ **To Stop the Automatic Retry Attempts**

If the transfer fails and you wish to stop the automatic retries, click **Abort**.

➢ **To Clear the Buffer of Any Fault Record**

Note: You can clear the buffer for troubleshooting or testing purposes.

Click **Clear FIFO** to clear the buffer of any fault record or test file that the APP Recorder is trying to send to the remote directory.

6.7.14 Configuring Automatic SER Reports

If a receipt printer is connected to the parallel port of the computer running the APP Recorder, the APP Recorder can automatically print an SER report when a SER (SOE) channel experiences a change of state. The printed report includes the date, time, channel description, channel number, and if the channel has switched to a normal or abnormal state.

➢ **To Configure Automatic SER Reports**

1. Open the **Recorder Configuration** window and open the **Automatic Tasks** tab.
2. Select the **Auto Print SER Reports On Receipt Printer** check box.
3. From the menu bar, click **Save**.

6.7.15 Calling the Master Phone List when Alarms Occur

You can configure the APP Recorder to automatically call the numbers in the master phone list when alarms occur. For information on configuring the master phone list, see 6.7.16 Configuring the Master Phone List.

➢ **To Configure whether the APP Recorder Calls the Master Phone List when Alarms Occur**

1. Open the **Recorder Configuration** window and open the **Automatic Tasks** tab.
2. Under the **When Alarms Occurred, Do** section, do one of the following:
   - If you want the APP Recorder to call the numbers in the Master Phone list, select the **Call Master…** check box.
   - If you want the APP Recorder to ***not*** call the numbers, de-select the **Call Master…** check box.
3. From the menu bar, click **Save**

Note: The Fault alarm is not affected by the setting of the **Call Master…** check box.

6.7.16 Configuring the Master Phone List

➢ **To configure the master phone list, you can specify:**

- The phone numbers, IP Address, or Master IDs of the master stations that the APP Recorder Program will automatically call.
- The password APP Recorder should use to log in to the master station.

➢ To Configure the Master Phone List

1. Open the **Recorder Configuration** window and open the **Automatic Tasks** tab.
2. Click the **Master Phone List** button.
3. The **Master Phone & Network List** window appears, as shown in the following figure.

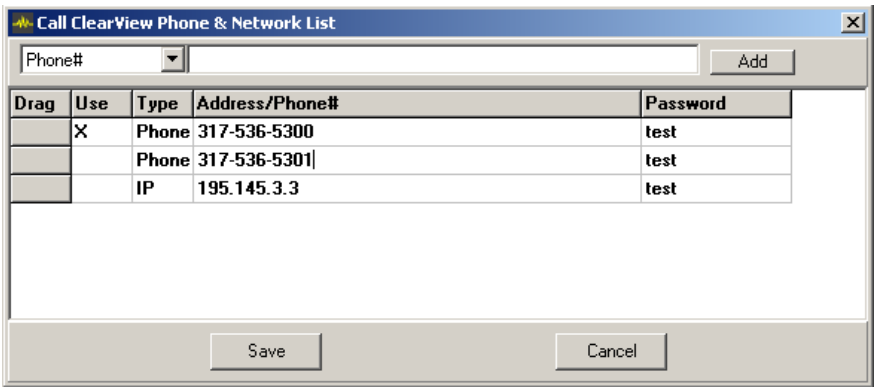


Figure 66: Master Phone & Network List Window

4. Do you want to add a new IP address or phone number?
   - If **yes**, then do one of the following:
     - If the APP Recorder is connected to a dial modem, then from the list, select **Phone#**. Then in the corresponding box, type the phone number. You can use any standard Windows format. Click the **Add** button.
     - If the APP Recorder is connected to an IP address, then from the list select **IP Addr**. Then in the corresponding box, type the IP address. You can use any standard Windows format. Click the **Add** button. For information on configuring DialNet, see 6.7.4 *Setting Up Dial-up Networking*.
   - If **no**, skip to the next step.
5. By default, the first entry that you make is selected, as indicated by the X in the **Use** column. The entry with the "X" is the number that APP ClearView will call when it connects to or calls the APP Recorder. You can activate multiple phone numbers and/or IP addresses.

   Do you want to activate or de-activate a phone number or IP address?
   - If **yes**, then in the **Use** column, click the box next to the entry. An X appears when the entry is activated; it disappears when the entry is deactivated.
   - If **no**, skip to the next step.
6. Do you want to delete a number?
   - If **yes**, then right-click the number and then click **Delete**.
   - If **no**, skip to the next step.
7. Do you want to reorder entries?
   - If **yes**, then under the Drag column, click the gray box that corresponds to the entry you want to move and then move it to its new position.
   - If **no**, skip to the next step.
8. Click **Save**.

➢ **To Configure the Recorder Password**

1. Open the **Recorder Configuration** window and open the **Automatic Tasks** tab.
2. Click the **Recorder Password** button.
   The **Recorder Password** window appears.
3. Type the new APP Recorder password.

   Note: The password is case-sensitive.

4. Click the **OK** button.

6.7.17 Ping Master Every 5 minutes

Ping Master every 5 minutes will continually test the connection between the DFR and the Master Computer. The Master has to be set up in the Master Phone list, Call Master has to be set to "Yes". If a failure occurs, it will cause a Master Comm Error. You must map that alarm in the Point Assignment Record, General Settings, Recorder Setup tab to have a hard alarm displayed.

6.7.18 Do TestRun Periodically

Do TestRun Periodically allows you to set up test runs on a schedule defined by a date range and interval in minutes. The test run will occur precisely at the top of the minute and is accurate to the sample point.

To cause a periodic test run, enter the Start Date and Time, the End Date and Time and the number of minutes between Test Runs. Once the end date and time has passed no more scheduled Test Runs will occur.

6.7.19 Configuring Allowed IPs

The APP Recorder includes a security feature that will limit remote connections to the APP Recorder. Only specified IP addresses will be permitted remote access to the APP Recorder.

Note: If you specify no IP addresses, then all IP address will be allowed access to the APP Recorder.

➢ To Configure Allowed IPs

1. Open the **Recorder Configuration** window and open the **Allowed IPs** tab.
   The **Allowed IPs** tab appears, as shown in the following figure.

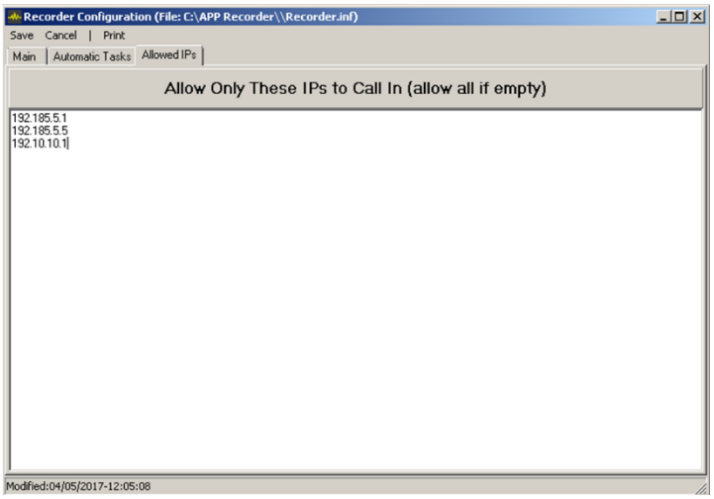


Figure 67: Allowable IPs Entry Window (Security Feature)

2. In the box, type the IP addresses. Press the **Enter** key between each IP address.
3. To delete an IP address, right-click the IP address and click **Delete**.

   Note: You can also use the **Undo**, **Cut**, **Copy**, and **Paste** options from the pop-up menu.

4. From the menu bar, click **Save.**

6.7.20 Printing Recorder Configuration

You can print the configuration information by clicking **Print** at the top of the screen then selecting **Print Preview** or **Print**. **Print Preview** allows you to review the report, save, change the printer preferences, and print.

6.8 Editing the Point Assignment Record

The Point Assignment Record is a user-defined record that is used by the APP Recorder to control system operation, perform calculations, and perform analysis. A Point Assignment Record contains information concerning the recorder hardware, analog channels, analog triggers, events, sampling rates, and different types of recording. The Point Assignment Record is saved in the setup folder and is structured **Rxxx.par** where **xxx** is the recorder number.

If your company provides point assignment information, APP factory personnel will enter that information into the APP Recorder before shipping it to you. You can edit a Point Assignment Record via the APP Recorder Software or the APP ClearView Software. The Point Assignment Record file can be downloaded from the master station (APP ClearView) to the APP Recorder or vice versa.

In the APP Recorder, you can access the Point Assignment Record from the **Edit** menu of the **APP Recorder** window.

Note: The Point Assignment Record is a key file for the Recorder operation. For complete details on how to create and edit the Point Assignment Record, see the APP ClearView Operating Manual.

Note: If an administrator password is defined, only the administrator has privileges to save a newly created Point Assignment Record or save changes to an edited Point Assignment Record.

6.9 Editing the Line Group Record

The Line Group Record is a user-defined record. Here channels that form a line group are linked together. This permits the APP Recorder to perform distance to fault calculations, various power calculations, and provides a quick convenient means for viewing oscillograms for different line groups. The Line Group Record is saved in the setup folder and is structured **RxxxLines.inf** where **xxx** is the recorder number.

If your company provides line group information, factory personnel will enter that information into the APP Recorder before shipping it to you. In addition, you can create and edit a Line Group Record via the APP Recorder or the APP ClearView. The line group file can be downloaded from the master station (APP ClearView) to the APP Recorder or vice versa.

In the APP Recorder, you can access the Line Group Record from the **Edit** menu of the **APP Recorder** window. For complete details on how to create and edit the Line Group Record, see the *APP ClearView Operating Manual*.

Note: If an administrator password is defined only the administrator has privileges to save a newly created Line Group Record or save changes to an edited Line Group Record.

6.10 Connecting to ClearView

You can manually initiate a phone call connection between the APP Recorder and the master station. The APP Recorder will call the phone numbers or IP addresses that are entered in the Master Phone List.

The APP Recorder only calls those numbers/IP addresses that have a checkmark beside them. If more than one number has a checkmark, the recorder will call them in sequential order.

Upon a successful connection to a master station, the APP Recorder uploads the information that you designated on the **Automatic Tasks** tab (summary file only, summary file and data, etc.).

After uploading the appropriate information, the APP Recorder automatically disconnects from the master station.

6.10.1 Connecting to ClearView

- **To Connect to ClearView**

In the **APP Recorder** window, from the **Connect** menu, click **Connect** to **ClearView**.

Note: The APP ClearView master station program will not receive a call unless it is set to “monitor incoming calls.”

6.10.2 Disconnecting from ClearView

You can manually break the connection between the recorder and master station.

➢ **To Disconnect from ClearView**

In the **APP Recorder** window, from the **Connect** menu, click **Disconnect from ClearView**.

6.10.3 Viewing the Connection Status Window

While the APP Recorder is connected to the master station, you can view real-time messages related to the communications and data transfer progress between the computers in the Connection Status window. This window is useful in determining if a successful connection has been established between the master station and APP Recorder.

➢ **To View the Connection Status Window**

In the APP Recorder window, from the Connect menu, click Show Status Screen.
The Connection Status screen appears. You can also press (F2) anytime to show Connection Status Screen.

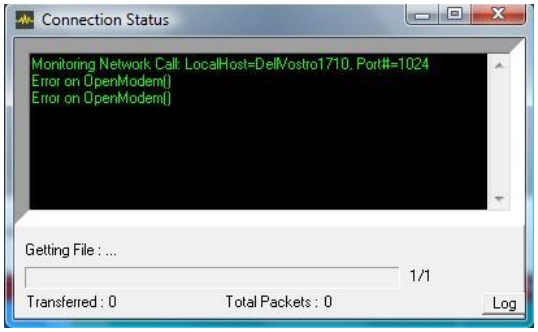


Figure 68: Connection Status Screen

To close the window, click the X button in the upper right-hand corner.

➢ **To view the Trace File**

From the **Connection Status Window**, you can view the **CTrace file** by clicking on the Log button. The CTrace file will open.

Note: You can leave this window open while you access other functionality in the APP Recorder

6.10.4 Choosing a Modem

You can view the currently installed modems and choose which modem the APP Recorder should use. With Windows 10 The Modem is not available and is disabled.

Note: After choosing your modem, you should not need to configure it; the process is automated for you. The instructions for accessing the **Modem Connection Preferences** window are included in this section in case you need to verify or adjust settings during troubleshooting.

➢ To Choose the Modem

1. In the **APP Recorder** window, from the **Connect** menu, point to **Modem** and then click **Choose Modem**. The Choose Modem dialog box appears.

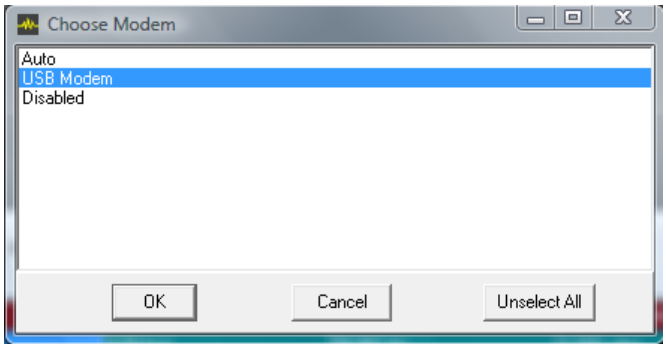


Figure 69: Choose Modem Window

2. Click the modem to use.
3. Click the **OK** button.

➢ To View the Modem Connection Preferences Window

In the **APP Recorder** window, from the **Connect** menu, point to **Modem** and then click **Configure Modem**.
The **Modem Connection Preferences** window appears.

6.10.5 Setting the Network Port Number

The default network port number of **1024** is automatically configured for the APP Recorder. You can change the port number, if necessary.

➢ To Set the Network Port Number

1. In the **APP Recorder** window, from the **Connect** menu, click **Set Network Port#**.
   The Network Port# dialog box appears.
2. Enter the network port number and click OK.

6.10.6 Turning On or Off Dial-up Networking

If you have configured dial-up networking, you can manually turn it on or off as necessary. Windows 10 does not have Dial-Up Networking available. If Windows 10 is running Dial-Up Networking will be set to Off and unable to be turned ON.

See *Setting Up Dial-up Networking* for instructions on setting up dial-up networking

➢ To Turn On or Off Dial-up Networking

In the **APP Recorder** window, from the **Connect** menu, click **Dial-up Networking**.

- If the menu option says, **Off**, then clicking this option immediately turns on dial-up networking.
- If the menu option says, **On**, then clicking this option immediately turns off dial-up networking.

6.11 Maintaining the APP Recorder

You can perform the following maintenance tasks for the APP Recorder:

- View the trace files
- Run a diagnostic test
- View all SER abnormal or stopped channels
- Perform a test run
- View the list of "ON" alarms
- Reset the Fault ID
- Reinitialize the APP Recorder
- Restart APP Recorder
- Reboot the APP Recorder
- Reserve the Memory and Defrag the data drive

6.11.1 Viewing Trace Files

You can use trace files to help during troubleshooting. There is a separate trace file for the APP Recorder and the APP Driver.

Trace files include:

- Tracexxx.wri Driver Trace File
- CTracexxx.wri Connection Trace File
- RTracexxx.wri Recorder Trace File
- ATracexxx.yyy All Trace File

Note: xxx is recorder number and **yyy** is a sequence number

Each trace file lists the major processes carried out by its respective program, either the APP Recorder or the APP Driver. When a trace file grows to approximately 500 Kbytes, it will automatically be closed and given an extension an incremented extension (for example, .001, .002, and so on.) A new trace file will be created.

There is also an All Trace (**ATrace**) file available. The ATrace is intended for use with software to parse the ATrace log for specific trace information. The ATrace is not simply a consolidation of the Recorder and Driver trace files. The ATrace includes additional trace information from: Recorder, Driver, PMU, DNP3, Modbus, IRIG-B and is intended for diagnostics and correlation of log entries.

The Recorder, Driver trace and ATrace files are stored in the **C:\APP Recorder\Setup** directory.

➢ **To View the Trace File for the APP Recorder**

In the **APP Recorder** window, from the **Maintenance** menu, point to **Trace Files** and click **Show Trace File**.
The trace file for the APP Recorder appears.

➢ **To View the Trace File for the APP Driver**

In the **APP Recorder** window, from the **Maintenance** menu, point to **Trace Files** and click **Show Driver Trace File**.
The trace file for the APP Driver appears.

➢ To View the All Trace (ATrace) File

In the APP Recorder window, from the Maintenance menu, point to Trace Files and click Show All Trace File.
The trace file for the APP Driver appears.

6.11.2 Running a Diagnostic Test and Viewing Results

Each APP Recorder does an automatic diagnostic test every 5 minutes. In addition, you can initiate a manual diagnostic test against the APP Recorder and view the results.

Note: You can also run a diagnostic test from within the **APP Driver** window and from the master station.

➢ To Run a Diagnostic Test and View Results

1. In the **APP Recorder** window, from the **Maintenance** menu, point to **Diagnostic** and click one of the following:

   - Click **Show Result** to view the results of the last diagnostic test that was completed.
   - Click **Redo Diagnostic** to perform a new diagnostic test and view its results. **Show Result**.

   The **Recorder Diagnostic Results** window appears.

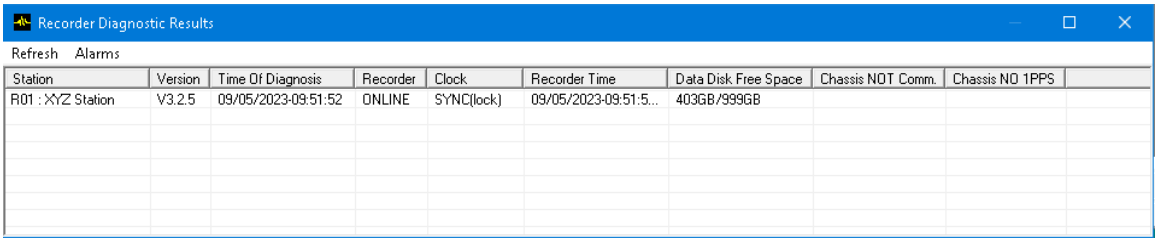


Figure 70: Recorder Diagnostic Results Window

To see the details of an entry, double-click its name in the list. To see the latest diagnostic results, from the menu bar, click Refresh.

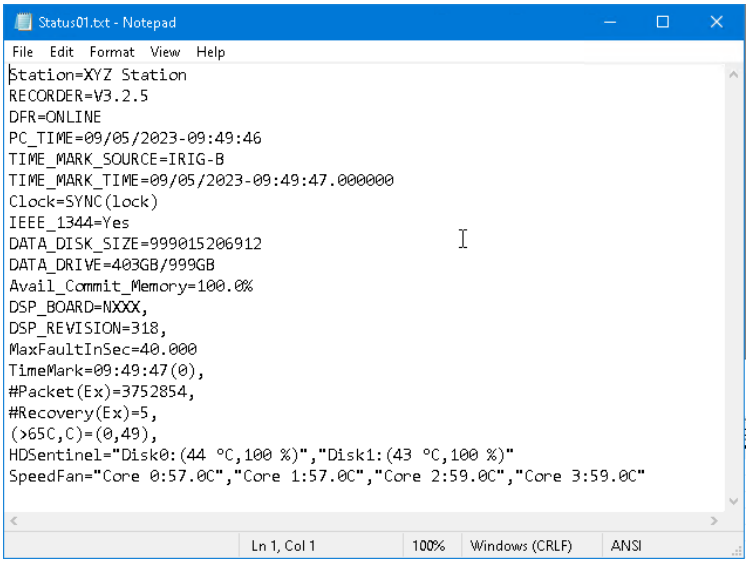


Figure 71 Diagnostics Results Detail

2. To see which alarms are currently ON, from the menu bar, click **Alarms**.
   The **Alarms** dialog box displays the alarms.

3. To close the **Recorder Diagnostic Results** window, click the X in the upper right-hand corner.

6.11.3 Viewing All SER Abnormal or Stopped Channels

Note: The Point Assignment Record contains a setting, under the **General Settings** tab that allows you to automatically shut down an SER channel if it changes state too many times in a fixed period. The SER channel will automatically restart after a user-defined shutdown period.

➢ **To View All SER Abnormal or Stopped Channels**

1. In the **APP Recorder** window, from the **Maintenance** menu, click **Show All SER Abnormal Or Stopped Channels**.
   The following window appears and displays SER channels that are in a stopped or abnormal state:

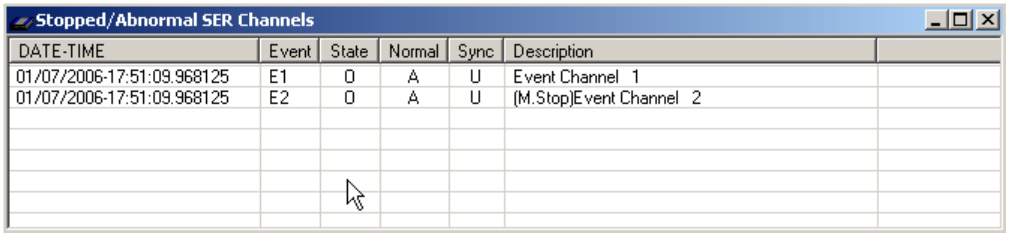


Figure 72: Stopped/Abnormal SER Channels Window

- In the **State** column, an **O** represents an open contact and a **C** represents a closed contact.
- In the **Normal** column, an **A** indicates the channel is currently in an abnormal state and an **N** indicates the channel is currently in a normal state.
- In the **Sync** column, a **U** indicates an unsynchronized time and an **S** represents a synchronized time.
- If an SER channel is stopped, the word **Stop** will appear at the beginning of the channel description, along with either an **M** or an **A:**
  - **M** indicates that the channel has been stopped manually via the Point Assignment Record.
  - **A** indicates that the channel stopped automatically.

6.11.4 Performing a Test Run

You can perform a test run to test if the APP Recorder is really recording and to check all the channel data.

When you perform a test run, the APP Recorder trips, creating a transient COMTRADE record. The COMTRADE records contain a snapshot of all the analog channel signals, and the state of all DFR channels, plus the present status of the event inputs.

In addition, if the extended recording feature is enabled in the Point Assignment Record (**General Settings** tab: **Sampling** tab), an extended RMS COMTRADE record and an extended oscillography COMTRADE record will also be created. You can view the transient, extended-RMS, and extended oscillograph records with the APP ClearView program, which is loaded on the APP Recorder computer, or with any COMTRADE viewer.

If the Transient Alarm is turned on, during a Test Run the Cross Trigger Alarm will turn on as well as if there is an IP Cross Trigger set up it will turn on.

The record length will be prefault + post fault. The trigger alarm will not energize during a test run. However, the trigger front panel LED will illuminate.

If the auto-call feature is enabled (**Recorder Configuration** window: **Automatic Tasks** tab), the APP Recorder will call the master station(s) and upload the records.

➢ **To Perform a Test Run**

In the **APP Recorder** window, from the **Maintenance** menu, click **Test Run**.
The system immediately responds. The fault will appear on the screen. You can also, start a test run by pressing **F12** anytime except when offline like when the Oscope is being displayed.

➢ **Test Run at Start of Minute**

In the **APP Recorder** window, from the **Maintenance** menu, click **Test Run at Start of Minute**.
The system will await the start of the next minute and do a test run. The fault will appear on the screen.

6.11.5 Viewing the ON Alarms

You can view a list of the alarms that are currently turned on.

➢ **To View the ON Alarms**

In the **APP Recorder** window, from the **Maintenance** menu, click **Show Alarm ON List**.
The **Alarms Currently On** window appears.

Figure 73: Alarms Currently ON Window

6.11.6 Resetting Fault ID

As each fault record is created the Fault Identification number, or FID, is incremented by one. If the extended recording feature is enabled in the Point Assignment Record (**General Settings** tab: **Sampling** tab), a single trigger will create two new FID numbers, one FID for the transient record and one FID for the extended records.

At any time, you can reset the Fault Identification number to 1. You may want to do this to clean up any old records.

Note: An old record with the same FID as newly created record will not be overwritten due to date and time difference.

CAUTION **Resetting the FID causes the APP Recorder Program to re-initialize and the APP Recorder to go offline for a few moments.**

➢ **To Reset the FID**

1. In the **APP Recorder** window, from the **Maintenance** menu, click **Reset FID**.
2. Enter the password
3. Click **ok**

6.11.7 Re-initializing the APP Recorder Program

You can re-initialize the APP Recorder program to help with troubleshooting.

Note: Re-initializing only restarts the APP Recorder software. Rebooting turns off the entire APP Recorder machine.

CAUTION **The re-initialize command will take the APP Recorder offline for a few moments.**

➢ **To Re-Initialize the APP Recorder Program**

1. In the **APP Recorder** window, from the **Maintenance** menu, click **Reinitialize**. You can also press (F8) at any time except when offline like when displaying oscope.

6.11.8 Restart Recorder

Restart Recorder will immediately **EXIT** APP Recorder program and then re-start it.

1. In the **APP Recorder** window, from the **Maintenance Menu**, select **Restart APPRecorder.**
2. **Recorder will be exited and go Offline.**
3. App Monitor will restart APP Recorder within 60 seconds

CAUTION **The re-initialize command will take the APP Recorder offline for a few moments.**

6.11.9 Rebooting the APP Recorder Program

You can re-boot the APP Recorder program to help with troubleshooting.

When you reboot, power is momentarily cut to the APP Recorder. The computer and all circuit boards will see a hard power shutdown. Power is cut via a normally closed relay on the data chassis power supply circuit board. After 9-10 seconds power will return, and the system will restart. It takes approximately 1minute and 30 seconds for the system to return to an online state.

Note: Rebooting turns off the entire APP Recorder machine. Re-initializing only restarts the APP Recorder software.

CAUTION **The APP Recorder will be offline during the restart period.**

➢ **To Re-Boot the APP Recorder Program**

In the **APP Recorder** window, from the **Maintenance** menu, click **Reboot**. You can also reboot by pressing F9 anytime except when offline (e.g. when displaying oscope).

6.11.10 Reserving Memory and Defragging the Data Drive

Occasionally, you may need to reserve memory and/or defragment the data hard drive remotely. Reserving memory or defragmenting the hard drive will take up considerable CPU time (hours) and once started, you will be unable to stop these processes remotely.

CAUTION **Perform these functions only if there is little or no likelihood of a fault for 2 to 24 hours.**

➢ **To Reserve Memory**

1. Make sure **Sampling tab** is set as desired.
2. Go to **Chassis tab**. Create a temporary Chassis Configuration that contains the number of analog channels you want to reserve memory for plus add 10% more channels than actual channels present.

CAUTION **We recommend keeping 30% or more hard drive space available for other computer operations**

3. In the **APP Recorder** window, from the **Maintenance** menu, click **Reserve Memory**.
   A **Warning** message appears.
4. Click **Yes**.
5. To check if the reserve memory process is finished, look at the APP Recorder trace file. In this file, the message, "Begin Reserve Memory" appears when the reserve memory process starts. The message, "End Reserve Memory" appears when the process finishes. For information, see *Viewing Trace Files*.
6. Reserve memory is done to allocate designated space on the computer hard drive for continuous recording. Reserving memory helps eliminate disk fragmentation over time. A disk defrag should be done after reserving memory.

➢ **To Perform a Defrag Analysis, Defrag the Data Drive, and View the Results**

1. In the **APP Recorder** window, from the **Maintenance** menu, click **Run Defrag Analysis on Data Drive**.
2. After viewing the results, do you want to defrag the data drive?
   - If **yes**, continue with step 3.
   - If **no**, you are finished with this procedure.
3. From the **Maintenance** menu, click **Defragment Data Drive…**.
   A confirmation window appears.
4. Click the **Yes** button.
5. Wait a minute or two.
6. From the **Maintenance** menu, click **Show Defragment Status**.

6.12 Continuous Recording

You can enable or disable continuous recording in the Point Assignment Record. Two types of continuous recording can be enabled:

A combination of continuous RMS, Frequency, and Phase. You enable or disable these three choices together. They have a 99-day maximum circular buffer. You can view these types of continuous recording in near real-time in the **APP Recorder** window.

Note: Phase angle is shown relative to a selected channel.

Continuous oscillography recording. This has a 99-day maximum circular buffer, however, 15 days is more practical and depends on the number of analog channels and hard drive size.

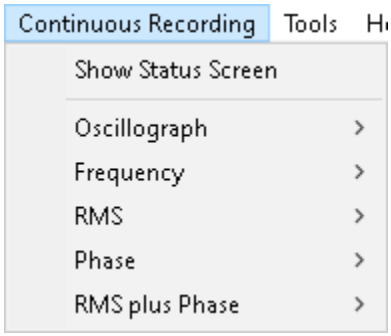


Figure 74: Continuous Recording Menu

6.12.1 Viewing the Continuous Recording Status Window

You can verify that the APP Recorder is actively calculating quantities and saving data by viewing the status window. The APP Recorder stores the continuous oscillography data and calculated RMS, Frequency, and Phase quantities in the following folders:

- C:\APP Recorder\Data*OsclgrDatq*
- C:\APP Recorder\Data*RmsData*
- C:\APP Recorder\Data*FreqData*
- C:\APP Recorder\Data*PhaseData*

Trend files are created in the **RmsData and FreqData** Folders as well. COMTRADE files are created for the Trend files automatically every 10 minutes.

➢ To View the Continuous Recording Status Window

In the **APP Recorder** window, from the **Continuous Recording** menu, click **Show Status Window**. The following window appears.

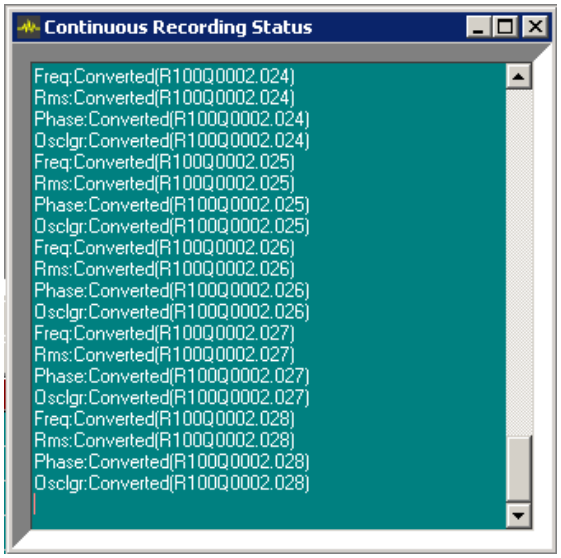


Figure 75: Continuous Recording Status Window

6.12.2 Saving Oscillograph Data

You can save a time slice of data to a file. You can open and view the file with the APP ClearView program.

1. In the **APP Recorder** window, from the **Continuous Recording** menu, point to **Oscillograph** and then click "**Save Oscillograph Data**…". The following window appears.

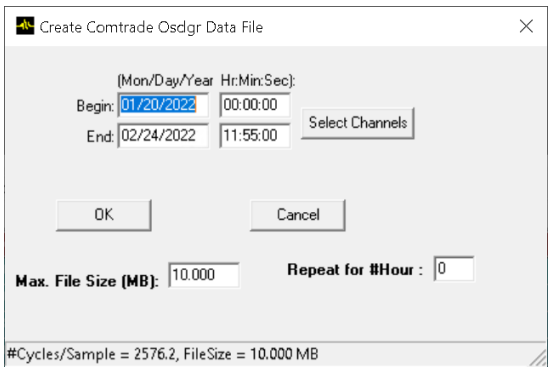


Figure 76: Time Slice Entry Window

2. In the **Begin:** and **End:** fields, enter time slice values.

3. Click the **Select Channels** button to select the channels you want. If you do not select specific channels, then all analog channels will be retrieved.

4. **MAX File Size,** Enter the file size in Megabytes for the file size you wish to allow. Typically, you want to make the file size large enough to capture full record resolution. The continuous oscillography in normally recorded at 16 samples per cycle. So, increase the file size until the "#samples/cycle = 16" (see bottom of the window in Figure 76: Time Slice Entry Window). The same is true for the other continuous recording types. If the file size entered results in a number of samples/cycles less than full resolution, then data samples will be reduced equally throughout the record length. This may result in an unusual looking wave form.

5. **Repeat for #Hour,** will repeat the interval by adding 1 hour to the Start and End then repeat the process for the number of hours entered.
   Enter the number of hours to repeat the interval.

6. click **OK**.

6.12.3 Saving Frequency Data

You can save a time slice of data to a file. You can open and view the file with the APP ClearView program.

Continuous frequency is calculated using a sliding window. A single frequency data point is calculated using 5000 data samples (total cycles/time). At a recording rate of 600Hz it will take 8 seconds to obtain the first data point. Thereafter, a point is calculated every X cycles (X is the user entered cycles/point value, see Point Assignment Record) but still using 5000 data points.

➢ To Save Frequency Data

1. In the **APP Recorder** window, from the **Continuous Recording** menu, point to **Frequency** and then click **Save Freq. Data**.

2. Complete the entry fields

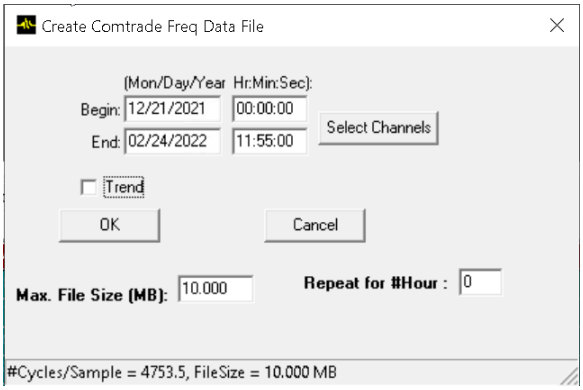


Figure 77: Save Freq Data File

3. **Trend Check Box**, checking the **Trend** box will create a **Frequency Comtrade file** for all channels or specified channels, including a Maximum, Minimum, and Average Voltage value for each interval over the period indicated.

   Do you want to capture frequency data over a period of time, contingent on the number of days set in the PAR General Settings tab, Continuous Recording Freq + RMS + Phase, # of Days, and maintain a manageable file size?

   - **If yes**, click the Trend check box and enter an **interval** in minutes typically 1 minute is used. At the bottom of the window, you can see the expected file size and the effect of interval minutes selected.
   - **If no**, then skip to the next step

Note: Trend and Repeat for #Hour cannot be used at the same time. If you check the Trend box, the Repeat for #Hour will be unavailable on the screen.

4. **MAX File Size,** Enter the file size in Megabytes for the file size you wish to allow. Typically, you want to make the file size large enough to capture full record resolution. The continuous oscillography in normally recorded at 16 samples per cycle. So, increase the file size until the "#samples/cycle = 16" (see bottom of the window in Figure 77: Save Freq Data File)The same is true for the other continuous recording types. If the file size entered results in a number of samples/cycle less than full resolution, then data samples will be reduced equally throughout the record length. This may result in an unusual looking wave form.
5. **Repeat for #Hour,** will repeat the interval by adding 1 hour to the Start and End then repeat the process for the number of hours entered. To use Repeat for #Hour do not check the Trend box

   Enter the number of hours to repeat the interval.
6. Click **OK**.

6.12.4 Saving RMS Data

You can save a time slice of **RMS** data to a file. You can open and view the file with the APP ClearView program.

➢ **To Save RMS Data**

1. In the APP Recorder window, from the **Continuous Recording** menu, point to **RMS** and then click **Save RMS Data**

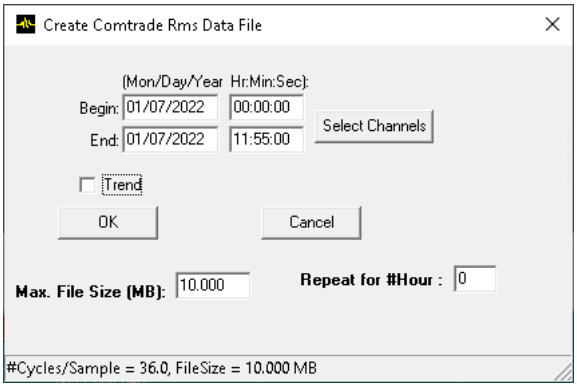


Figure 78: Create Comtrade RMS Data File

2. In the **Begin:** and **End:** fields, enter time slice values.
3. Click the **Select Channels** button to select the channels you want. If you do not select specific channels, then all analog channels will be retrieved.
4. **Trend Check Box**, checking the **Trend** box will create an **RMS Comtrade file** for all channels or specified channels, including a Maximum, Minimum, and Average Voltage value for each **Interval** over the period indicated.

   Do you want to capture frequency data over a period of time, contingent on the number of days set in the PAR General Settings Tab, Continuous Recording Freq + RMS + Phase, # of Days, and maintain a manageable file size?

   - **If yes**, click the **Trend** check box and enter an **interval** in minutes typically 1 minute is used. At the bottom of the window, you can see the expected file size and the effect of interval minutes selected.

- **If no**, then skip to the next step

Note: Trend and Repeat for #Hour cannot be used at the same time. If you check the Trend box, the Repeat for #Hour will be unavailable on the screen.

5. **MAX File Size,** Enter the file size in Megabytes for the file size you wish to allow. Typically, you want to make the file size large enough to capture full record resolution. The continuous oscillography in normally recorded at 16 samples per cycle. So increase the file size until the "#samples/cycle = 16" (see bottom of the window in (Figure 76: Time Slice Entry Window). The same is true for the other continuous recording types. If the file size entered results in a number of samples/cycle less than full resolution, then data samples will be reduced equally throughout the record length. This may result in an unusual looking wave form.
6. **Repeat for #Hour,** will repeat the interval by adding 1 hour to the Start and End then repeat the process for the number of hours entered. To use Repeat for #Hour do not check the Trend box

   Enter the number of hours to repeat the interval.
7. Click the **OK** button

6.12.5 Saving Phase Data

You can save a time slice of data to a file. You can open and view the file with the APP ClearView program. You can also change the relative phase angle that is shown APP Recorder main window (continuous metering window).

➢ **To Save Phase Data**

1. In the **APP Recorder** window, from the **Continuous Recording** menu, point to **Phase** and then click **Save Phase Data**.

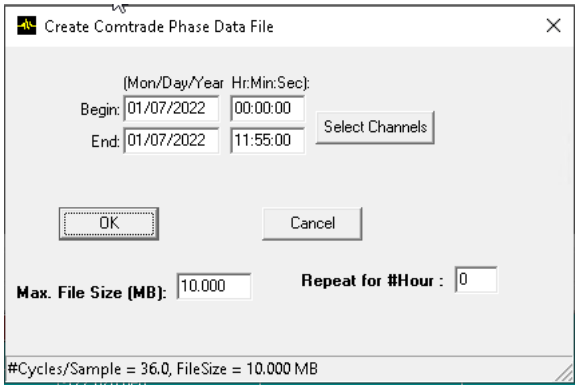


Figure 79: Create Comtrade Phase Data File

2. In the **Begin:** and **End:** fields, enter time slice values.
3. Click the **Select Channels** button to select the channels you want. If you do not select specific channels, then all analog channels will be retrieved.

4. **MAX File Size,** Enter the file size in Megabytes for the file size you wish to allow. Typically, you want to make the file size large enough to capture full record resolution. The continuous oscillography in normally recorded at 16 samples per cycle. So increase the file size until the "#samples/cycle = 16" (see bottom of the window in (Figure 79: Create Comtrade Phase Data File). The same is true for the other continuous recording types. If the file size entered results in a number of samples/cycle less than full resolution, then data samples will be reduced equally throughout the record length. This may result in an unusual looking wave form.
5. **Repeat for #Hour,** will repeat the interval by adding 1 hour to the Start and End then repeat the process for the number of hours entered.

   Enter the number of hours to repeat the interval.
6. Click the **OK** button.

6.12.6 Save Phase Data - Change Reference Channel

You can change the reference channel for Phase data.

1. In the **APP Recorder** window, from the **Continuous Recording** menu, point to Phase and then click **change Reference Channel**.

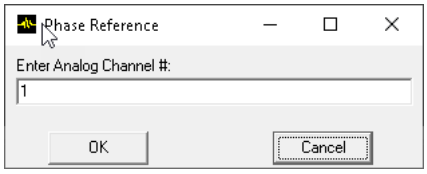


Figure 80: Change Phase Reference Channel

2. Enter the **Analog Channel number** to make the reference.
3. Click **OK**

6.12.7 Saving RMS-Plus Phase Data

You can save a time slice of data that contains both continuous RMS values and continuous Phase values to a file. You can open and view the file with the APP ClearView program. The data is displayed in channel sequential order.

IMPORTANT If you created a line group, then you can view power and impedance graphs for this data time slice.

➢ To Save RMS-Plus Phase Data

1. In the **APP Recorder** window, from the **Continuous Recording** menu, point to **RMS Plus Phase** and then click **Save RMS Plus Phase Data**.

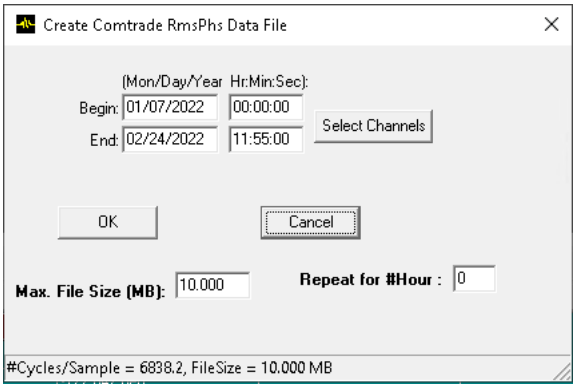


Figure 81: Create Comtrade RMS and Phase Data File

2. In the **Begin:** and **End:** fields, enter time slice values.

3. Click the **Select Channels** button to select the channels you want. If you do not select specific channels, then all analog channels will be retrieved.

4. **MAX File Size,** Enter the file size in Megabytes for the file size you wish to allow. Typically, you want to make the file size large enough to capture full record resolution. The continuous oscillography in normally recorded at 16 samples per cycle. So, increase the file size until the "#samples/cycle = 16" (see bottom of the window in (Figure 81: Create Comtrade RMS and Phase Data File). The same is true for the other continuous recording types. If the file size entered results in a number of samples/cycle less than full resolution, then data samples will be reduced equally throughout the record length. This may result in an unusual looking wave form.

5. **Repeat for #Hour,** will repeat the interval by adding 1 hour to the Start and End then repeat the process for the number of hours entered.

   Enter the number of hours to repeat the interval.

6. Click the **OK** button.

6.13 Using Other Tools

The **Tools** menu contains additional tools for the APP Recorder.

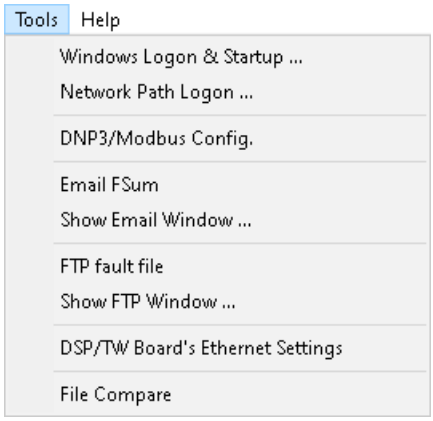


Figure 82: Tools Menu Window

6.13.1 Startup and Running the APP Monitor

APP Recorder can be set up to automatically start when the computer restarts and using APP Monitor to automatically start if APP Recorder is shutdown. When APP Monitor is running, APP Recorder will restart within 60 seconds of being closed. This is important to ensure no manual intervention is required to maintain APP Recorder operation.

See **Section 5.3 Startup and Running the APP Monitor**

6.13.2 Network Path Logon

This feature is used to automatically log the DFR onto a network drive at APP Recorder Startup or is reinitialized. Fill in the fields shown to achieve connectivity to the desired network drive. To see if connection has been established, go to Windows Directory, and see if the desired drive is shown and/or accessible. This feature is in lieu of writing your own batch file that launches when the DFR computer starts.

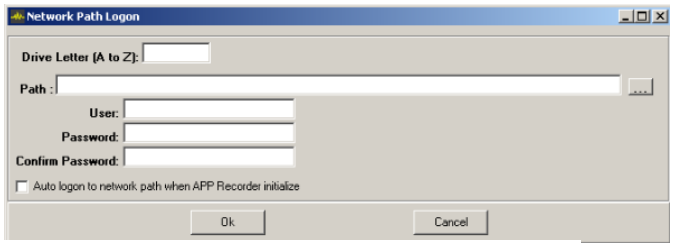


Figure 83: Network Path Logon

6.13.3 Configuring a DNP3/Modbus Outstation

➢ **Configuring DNP-3 or Modbus Protocol**

You can configure a DNP3 or Modbus outstation for the APP-601 Recorder. The APP-601 Recorder provides the following information through DNP-3 and Modbus:

1. Analog Channel RMS
2. Analog Channel Frequency
3. Analog Channel Phase
4. Fault Location
5. Trigger Channels
6. PMU Line (Hz)
7. PMU Line (kW)
8. PMU Line (kVar)

NOTE: The analog channel frequency and phase are obtained by asking for an extended range of the analog information. The information needed for DNP-3/Modbus master to translate the data after received is located in the file RxxDnp3.txt in setup folder of the recorder. This file is generated by the APP-601 Recorder automatically.

DNP-3/Modbus Prerequisites

You can configure a DNP3 or Modbus outstation only if the DNP-3/Modbus check box in the **Point Assignment Record/General Settings** has been selected. Additionally, to generate data to output via DNP-3/Modbus, the extended recording and continuous recording features must be enabled. You can enable these on the **General Settings** tab: **Recorder Setup** tab in the Point Assignment Setup window.

➢ **Configuring DNP-3**

1. In the **APP Recorder** window, from the **Tools** menu, click **DNP3/Modbus Config.** The following window appears.

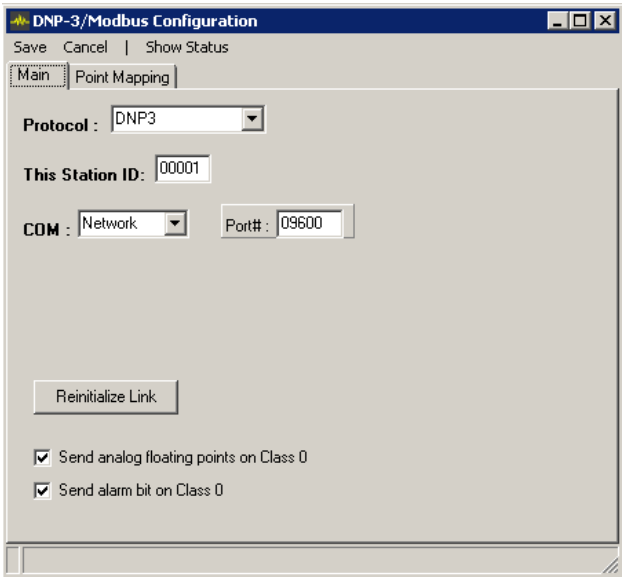


Figure 84: DNP-3/Modbus Configuration Window (DNP-3)

2. In the Protocol field, select the protocol DNP-3.
3. In the **This Station ID** box, type the Recorder ID which was setup in the Recorder Configuration window. For information on setting the Recorder ID, see Section 6.7.3 *Configuring the Main Configuration Settings*.
4. From the **COM** list, select the desired communication port.
5. Are you using an RS232 port or a TCP/IP network protocol?
   - If you are using a **RS232** port, select RS232, then from the **Baud Rate** list select a baud rate that will work with your RTU. For RS232 Pinout See Table 16 RS232 Pinout - DNP3, Modbus.
   - If you are using a TCP/IP, select **Network**, then enter the **port number**.
5. **Sending analog floating points on Class 0:** Check this box if you want to send values converted to Floating Point instead of HEX values to the RTU. Otherwise, for the RTU to receive HEX leave unchecked.
6. **Sending Alarm Bit on Class 0:** Check this box if you want to send an alarm bit on class 0 to the RTU to indicate if the DFR has an alarm.
7. From the menu bar, click **Save**.

The APP-601 Recorder accepts the DNP-3 objects and variations shown in the following table.

Table 14: DNP-3 Objects and Variations

Object	Variation	Description	Request Function Codes (dec)	Request Qual Codes (Hex)	Response Function Codes (dec)	Response Qual Codes (Hex)
1	1	Binary Input	1	06	129	
2	2	Binary Input Change with Time	1	06	129	28
30	4	16-Bit Analog Input without Flag	1	06, 01, 28	129	01, 28
60	1	Class 0 Data	1	06	129	01
100	1	Short Floating Point	1	06, 01, 28	129	01, 28

➢ Configuring Modbus

1. In the **APP Recorder** window, from the **Tools** menu, click **DNP3/Modbus Config**. The following window appears.

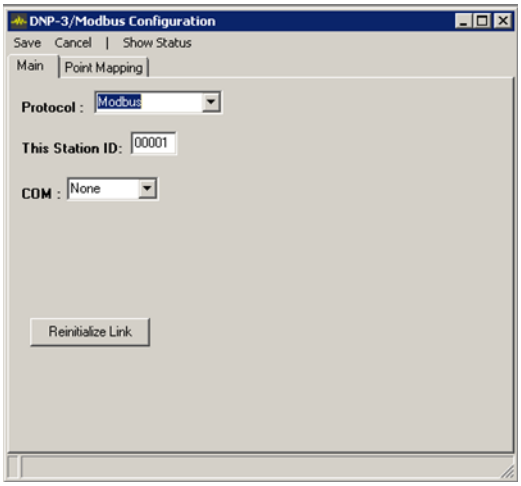


Figure 85: DNP-3/Modbus Configuration Window (Modbus)

2. In the **Protocol field**, select the protocol **Modbus**
3. In the **This Station ID** box, type the Recorder ID, which was setup in the Recorder Configuration window. For information on setting the Recorder ID, see Section 6.7.3 *Configuring the Main Configuration Settings*.
4. From the **COM** list, select the desired communication port.
5. Are you using an RS232 port or a TCP/IP network protocol?
   - If you are using a **RS232** port, select RS232, then from the **Baud Rate** list select a baud rate that will work with your RTU. For RS232 Pinout See Table 16 RS232 Pinout - DNP3, Modbus
   - If you are using a **TCP/IP**, select **Network**, then enter the **port number**. The standard port is **502** for Modbus.
6. From the menu bar, click **Save**.

APP-601 Recorder accepts the Modbus Function Codes as shown in Table-13.

Table 15: Modbus Function Codes

Function Code	Modbus Function Name	Recorder Function
2	Read Discrete Input	Binary Input
4	Read Input Registers	16-Bit Analog Input

RS232 Com1 and Com2 Pinouts

Pin outs for Com1 and Com2 are below. We only use RXD and TXD which are pins 3 and 5 for both Com1 and Com2.

Table 16 RS232 Pinout - DNP3, Modbus

COM1 (RS-232/422/485):

Pin	RS-232	RS-422	RS-485
1	DCD	TX-	Data-
2	DSR	No use	No use
3	RXD	TX+	Data+
4	RTS	No use	No use
5	TXD	RX+	No use
6	CTS	No use	No use
7	DTR	RX-	No use
8	RI	No use	No use
9	GND	No use	No use
10	No use	No use	No use

COM2 (RS-232 only):

Pin	Signal	Pin	Signal
1	DCD	2	DSR
3	RXD	4	RTS
5	TXD	6	CTS
7	DTR	8	RI
9	GND	10	N.C.

6.13.4 To Configure a DNP3/Modbus Outstation Point Mapping TAB

➢ **Click Point Mapping Tab**

The Point Mapping Tab allows you to limit the records sent to the RTU. You can limit the channels for RMS, Frequency and Phase, as well as limit the Lines provided for Fault Location.

If the Point Mapping table is empty, only analog channels RMS, and no frequency, phase or fault location will be sent, and the order for analog channels will be analog channel 1, 2, 3 and so on. If the table is not empty, then only the ones on the table will be sent and according to the order on the table.

For fault location, the unit is in miles and is multiplied by 10 for 16-bit analog input. For example, a fault location of 24.6 miles will be represented by 246. The fault location can be configured to be reset to 0 in number of minutes or never reset until next valid fault location has arrived.

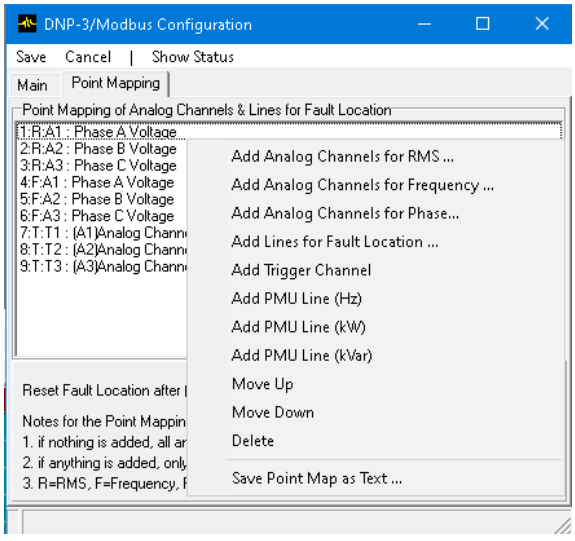


Figure 86: Point Mapping

Right click in the open screen to get mapping menu

- Select one of the five options for adding Channels or lines to the mapping.
- Analog Channels for RMS
- Analog Channels for Frequency
- Analog Channels for Phase
- Lines for Fault Location
- Trigger Channel
- PMU Line (Hz)
- PMU Line (kW)
- PMU Line k(Var)

Note: When adding Trigger Channels, a trigger must be configured in the Point Assignment Record.

Each record will be labeled with a number and type: R=RMS, F=Frequency, P=Phase, L=Line, T=Trigger.

1. Order the list by selecting one or more and click Move Up or Move Down.
2. Remove from the list by selecting one or more and click **Delete**.
3. You can save a Text File of the list by clicking Save Point Map as Text then browsing to the folder you want and type a name and click OK.

➢ To View the DNP3/Modbus Communication Status

You can view the DNP3 communication status while the APP Recorder is running.

1. In the APP Recorder window, from the Tools menu, click **DNP3**. The DNP-3/Modbus Configuration Window appears as shown in Figure 84.
2. From the menu bar, click Show Status. The window appears, as shown in the following figure.

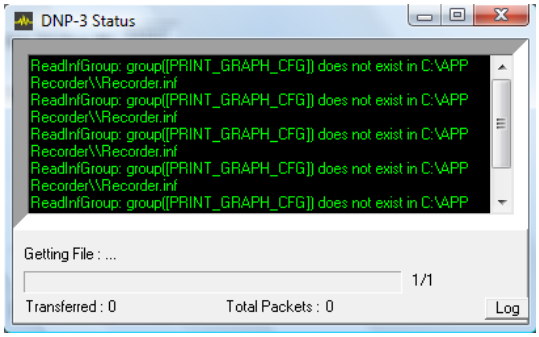


Figure 87: DNP-3/Modbus Status Window

6.13.5 Emailing a Fault Summary Record

You can email a Fault Summary record at any time to those email addresses that you configured to receive it. For information on setting up these email addresses, see Configuring Email Settings on page 6-21.

Note: The Fault Summary record is sent to all of the configured email addresses.

➢ **To Email a Fault Summary record**

In the **APP Recorder** window, from the **Tools** menu, click **Email FSum**.
The Fault Summary record is immediately sent.

6.13.6 Showing the Email Settings Window

Email configuration settings, including the list of recipients who receive Fault Summary Reports, are centrally managed in the Email Settings window. You can access this window when you configure the APP Recorder (**Edit** menu, **Configuration** menu option). A more direct route is to access the **Email Settings** window directly from the **Tools** menu.

➢ **To Show the Email Settings Window**

In the **APP Recorder** window, from the **Tools** menu, click **Show Email Window**.
The **Email Settings** window appears. For information on these settings, see Configuring Email Settings on page 6-21.

6.13.7 FTP a Fault File

A fault file contains an individual fault record.

If a Fault file is stalled in the FTP buffer, you can manually send it via FTP to the host directory. The APP Recorder uses the FTP settings that you configured. For information on the FTP configuration settings, see *Configuring FTP Settings* on page 6-24.

➢ **To FTP a Fault File**

In the **APP Recorder** window, from the **Tools** menu, click **FTP Fault File**.
The file is immediately sent.

6.13.8 Show FTP Window

FTP configuration settings are centrally managed in the FTP Settings window. You can access this window when you configure the APP Recorder (**Edit** menu, **Configuration** menu option). A more direct route is to access the FTP Settings window directly from the **Tools** menu.

➢ **To Show the FTP Settings Window**

In the **APP Recorder** window, from the **Tools** menu, click **Show FTP Window**.
The FTP Settings window appears. For information on the FTP configuration settings, see *Configuring FTP Settings* on page 6-24.

6.13.9 Configuring a DSP/TW Board's Ethernet and IP Address Settings

Before an APP-601 Recorder leaves the factory, each of its DSP/IRIG boards is programmed with an Ethernet Address, IP Address, Subnet Mask, and Default Gateway. In a centralized or turn-key system, it is highly unlikely the Ethernet or IP Addresses will ever need to be changed. However, if the factory ships an-add on Data chassis for a distributed architecture system and does not know the location of the installation, you will need to program the appropriate DSP Ethernet Address and IP Address upon receipt.

You can configure the DSP board using one of 2 connection approaches. By RS232 or by Ethernet cable using UDP. See below the instructions for each connection approach. Advanced users only should attempt using the Ethernet/UDP connection approach.

Examples of Ethernet and IP Addresses

The Ethernet and IP addresses should increase by an increment of 1 for each successively installed Data chassis. For example:

Computer Control Chassis (Typical)
IP Address: 192.168.203.220
Subnet Mask: 255.255.255.0

1st Data Chassis (Typical)
Ethernet Address = 2-35-69-86-203-1
IP Address = 192.168.203.1
Subnet Mask = 255.255.255.0
Default Gateway = 192.168.203.220

2nd Data Chassis (Typical)
Ethernet Address = 2-35-69-86-203-2
IP Address = 192.168.203.2
Subnet Mask = 255.255.255.0
Default Gateway = 192.168.203.220

3rd Data Chassis (Typical)
Ethernet Address = 2-35-69-86-203-3
IP Address = 192.168.203.3
Subnet Mask = 255.255.255.0
Default Gateway = 192.168.203.220

The same pattern would be followed for additional Data chassis.

Caution **Duplicating an IP Address on two Data Chassis could cause the DSP Board to need repair if left in conflicting state too long.**

WARNING **See Installation Section on page 3-1, for proper installation and chassis power up instructions. Ensure that any newly installed chassis are earth grounded before powering up.**

Note: IP and Ethernet address can be different depending on customer requirements

➢ **To Configure a DSP Board's Ethernet and IP Address Settings Using RS232**

1. Disconnect any Ethernet cable plugged into the DSP RJ45 connector.
2. Connect an APP-provided programming cable from the computer control chassis RS232 port (which is usually COM1) to the 6-pin Mini-Din on the DSP circuit board.

Note: If the programming cable will not reach from the DFR computer to the desired DSP board, you can also make the change from APP ClearView, which can run on your laptop.
In this case, start the APP ClearView program, connect the programming cable between your laptop (COM 1) and the DSP board, click on Tools, and then click on DSP Board's Ethernet Settings. A physical connection should be established, and you will be able to make the necessary settings changes. If a connection is not established, verify that your laptop and the setting on the DSP Board's Ethernet Settings are set to the same Com Port (usually COM 1).

3. Verify that the Data chassis is powered on.

4. In the **APP Recorder** window, from the **Tools** menu, click **DSP/TW Board's Ethernet Settings**. The following window appears. The default connection screen is RS232. If you click the UDP check box, the screen changes to the UDP screen described below.

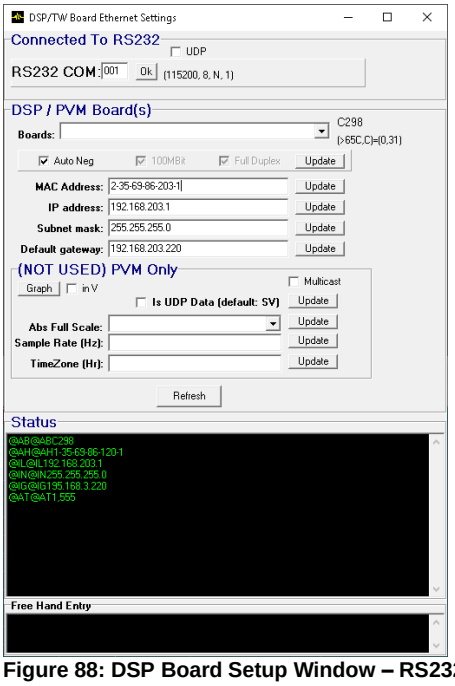


Figure 88: DSP Board Setup Window – RS232

5. **DSP Board check boxes; Auto Negotiate (Auto Neg), 100 Mbit, and Full Duplex**. These are to configure physical connectivity parameters to the APP Recorder or to a communications device (switch). **Auto Neg** is the default setting and is used when connected directly to the APP Recorder computer or to an APP Engineering supplied switch. Customer specified programmable switches not set to Auto Negotiate may need to check the 100Mbit and Full Duplex options to successfully communicate with the switch.

6. Make the necessary updates to the address fields. See *Examples of Ethernet and IP Addresses* above for more information.

7. Click **Update**.

➢ To Configure a DSP Board's Ethernet and IP Address Settings using Ethernet/UDP

Caution **Advanced users only should attempt using the Ethernet/UDP connection approach.**

1. Connect Ethernet cable plugged into the DSP RJ45 connector to the Ethernet port of the computer you will use to configure DSP. You can also use the Recorder Computer.

2. Ensure your computer Firewall software is off/disabled.

3. Verify that the Data chassis is powered on.

4. In the **APP Recorder** window, from the **Tools** menu, click **DSP/TW Board's Ethernet Settings**. Click the **UDP** check box, the screen changes to the UDP screen shown below.

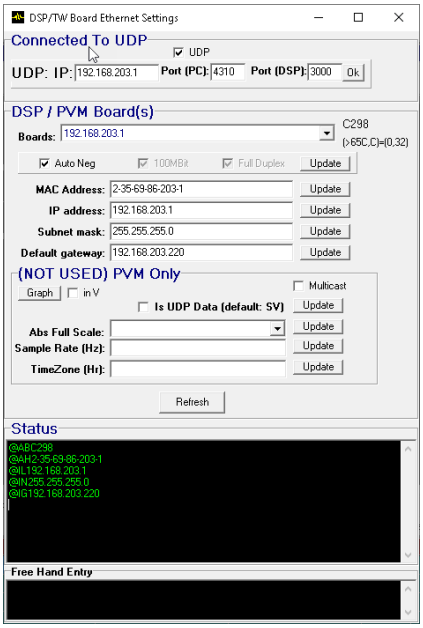


Figure 89: DSP Board Setup Window - UDP

5. Enter the IP address of the DSP board. The multicast address will appear as default. If the computer has multicast enabled, you may be able to use that address. Otherwise, enter the IP address of the DSP board. This can be found in the Point Assignment Record, Chassis TAB.

6. Ports, The PC and DSP Port number defaults will appear. You should use the default assignments.

7. Click the OK button to the right and the MAC, IP, Subnet, and Default Gateway addresses should appear.

8. **DSP Board check boxes; Auto Negotiate (Auto Neg), 100 Mbit, and Full Duplex**. These are to configure physical connectivity parameters to the APP Recorder or to a communications device (switch). **Auto Neg** is the default setting and is used when connected directly to the APP Recorder computer or to an APP Engineering supplied switch. Customer specified programmable switches not set to Auto Negotiate may need to check the 100Mbit and Full Duplex options to successfully communicate with the switch.

9. Make the necessary updates to the address fields. See *Examples of Ethernet and IP Addresses* on page 6-54 for more information.

10. Click **Update.**

CAUTION **If you change an IP Address, be sure to enter the new DSP IP Address in the Point Assignment Record.** See Figure 32: Point Assignment Window's Chassis Configuration

6.13.10 File Compare

File Compare enables viewing two text files to find differences. A primary use could be to find the differences in versions of a Point Assignment Record (PAR)

Click file Compare in the Tools Menu

Figure 90 File Compare window

Select two files by clicking the explorer button to the right of each file field and navigate to the files you would like to compare.

Once both files are listed, **click Compare button**. Once the compare is complete, the differences will appear in Red.

If you click the Animate box, the compare process will show the changes as comparison progresses down the files.

The Status line at the bottom displays compare status and difference in character count.

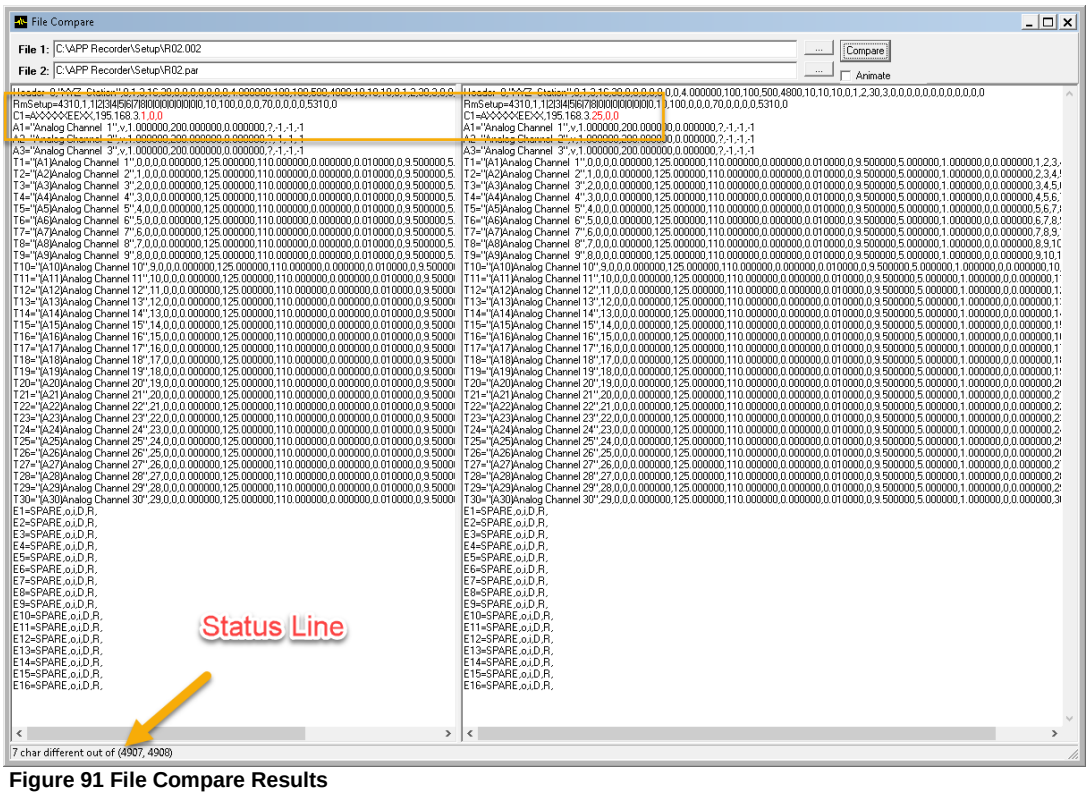


Figure 91 File Compare Results

6.14 Configuring a Phasor Measurement Unit (PMU)

The APP-601 Recorder **PMU** feature supports the IEEE Standard C37.118-2005, which describes the functional requirements for PMUs and basic data measurement and verification requirements. For additional information on the benefits of using PMUs, go to www.naspi.org

Before you can configure a PMU, you must configure the following information in the Point Assignment Record:

- Select the **PMU** check box
- Specify the analog channels

➢ To Configure the Point Assignment Record for PMU Data

1. In the **APP Recorder** window, from the **Edit** menu, point to **Point Assignment Record** and then click **Edit Record**.
   The Point Assignment Record window appears.
2. Click the **General Settings** tab**.**
3. Click the **Recorder Setup** tab.
4. Select the **PMU** check box.
5. From the menu bar, click **Save**.
   A message window appears confirming the save operation.
6. Click the **OK** button.
7. Click the Analog Channels tab. For more information on how to set up analog channels, see the *APP ClearView Instruction Manual*.

➢ To Configure a PMU

1. From the **File** menu, click **Show Driver** then click **PMU**. The PMU window appears, as shown in the following figure.

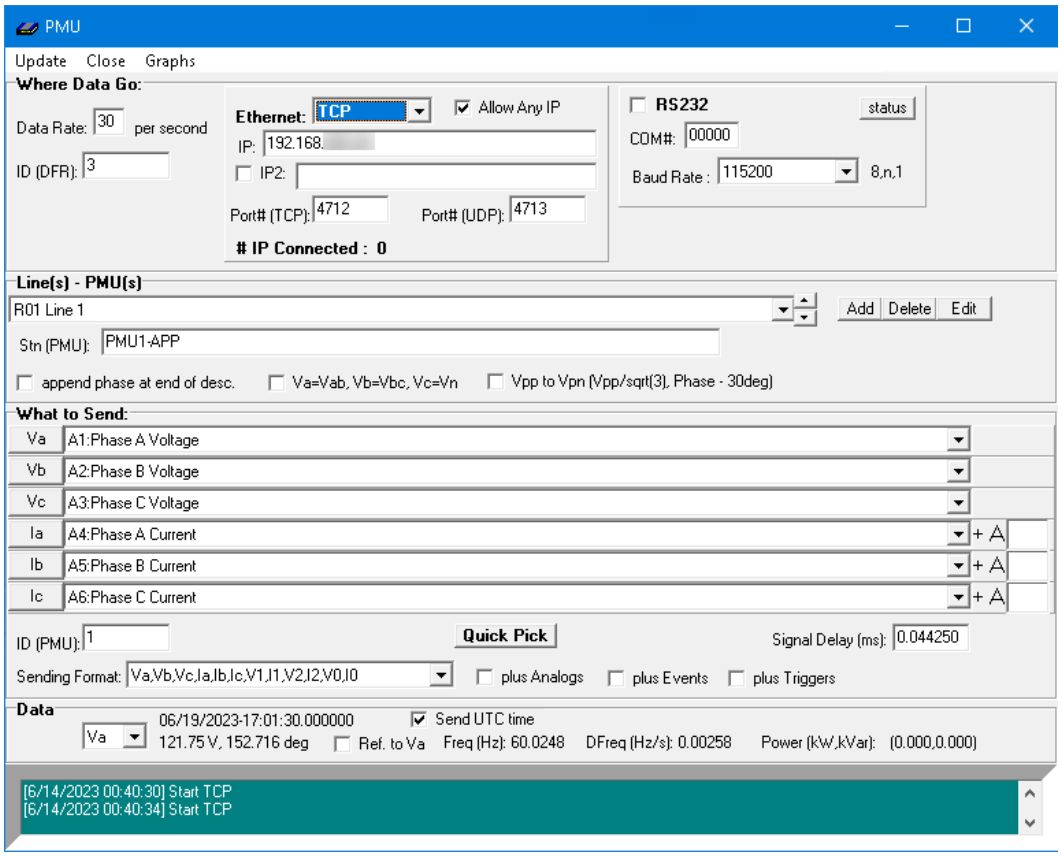


Figure 92: PMU Window

2. Data may be streamed via Ethernet or RS232

3. In the **Data Rate** box, type the desired data rate. 60 per second is the maximum setting. If you are streaming many lines and select 60 frames per second, ensure enough network bandwidth is allocated.

4. In the **ID** box enter an ID number that matches the ID number set in the data concentrator (many times it is 1.)

5. If streaming by Ethernet, select the desired protocol.

   a) UDP will stream commands, configuration, and data via UDP

   b) UDP_T will stream commands, and configuration via TCP and data via UDP

   c) TCP will stream commands, configuration, and data via TCP

   d) UDP_U will stream commands via TCP and configuration, data via UDP

   In the **IP** box, type **the IP address** to where the information will be sent. Default **port number** for **TCP** is 4712 and the default **port number** for **UDP** is 4713. Check with your IT or PMU data concentrator administrator to ensure these are the desired ports.

   IP2, if you have a second IP address you want data streamed to in parallel with the primary IP, Check the box and enter the IP address for IP2.

Allow Any IP, If you want any IP to be able to connect to the recorder click the check box. This will override the IP and IP2 fields.

 # IP Connected shows the number of connections made.

6. If you stream information to a data concentrator that needs to connect via RS232 then check mark **RS232 box** and make the appropriate settings. For the recorder, go to the Windows device manager (Ports) to determine which com port is active. The port can change depending on the computer type and features purchased.
7. **Lines Field** You can manage the line(s) included using the Add, Delete, Edit buttons to add remove or change Lines.
8. **Stn (PMU) Field** allows you to include a custom station label. Type the Station name associated with the Line if desired.
9. **Append Phase at end of Desc,** checking the box causes the format of the Line and Phase information being streamed to be reversed and places the Phase at the end instead of the beginning which is the default.
10. **VPP to VPN (VPP/sq root(3), Phase – 30deg), checking the box causes line voltages to be converted to VPN (Amplitude/ sqrt(3) and phase – 30 Degrees).**
11. **Va-Vab, Vb=Vac, Vc=**Vn check box should be checked when the connection to the analog channel is Phase to Phase instead of Phase to Ground in order to send the correct values.
12. Under **What to Send**, select the appropriate channels for Va, Vb, Vc, Ia, Ib, and Ic. To do this, click the corresponding pull-down menu and select the desired channel.
13. Use the **+A** boxes if you would like to add them to the stream. Enter the number of the Current Channel you would like to add.

Note: The analog channels that appear here are configured in the Point Assignment Record.

14. The 

button opens the list of channels and allows you to select any or all and inserts them. **Select the channels in the correct sequence they should appear**.

CAUTION **When Using Quick Pick to select channels You need to click the check Boxes in the correct order. Not doing so could result in lost data.**

Note: Before you select the channels, be sure that the Point Assignment Record is complete.

15. Specify the **sending format** by clicking the drop down menu and selecting one of the following:
    - If only the positive sequence voltage and positive sequence current should be streamed, select the sending format set (V1, I1).
    - If the phasor for each channel should be sent with the calculated positive sequence voltage and positive sequence current, select the sending format (Va, Vb, Vc, Ia, Ib, Ic, V1, I1).
    - If the phasor for each channel should be sent select (Va, Vb, Vc, Ia, Ib, Ic)
    - If the phasor for each channel should be sent with the calculated positive sequence voltage and positive sequence current, the negative sequence voltage and negative sequence current, and the zero sequence voltage and zero sequence current select the sending format (Va, Vb, Vc, Ia, Ib, Ic, V1, I1, V2, I2, V0, I0).
    - If the phasor for all channels in the DFR should be sent, select the sending format **All Analog Channels**.

- If no phase group should be sent select **No Phase.**

These values can be sent for several lines. The limit on the number of lines that can be sent is dependent on the total analog channel count, sampling rates, and system computer selection.

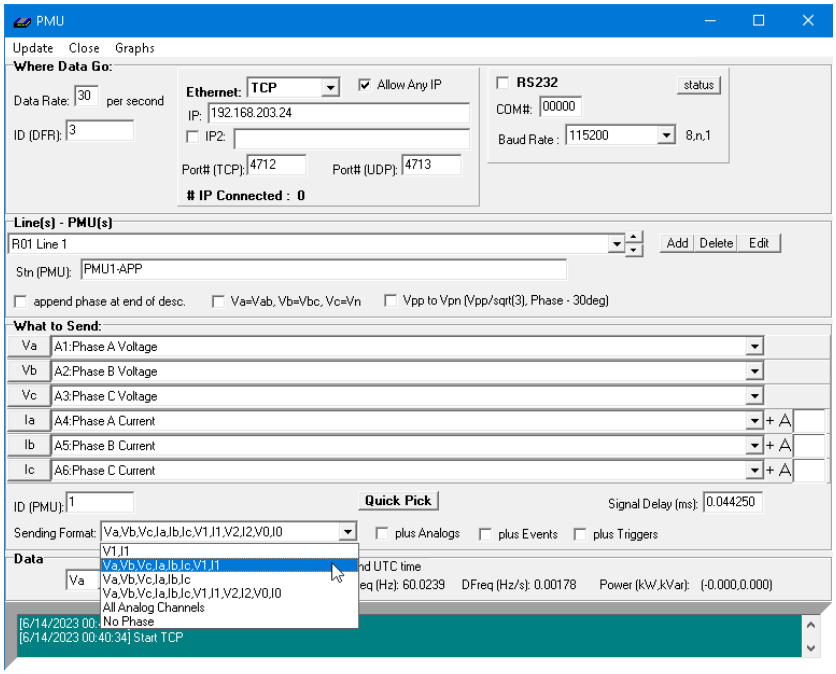
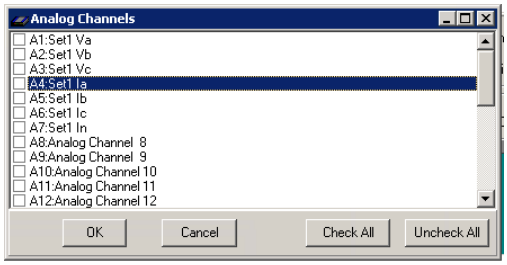


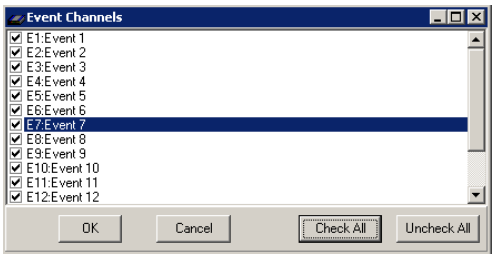
Figure 93: PMU - Sending Format

16. **Plus Analog** check box allows you to add analog channels to the PMU to include the state of each analog channel. When you click the **Plus Analog** check box, a list of the analog channels appears for you to select the channels to include.



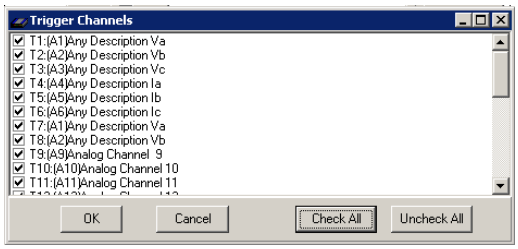
Select the channels and click **OK**

17. **Plus Events** check box allows you to add event channels to the PMU to include the state of each event channel. When you click the **Plus Event** check box a list of events appears for you to choose which events to include.



Select the channels and click **OK**

18. **Plus Triggers** check box allows you to add trigger channels to the PMU to include the state of each analog channel. When you click the **Plus Triggers** check box, a list of the trigger channels appears for you to select the channels to include.



Select the Channels and click **OK**

19. **Send UTC time**, if you want to send the time stamp to the PMU in Coordinated Universal Time (UTC), click the check box for **Send UTC Time**. This will not affect the local time stored on the DFR.

20. The **DATA** section provides the ability to dynamically view the channels' current values by selecting the channel in the drop down.

    Are the Va, Vb, and Vc inputs true 3-phase?

    - If **yes**, then select the **Use Va to measure frequency** check box.
    - If **no**, skip to the next step.

21. Click **Update**.
    The settings are now saved in the APP Recorder\Setup folder under RnnPmu.inf where Rnn is the recorder ID. There are RnnPmu backup files created as well.

22. Click **Close**.

    Note: Clicking **Close** does not automatically save the settings. Remember to click **Update**.

23. Click **Graphs** menu to see graph options.

The Graph option will display the channels selected in Vector diagrams or an RMS sine wave.

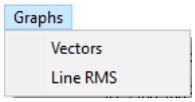


Figure 94: PMU Graphs Options

Selecting **Vectors** will bring up the Phasor Diagram screen and options as described in the **Clearview Instruction Manual. Please see Section 13.20 for more information.**

Selecting **Line RMS** will display a graph of the Voltage and current channels selected in the PMU configuration

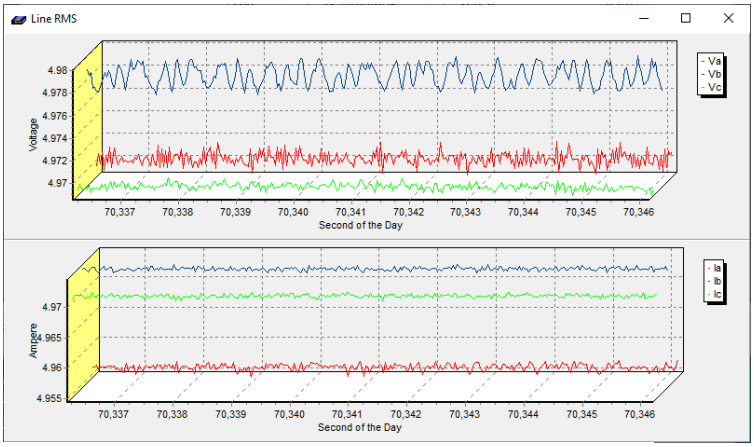


Figure 95: PMU Line RMS Graph

6.15 Viewing the Help and About Information

You can view the online help for the APP Recorder. The About information includes the driver version and factory contact information.

➢ To View the Help

In the **APP Recorder** window, from the **Help** menu, click **Recorder Help**.

➢ To View the About Information

In the **APP Recorder** window, from the **Help** menu, click **About**.

➢ To set up GPU FTP

GPU-FTP is for testing FTP to GPU computer and uploading cfg.gpu. Clicking GPU-FTP opens the FTP settings window. For more on FTP settings see 6.7.11Configuring FTP Settings

7. Running GooseCap Software

7.1 Introduction

This section provides instructions for running the GooseCap software in conjunction with APP Recorder.

Once the GOOSE Point Record has been created and saved, the user will manually **start** the GooseCap capture the first time

Note: If a network device is selected, whenever APP Recorder and Goose Capture starts, Goose will be running automatically when it begins.

7.2 Starting GOOSE Capture

7.2.1 Running Goose

Click the Goose  icon in the Task Bar at the bottom of the screen to return to the main GOOSE Capture screen, you will see a window like the figure below. If the Network device is not selected, click the down arrow, and select the network port connected to the network where the devices to monitor are connected. Usually LAN ENET port.

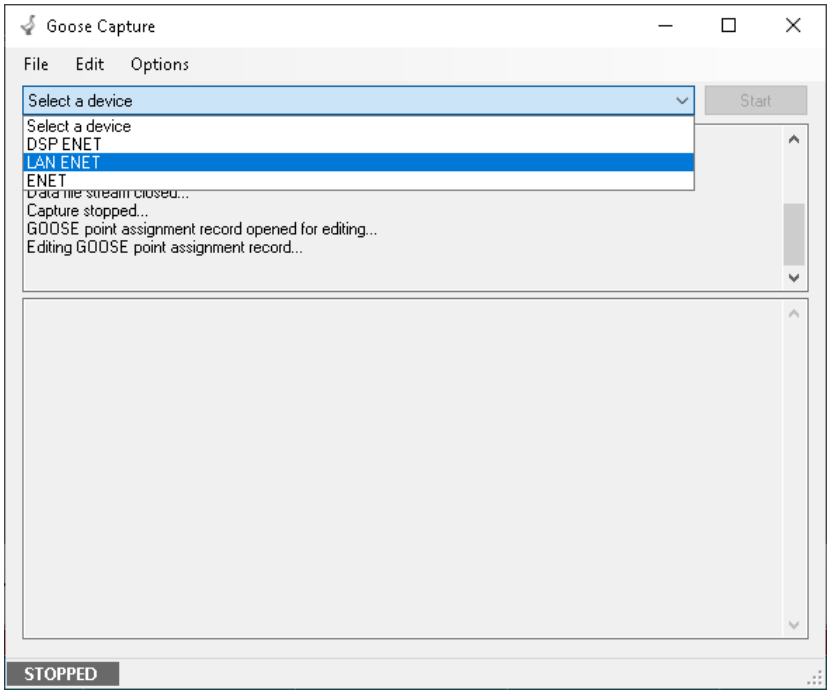


Figure 96 Select Network Device

When the network device is selected, then click the **Start** button. The **"Running"** indicator will appear at the bottom of the window. See figure below.

If you do not click **Start**, the network device selected will not be saved. Once you click **Start** the network device selected is saved and whenever Goose Capture restarts it will automatically start running with the network device last selected.

If you do not want Goose Capture to automatically start, select the **"Select a Device"** option effectively unselecting a device.

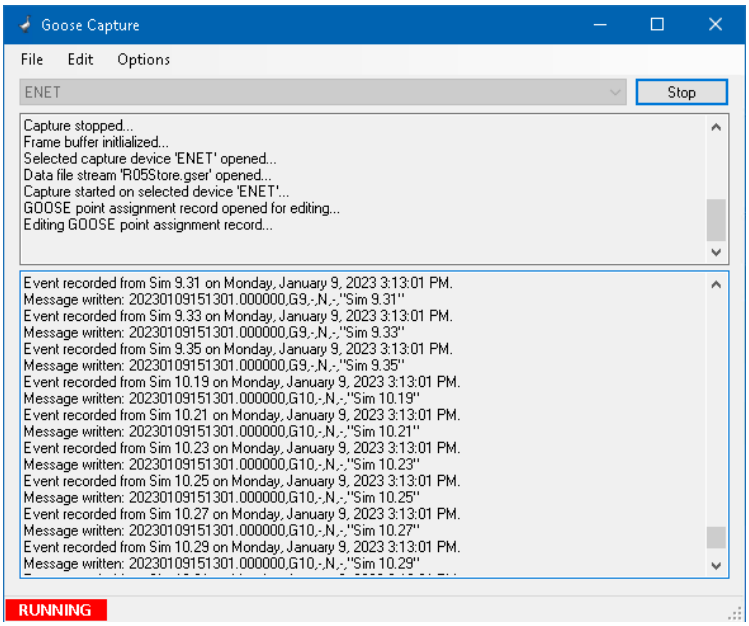


Figure 97 GOOSE Capture Status - Running

7.2.2 Automatic Restart and Running

Goose Capture will automatically restart whenever APP Recorder restarts after being closed, or a reboot occurs. However, if you close Goose Capture it will **not** restart by itself. Goose Capture can be started manually by clicking the executable in the recorder directory or Goose will auto start when APP recorder is restarted.

As mentioned earlier, if a network device is selected, when App Recorder comes up Goose Capture will start and automatically run even if it was stopped before Goose Capture was closed.

7.3 Stopping GOOSE Capture

While GOOSE Capture is running, click the **Stop button** or you can close the GooseCap software by clicking **file** and selecting **Close**.

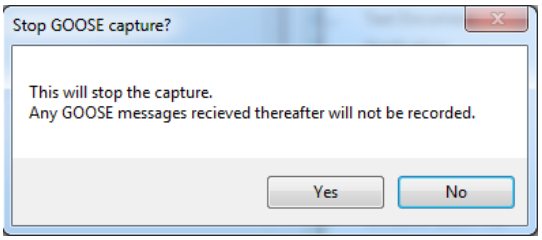


Figure 98 Confirm Stop GOOSE Capture

Click **Yes** when the warning appears indicating recording will be stopped.

7.4 Closing Goose Capture program

You can close Goose Capture in two ways.

1. Click on the File menu and click Close
2. Click the close window **X** at the upper right corner of the Goose Capture window

When the Stop GOOSE capture warning window appears (See Figure 98 Confirm Stop GOOSE Capture),

Click **Yes**

7.5 Viewing GOOSE Capture status and messages

7.5.1 Introduction

This section describes where to view the GooseCap software log, captured and saved messages, and GOOSE Capture Status. The next three sections are a breakdown of the GOOSE Capture main window.

7.5.2 GOOSE Capture operating Log

The upper window provides a log readout for GOOSE Capture showing step-by-step activity of the software itself.

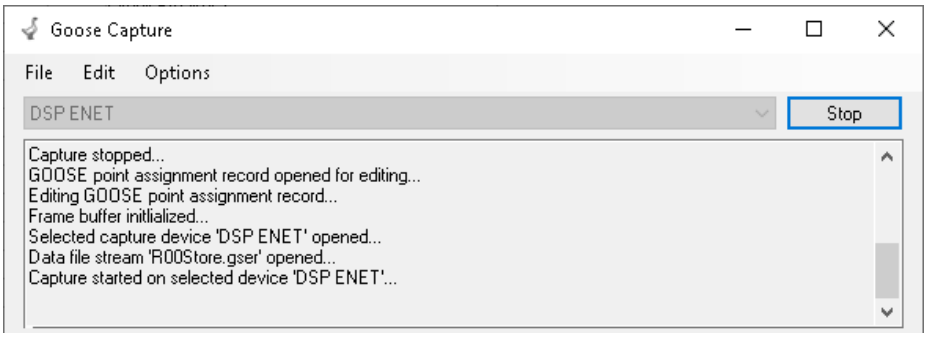


Figure 99 GooseCap software Log

7.5.3 GOOSE Message Capture log

The second section in the window shows the status messages captured. These are written to the .GSER file and then APP Recorder writes them to the APP Recorder SER file.

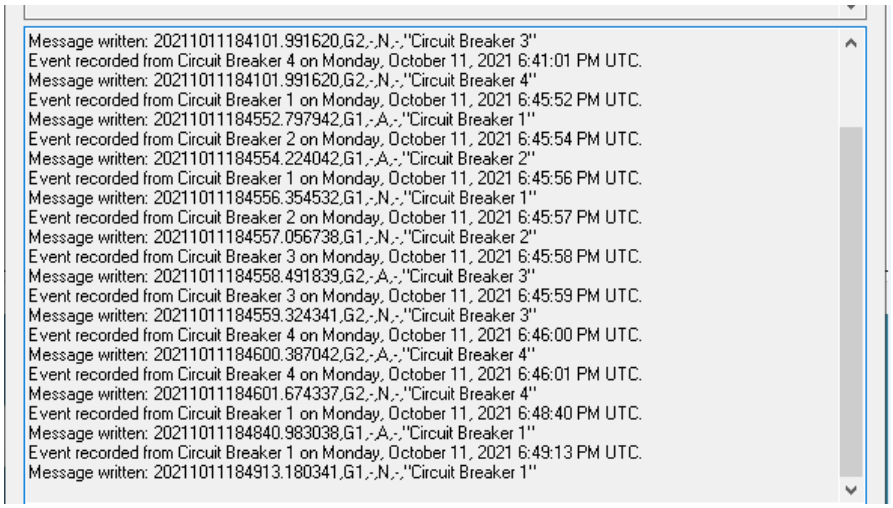


Figure 100 GOOSE Message Capture Log

7.5.4 GOOSE Capture Status Line

The Status line appears at the bottom of the GOOSE Capture window.

The indicators are:

Running/Stopped – Indicates if GOOSE Capture is monitoring the Process Bus or is Stopped

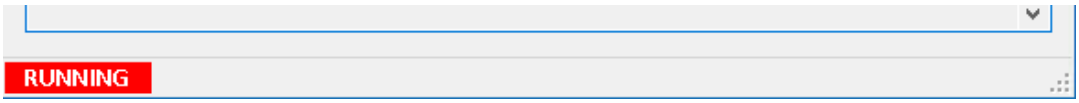


Figure 101 GOOSE Capture - Status Line

7.6 Viewing GOOSE Messages in APP Recorder

As described earlier, The GOOSE Messages are captured are written by APP Recorder the SER file. You can then view the SER report in the APP Recorder and APP Clearview.

The Sequence of Event Report includes the following information:

Date and time of the event

GOOSE ID = Gx where x is the id

State - is not used

Normal - is defined as (A = Abnormal= Closed, N = Normal= Open)

Sync - is not used

User-defined GOOSE Entry Description as entered in the GOOSE Points Record.

7.6.1 APP Recorder SER view

From the main APP Recorder screen, select the SER Report Tab.

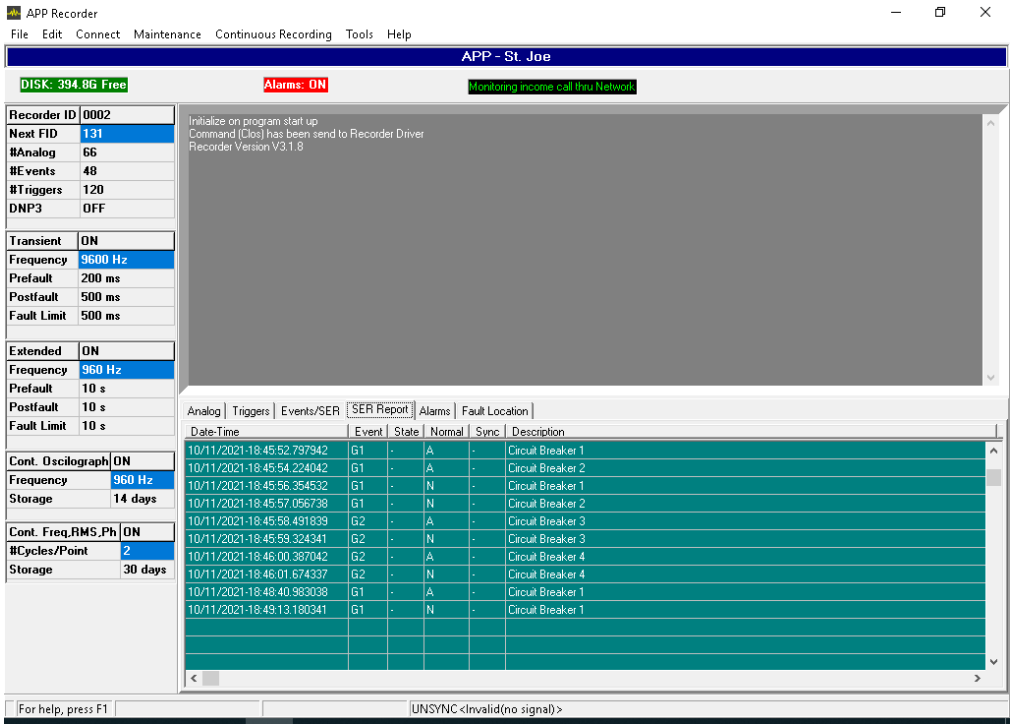


Figure 102 View events via GOOSE Capture in APP Recorder

8. Using the APP Driver

8.1 Introduction to the APP Driver

The APP Recorder Driver is the program that manages the physical APP Recorder hardware. You can access the APP Driver from within the APP Recorder program.

In the APP Driver, you can view communications between the following items:

The APP Recorder and the APP Driver

The APP Driver and all the system DSP circuit boards

The computer control chassis and all the data chassis

8.2 Viewing the APP Recorder Driver Window

➢ To View the APP Recorder Driver Window

From the **APP Recorder** window, open the **File** menu, and click **Show Driver**.
The **APP Recorder Driver** window appears.

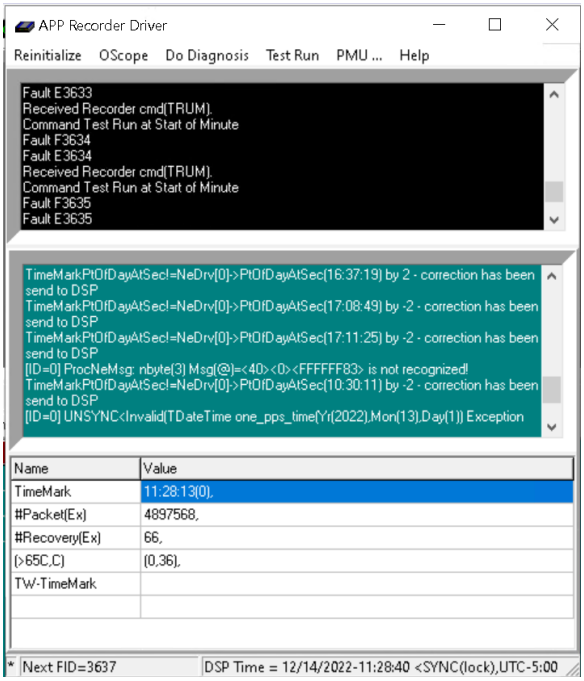


Figure 103: The APP Recorder Driver Window

The Information area contains the following fields:

Time Mark
This field displays the absolute times of the 1PPS signal for all the DSP boards. The times are updated every 30 seconds. If multiple times are displayed, meaning that there are two or more DSP boards, they should be the same. The format is HH:MM:SS(Point of Day time diff from clock) any time difference will typically be corrected within a minute after a restart or reinitialize.by the driver sending a time correction to the DSP.

#Packet (Ex)
If extended recoding is enabled, then you can see packet transfers (or data flow) from the DSP circuit boards to the computer hard drive.

#Recovery (Ex)
If the extended recording feature is enabled in the Point Assignment Record (**General Settings** tab: **Sampling** tab), then this area will display a running total of the number of times packets had to be re-sent from the DSP board to the computer hard drive.

(>65C, C)
The temperatures of the DSP boards are displayed here. In a normal situation, the display may look something like (0, 45C). The zero indicates that the DSP temperature is below 65C and it is now 45C. If the temperature on the board is over 65C, the zero will become one. Because the indicator (0 or 1) is sensed differently than the reading, you can trust that the temperature reading is correct.

TW-TimeMark

This field displays the absolute times of the Unmodulated IRIG-B signal for the Traveling Wave boards. The times are updated every 30 seconds.

The bottom tray displays the next fault identification number (FID), the fault date and time, and the sync status of the fault time.

8.3 Reinitializing the APP Driver

You may need to reinitialize the APP Driver to perform troubleshooting or maintenance. Reinitialize will also reset the DSP. Use this if the driver shows DSP not responding for 2 min.

CAUTION During this process the APP Recorder will momentarily go offline.

➢ **To Reinitialize the APP Driver**

From the APP Recorder Driver menu bar, click **Reinitialize**.
The APP Driver is reset and restarted.

8.4 Exiting the APP Driver

Exit the **APP Driver window** whenever you do not need to view it.

➢ **To Exit the APP Driver Window**

In the **APP Driver** window, click the X in the upper right-hand corner of the window.

Note: The APP Driver is still running in the background

8.5 Doing a Diagnosis

A diagnosis provides a general overview of the health of the Driver.

➢ **To Do a Diagnosis**

In the **APP Driver** window, from the menu bar, click **Do Diagnosis**.
The results will appear in the upper black area in the information area.

8.6 Performing a Test Run from the APP Driver

You can do a test run from within the APP Recorder or the APP Driver. For more information, see *Performing a Test Run* in Section 6. Also, from the APP Driver you can do a Test run of the Traveling Wave Channels.

➢ **To Do a Test Run from the APP Driver**

In **the APP Driver** window, from the menu bar, click **Test Run,** then select **Test Run or Test run at Start of Minute** from the menu.
The results will appear in the upper black area in the information area.

➢ To Do a Traveling Wave Channel Test Run from the APP Driver

In **the APP Driver** window, from the menu bar, click **Test Run,** then select **Test Run All TW Channels** from the menu.
The results will appear in the upper black area in the information area.

8.7 PMU

If PMU was selected in the Point Assignment Record General Tab, then the PMU option will appear on the APP Recorder Driver screen. Clicking PMU will bring up the PMU Configuration Screen.

For more information on configuring PMU see **Section 6.14 Configuring a Phasor Measurement Unit (PMU)**.

8.8 Viewing the Help and About Information

You can view the online help for the APP Driver. The information in the **About** window includes the driver version and factory contact information.

Note: If the help files do not answer your question(s), please do not hesitate to contact APP Engineering, Inc. at **(317) 536-5300**.

➢ To View the Help

In the **APP Driver** window, from the **Help** menu, click **Help**.

➢ To View the About Information

In the **APP Driver** window, from the **Help** menu, click **About**.

9. Using the OScope

9.1 Introduction to the OScope

The OScope window is very useful when setting up the APP Recorder for the first time. It allows you to view real-time analog signals, analog trigger status, event status, and to perform analog channel calibration.

9.2 Viewing the OScope (Oscilloscope) Window

CAUTION **When you open the OScope window, the APP Recorder automatically goes offline. Also, remember to exit the OScope function when you are finished using it. It will not automatically shut down and the APP Recorder will remain offline for as long as the OScope window is open.**

➢ To View the OScope Window

1. Do one of the following:
   - From the **APP Recorder** window, from the **File** menu, click **Show OScope**.
   - From the **APP Driver** window, from the menu bar, click **OScope**.
     The APP OScope window appears.

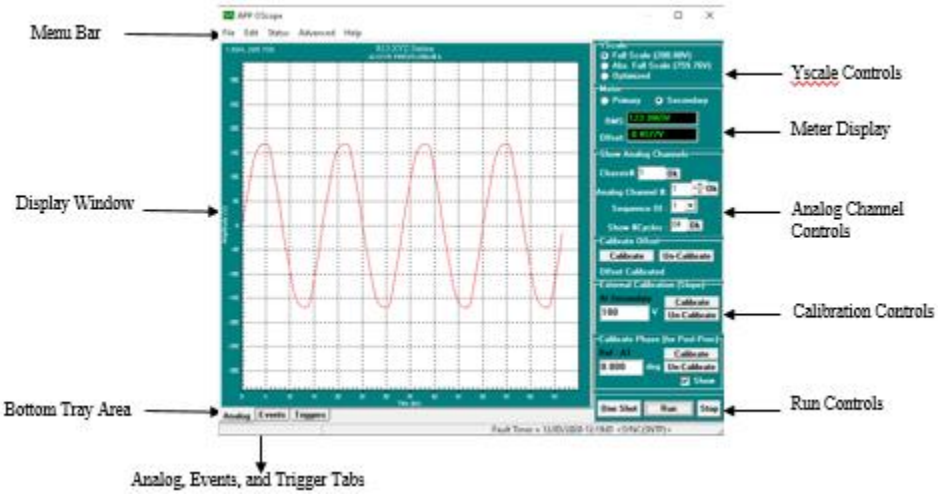


Figure 104: OScope Window, Analog Tab

9.2.1 Analog Tab

You can view DC or AC analog signals in the **Analog** tab (see Figure 104: OScope Window, Analog Tab).

The X-axis is defined by signal frequency and the desired number of cycles to be displayed. Enter the number of cycles in the **Show #Cycles** field.

The Y-axis is determined by the **Channel Full Scale** setting in the Point Assignment Record, and the Y-scale setting in the upper right-hand corner of the OScope window. For more information on these settings, see *Yscale Controls* below.

9.2.2 Events Tab

The **Events** tab shows the status of the event channels. An “O” indicates an open contact, and an “X” indicates a closed contact. If the box is green the channel is in a normal state. If the box is red the channel is in an abnormal state.

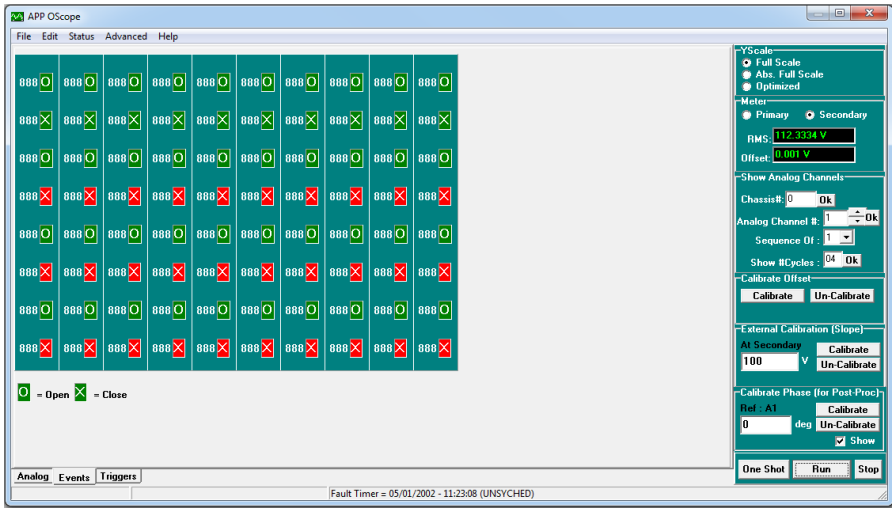


Figure 105: Oscope Window, Event Status Tab

9.2.3 Triggers Tab

The **Triggers** tab indicates which analog channels are in a trip condition:

Green indicates a normal condition.

Red indicates a trip condition.

The analog channels that appear here are defined in the Point Assignment Record.

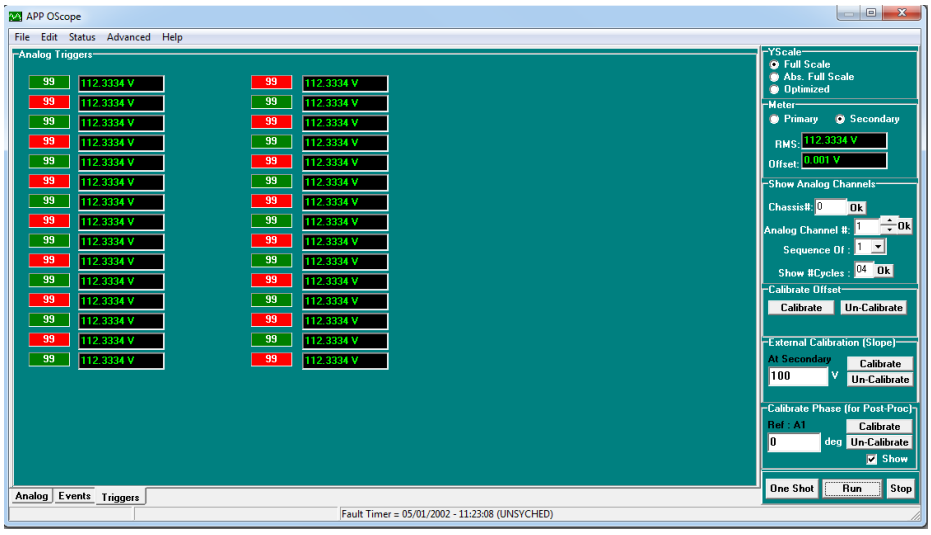


Figure 106: OScope Window, Analog Trigger Status Tab

9.2.4 Yscale Controls

In the **YScale** box, you can select from three options for the Y Scale. The following table describes these options.

Table 17: OScope Window—Y Scale Options

Option	Description
Full Scale	If **Full Scale** is selected, the displayed Y-axis maximum and minimum will be approximately 70% greater than the channel full scale listed in the Point Assignment Record.
Abs. Full Scale	**Abs. Full Scale** is short for **"absolute full scale".** This value is dependent on the channel full scale setting, but it reflects the absolute full scale as defined by the hardware divider and hardware gain circuitry values. The displayed Y-axis maximum and minimum will be approximately 70% greater than the channel full scale listed in the Point Assignment Record. Hardware divider values are limited to 31 choices that range from 0.309 to 954.214 and only apply to voltage inputs. Hardware gain circuitry values are limited to 16 choices that range from 77.277 to 1024.667 and apply to voltage and current inputs. Therefore, when you select a full scale value, the software automatically calculates an absolute full scale value based on the finite hardware choices. The absolute full scale is the amplitude at which the input signal will clip.
Optimize	If you select **Optimize**, the Y-axis will automatically adjust to display the input signal(s) as large as possible.

9.2.5 Meter Controls

In the **Meter Controls** group, you can indicate whether you want to display the RMS meter value and DC Offset value in primary or secondary values. The CT and PT multiplying values can be seen in the Point Assignment Record.

9.2.6 Analog Channel Controls

In the **Show Analog Channels** group, you can select which chassis and channel number to display. You can view more than one input signal at a time. If you want to show multiple channels, click the starting analog channel, then how many sequential channels you would like to view and the number of cycles to display. You can view up to 14 sequential channels at one time. Channels can only be viewed in sequence.

9.2.7 Run Controls

The Run Controls area in the right hand column contains **Run**, **One Shot**, and **Stop** buttons:

Click **Run** to put the OScope in free run and see continuous updates in the display area and in the meter boxes.

Click **One Shot** to perform a one-time update to the display area and meter boxes.

Click the **Stop** button to freeze the display and meter boxes.

9.2.8 Bottom Tray

The bottom tray shows the chassis number being viewed, the run/stop status of the OScope, the fault timer, and the sync status of the fault timer. If the sync status is followed by “unknown”, the recorder cannot detect any IRIG-B input. See Section *Other Information* for time quality details.

9.3 Reinitializing the OScope Window

Reinitialize the **APP OScope** window to restart the OScope and update the Display Window.

➢ **To Reinitialize the OScope Window**

In the **APP OScope** window, from the **File** menu, click **Reinitialize**.

9.4 Exiting the OScope Window

When you exit the **OScope** window, the APP Recorder returns to its normal, online status.

➢ **To Exit the OScope Window**

In the **APP OScope** window, from the **File** menu, click **Exit**.

9.5 Editing the Point Assignment Record

You can edit the Point Assignment Record from within the OScope window.

In the **APP OScope** window, from the **Edit** menu, click **Edit Point Assignment Record**.
The Point Assignment Record window appears. For complete details on how to create and edit the Point Assignment Record, see the *APP ClearView Operating Manual*.

9.6 Viewing Driver Status

You can view detailed information about the status of a channel, including key messages sent between the system DSP boards and the system computer.

➢ **To View the Driver Status**

In the **APP OScope** window, from the **Status** menu, click **Show Driver Status.**
The DSP Board Communication Status window appears.

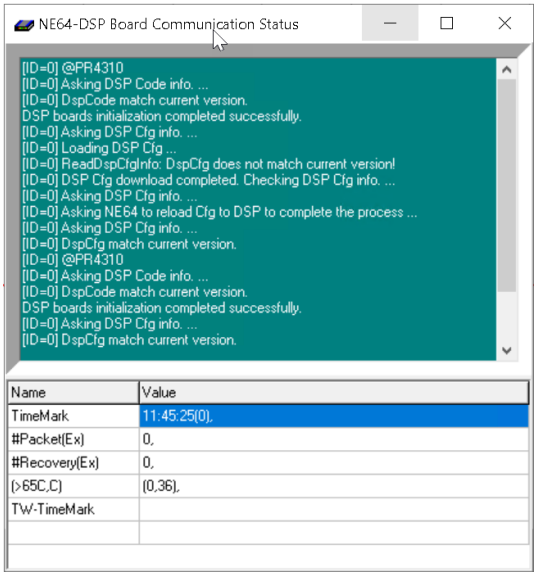


Figure 107: DSP Board Communication Status Window

The following table describes the fields that appear in this window.

Table 18: DSP Board Communication Status Window—Fields

Field	Description
Time Mark	The absolute times of the 1PPS signal for all the DSP boards, are displayed here. The times are updated approximately every 30 seconds. If multiple times are displayed, meaning that there are two or more DSP boards, they should be the same. The format is HH:MM:SS(Point of Day time diff from clock) any time difference will typically be corrected within a minute after a restart or reinitialize.by the driver sending a time correction to the DSP.
#Packet (Extended)	If the extended recording feature is enabled in the Point Assignment Record (**General Settings** tab: **Sampling** tab), packet transfers or data flow, from the DSP circuit boards to the computer hard drive, can be seen here.
#Recovery (Extended)	If the extended recording feature is enabled, this area will keep a running total of the number of times packets have had to be re-sent from the DSP board to the computer hard drive.
(>65C,C)	The temperatures of the DSP boards are displayed here. In a normal situation, the display may look something like (0, 45C). The zero indicates that the DSP temperature is below 65C and it is now 45C. If the temperature on the board is over 65C, the zero will become one. Because the indicator (0 or 1) is sensed differently than the reading, you can trust that the temperature reading is correct.
TW-TimeMark	The absolute times of the unmodulated IRIG-B signal for the Traveling Wave boards. The times are updated approximately every 30 seconds. If multiple times are displayed, meaning that there are two or more TW boards, they should be the same

9.7 Viewing Stopped/Abnormal SER Channels

In the **APP OScope** window, from the **Status** menu, click **Show Stopped/Abnormal SER Channels.** The Stopped/Abnormal SER Channels window appears.

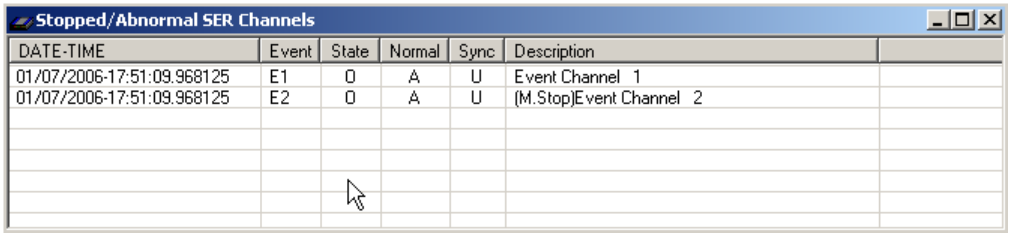


Figure 108: Stopped/Abnormal SER Channels Screen

On the **SER Report** tab, channels that are in a stopped or abnormal state appear. The following table explains the letters that appear on this window.

Table 19: SER Report Tab—Letter Values

In this column…	This letter…	Means this…
State	O	There is an open contact.
	C	There is a closed contact.
Normal	A	The channel is currently in an abnormal state.
	N	The channel is currently in a normal state.
Sync	U	There is an unsynchronized time.
	S	There is a synchronized time.

If an SER channel is stopped, the word "Stopped" will appear at the beginning of the channel description. The letter "M" or "A" will also appear with the stop message:

- "M" indicates that the channel has been stopped manually via the Point Assignment Record.
- "A" indicates that the channel stopped automatically.

Note: If an SER channel frequently changes its state, you can configure the Point Assignment Record to automatically address the issue. On the **General Settings** tab in the Point Assignment Record, you can specify the threshold of time for allowable state changes (in other words, the acceptable amount of time between state changes). If the SER channel changes its state more frequently than the acceptable amount, you can configure it to automatically shut down and then to restart itself after the period of time that you define.

9.8 Advanced Menu

9.8.1 Calibrating and Un-Calibrating All Offsets

You can calibrate the DC offset on every analog channel with a single click or it can be done on a per channel basis. If the scope function is running, it will automatically stop when you calibrate or un-calibrate all offsets. **Typically, the DC offset calibration is done with NO signals applied** to the analog channels.

This can be done before energizing the lines, while test switches are opened, test blocks pulled, or sliding links are opened to disconnect field signals.

Note: Before performing an offset calibration or a slope calibration let the system run for approximately 60 minutes. This will give the electronics time to achieve temperature stability.

Note: When calibrating, be sure no signal is present by ensuring all Test Switches or Sliding Links are open.

The time it takes to do an "all offset calibrate" is dependent on the number of channels but is usually less than 20 seconds. The factory performs an offset calibration, with no signals attached, before a recorder is shipped to you. **After the system is installed and field wires are connected, you should perform another offset calibration to eliminate the externally induced DC offset or the effects of DC offset when someone changes an analog channel full scale**.

- **To Calibrate Channel All Offsets**

  In the **APP OScope** window, from the menu bar, click **Advanced**, then **Calibrate All Offsets.**

  After calibrating all offsets, we recommend reviewing each channel offset by stepping through the channels in the **Show Analog Channels** section.

Note: After calibrating, click **Run** to restart the OScope function.

- **To Un-Calibrate All Offsets**

  To reverse the calibration procedure and delete software correction factors, you can un-calibrate all offsets.

  In the **APP OScope** window, from the menu bar, click **Advanced**, then **Un-Calibrate All Offsets.**

Note: After calibrating, click Run to restart the OScope function.

9.8.2 Setting all Analog Channel Inputs to Zero

You can set all analog channel inputs to zero in order to stop each analog channel input from reaching the analog board signal acquisition circuitry. You can do this to calibrate internal offsets or to perform troubleshooting.

- **To Set All Analog Channel Inputs to Zero**

  In the **APP OScope** window from the menu bar, click **Advanced** then **Set All Analog Channel Inputs to Zero.**

9.8.3 Reference Analog Channel # for Phase

You can change the reference channel used when calibrating phase for post processing. The default is channel 1.

- **To Reference Analog Channel # for Phase**

  In the **APP OScope** window from the menu bar, click **Advanced** then click **Reference all Channel # for Phase.** A window will appear, enter the **Analog Channel number to reference.** You will see the reference number change in the Calibrate Phase box.

9.8.4 Turning On All Alarms and LEDs

If you need to test the front panel LED's and alarm outputs, you can turn them all on simultaneously. When you do this, all of the relay coils will energize and the front panel LED's should illuminate.

➢ **To Turn On All Alarms and LEDs**

1. In the **APP Driver OScope** window from the menu bar, click **Advanced,** then **Turn On All Alarms and LEDs.**
2. To reset all the alarms and LEDs, from the **File** menu, click **Reinitialize**.

➢ **To Turn on a specific Alarm by its number**

1. In the **APP OScope** window, from the menu bar, click **Advanced,** then **Turn On All Alarms and LEDs**, then turn on Alarm #.
2. Enter the number of the desired alarm and click **OK**.

Note: You can use 0 for all off and 8 for all on.

3. To reset all the alarms and LEDs, from the File menu, click **Reinitialize**.

9.8.5 Sequence of Analog Channel

You can set Analog channel(s) to display along with the Selected Channel.

1. In the **APP OScope** window, from the menu bar, click **Advanced,** then **Sequence of Analog Channel #**.
2. Enter the number of the desired analog channel(s) comma separated and click **OK**.

9.8.6 Rebooting the Driver

You can reboot the Driver by momentarily cutting the power to the computer and all circuit boards. All instruments will experience a hard power shutdown. Power is cut via a normally closed relay on the Data chassis power supply circuit board. After 5-10 seconds, power will automatically return and the system will restart. It takes approximately 1 minute and 30 seconds for the system to return to an online state.

➢ **To Reboot the Driver**

In the **APP OScope** window from the menu bar, click **Advanced**, then **Reboot.**

9.9 Calibrating and Un-Calibrating One Channel at a time

9.9.1 Calibrating the DC Offset One Channel at a Time

You can calibrate out the DC offset one channel at a time. If the scope is running, it will automatically stop and you will need to click **Run** to restart the scope function.

We recommend calibrating the DC offset with NO signals applied. Before calibrating, notice the DC offset value. This Value should reduce after the offset calibration. Calibrating each channel takes about 6 seconds.

You can also calibrate all the channels simultaneously (see the beginning of this section).

9.9.2 Calibrating and Un-Calibrating Offsets One Channel at a time

If the full scale value for an analog channel is changed, recheck the offset and determine if another offset calibration is required.

CAUTION **It is recommended to recalibrate the DC Offset if the full scale value changes. For a voltage channel, A DC offset of 0.01 to 0.04 should be achievable. For a current Channel, a DC offset of 0.00 to 0.03 should be achievable.**

The offset calibration process creates a file named *RxxExCal*.ini in path location **C:\APP Recorder\Setup**. The *"xx"* in the file name is the unique recorder ID number. This is an ASCII file and can be viewed by doubling clicking it. An example file entry is, **A1=0,0.999965**. **A1** is the analog channel number, **0** is the offset calibration factor for the DC offset, and **0.999965** is the external calibration factor.

➢ **To Calibrate the DC Offset One Channel at a Time**

1. In the **Show Analog Channels** group in the **Analog Channel#** box, use the up and down arrows to enter the analog channel number to be calibrated. Holding the up or down arrow will scroll quickly, and then click the corresponding **OK** button.

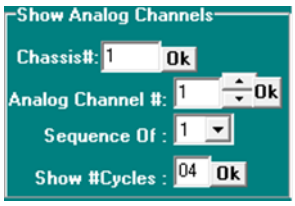


Figure 109: Show Analog Channels Group

2. Under **Calibrate Offset**, click the **Calibrate** button.
   The text, "Offset Calibrated" appears under the button when complete.

Figure 110: Calibrate/Un-Calibrate Offset

Note: After calibrating, click **Run** to restart the OScope function.

➢ **To Un-Calibrate the DC Offset One Channel at a Time**

1. In the **Show Analog Channels** group, in the **Analog Channel #** box, enter the analog channel number to be un-calibrated and then click the corresponding **OK** button.
2. Under **Calibrate Offset**, click the **Un-Calibrate** button.

The text, "**Offset Calibrated**" disappears under the button and no text remains.

9.10 Calibrating Slope (Performing an External Calibration)

The APP Recorder will have accurate un-calibrated analog channels as described in the specifications section. Therefore, you may not see much improvement in channel accuracy by performing an external calibration. The calibration process takes only a few seconds.

Note: Ensure that your calibration source or measuring meter is calibrated and has as a precision accuracy.

WARNING **Calibration should only be performed by trained, qualified technical personnel. Never calibrate a system alone. Ensure that another person is present who knows emergency procedures and is capable of rendering first aid.**

WARNING **Carefully disconnect station analog input signals from the recorder before applying a known signal from your calibrated, high-precision, certified source. Use caution if you are connecting an external metering device. Be sure to use the proper connecting leads and equipment.**

Note: The following procedure assumes that your known analog signal is connected to a recorder analog input.

➢ To Calibrate Slope (Perform an External Calibration)

1. In the **APP Recorder** window from the **File** menu, click **Show OScope**.
   The **APP OScope** window appears.
2. In the **Show Analog Channels** group in the **Analog Channel #** box, enter the analog channel number to be calibrated and then click the corresponding **OK** button.
3. In the **External Calibration Slope** group, in the **At Secondary** box, enter your known accurate secondary input calibration voltage or current value.

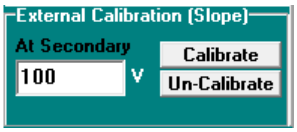


Figure 111: External Calibration (Slope) Group

4. Click the **Calibrate** button. A warning message may appear saying, "Entered value (xxx.xx) is >10% different to the measured value (xxx.xx). Do want to continue?"
5. Click **Yes** to proceed or **No** to abort the calibration process.
6. Repeat steps 3-5 to calibrate additional channels.

The calibration process creates an ASCII file named *RxxExCal*.ini in path location **C:\APP Recorder\Setup**. The *"xx"* in the file name is the unique recorder ID number. For example, in the file name **A1=0,0.999965, A1** is the analog channel number, **0** is the internal calibration factor for the DC offset, and **0.999965** is the external calibration factor.

You can view the file by doubling-clicking it.

The external calibration factor can be reset to **1** by clicking on the "Un-Calibrate" button.

Note: You must click the Stop button before doing a calibration.

9.11 Calibrate Phase (For Post-Processing Only)

Calibrate phase is used to remove phase shift between the analog channel shown and the reference channel selected. For example when using a CT.

➢ To Calibrate Phase (For Post-Processing)

1. In the **APP Recorder** window from the **File** menu, click **Show OScope**.
   The **APP OScope** window appears.
2. In the **Show Analog Channels** group in the **Analog Channel #** box, enter the analog channel number to be calibrated and then click the corresponding **OK** button.
3. Be sure the **Ref channel** you want is selected. If not use the **Advanced** menu to select Reference Channel # for Phase.
4. Type in the degrees of shift desired in the entry field.
5. Click **Calibrate**
6. Click **Un-calibrate** to go back to the actual value.

The **show** check box provides viewing of two or more channels selected that have been calibrated. With **Show** un-checked the scope will show the **actual** view. When **Show** is checked the scope will show the **calibrated** view.

10. Other Information

10.1 Time Quality

A 4-bit time quality indicator is used by several manufacturers of satellite controlled clocks. It is an indicator of time accuracy or synchronization to UTC and is based on a clock's internal parameters. Per the IEEE 1344 standard, the code recommended is by order of magnitude relative to 1(ns). The 1ns basic reference is adequate to accommodate present industry requirements now and into the foreseeable future. With present GPS technology at 100ns accuracy level, a 0000 code indicating locked will change to 0011 or a 0100 unlock code. The following table contains the IEEE 1344 quality indicator codes.

IMPORTANT **APP-601 clock accuracy/alignment with the 1PPS is 0.6 µsec with an un-modulated IRIG-B input. The accuracy with a modulated IRIG-B input is 1msec.**

If the satellite-controlled clock does not output a time quality code, APP-601 keys off the clocks synch/un-sync signal. If the clock is synchronized, then the fault record tag will show **locked**. If the clock is un-synchronized, then the fault record tag will show **unlocked**.

If there is no signal connected to the APP-601 IRIG input, or no PTP clock connected to the DSP network, then the fault record tag will display **"No Signal"**.

Table 20: IEEE 1344 Time Quality Values

Binary	Description	
1111	F	fault –unknown – clock fail
1011	B	10s
1010	A	1s
1001	9	100ms
1000	8	10ms
0111	7	1ms
0110	6	100µs
0101	5	10µs
0100	4	1µs
0011	3	100ns
0010	2	10ns
0001	1	1ns
0000	0	Normal Operation Clock Locked

Table 21: Time Quality and APP-601 Action

Value From GPS Clock	Binary	APP-601 Fault Record Tag	APP-601 Loss Sync LED Status	APP-601 Loss Sync Relay Status (coil)
Fault	1111	Fault	ON	Energized
10s	1011	10s	ON	Energized
1s	1010	1s	ON	Energized
100ms	1001	100ms	ON	Energized
10ms	1000	10ms	ON	Energized
1ms	0111	1ms	OFF	Not energized
100µs	0110	100µs	OFF	Not energized
10µs	0101	10µs	OFF	Not energized
1µs	0100	1µs	OFF	Not energized
100ns	0011	100ns	OFF	Not energized
10ns	0010	10ns	OFF	Not energized
1ns	0001	1ns	OFF	Not energized
Normal Operation Clock Locked	0000	Locked	OFF	Not energized

10.2 Recommended Maintenance and Calibration

APP Engineering recommends a combination performance-based and time-based maintenance.

10.2.1 Performance-based Maintenance

APP recommends that you complete performance-based maintenance by utilizing the Auto-Polling feature in ClearView. The auto-polling process retrieves the latest diagnostic or status file for each APP Recorder, (see Clearview Manual for more on setting up Auto-Polling). The following procedure explains how to complete the minimum recommended performance-based maintenance procedure.

➢ **To Complete the Minimum Recommended Performance-based Maintenance Procedure**

1. In the APP ClearView program running on your master station computer, set the APP ClearView Configuration to auto-poll all the APP Recorders once per day. This retrieves a Fault Summary Report and the SER dates.

2. After auto-polling, review the Auto-Transfer Notification Report to ensure that the last received date is correct and that each APP Recorder is online.

3. The auto-polling process retrieves the latest diagnostic or status file for each APP Recorder. The **Alarm** box in the upper right-hand corner of the **APP ClearView** window displays alarms for APP Recorder. Alarms appear as a red background with the text **Alarms On**. If an APP Recorder has an alarm, double-click the **Alarm** box to see which APP Recorder is in alarm.

4. During normal use of the APP ClearView analysis software, review the analog and digital data to ensure that there is an acceptable measurement of the power system input values.

10.2.2 Time-based Maintenance

The following table describes the minimum recommended time-based maintenance procedures.

Table 22: Time-based Maintenance Procedures

Chassis Type	Comments
APP-501 Computer Control Chassis	Once every year, ensure that the fan mounted to chassis rear panel is functioning properly. Once every two years, run Windows disk defragmenter "Analyze" and follow Windows Recommendations. You can run the defrag analysis and defragmenter from the master station computer running APP ClearView (Maintenance). **Note:** If the system is using a solid-state drive, defragmentation does not need to be done.
APP-601 Computer Control Chassis	Once every two years, run Windows disk defragmenter "Analyze" and follow Windows Recommendations. You can run defrag analysis and defragmenter from the master station computer running APP ClearView (Maintenance). **Note:** If the system is using a solid state drive, defragmentation does not need to be done.
APP-601 Data Chassis	Calibrate analog channels once every 5 years. See calibrating DC offset and calibrating Slope

10.3 Recommended Setup for MW Channels (Using 4ma-20ma Transducer)

To Complete the Recommended Setup for MW Channels

1. Calculate the CT/PT value.
   For example, suppose the resistor used with the transducer is 143 ohms and the transducer full scale is 550MW @ 20ma. In this case, the calculation would be as follows:

   4ma (143 ohms) = 0.572V, which needs to equal 0MW

   20ma (143 ohms) = 2.860V, which needs to equal 550MW

   2.860V – 0.572V = 2.288V

   550MW/2.288V = 240.3846 which is the CT/PT that needs to be used in order to display proper primary values.

2. In the Point Assignment Record for this analog channel, enter w(Mwatt) for the Channel Type. Then enter 240.384 for the CT/PT value, and enter 5 for the Full Scale value (on the secondary 1MW-1V). Click **Save** in the **Point Assignment** window.

3. In the APP Recorder, open the OScope (**File** menu, **Show OScope**). View the analog channel that is being setup for MW.

4. With no signals attached to this MW channel, un-calibrate the offset and the slope.

5. Apply a 0.572VDC signal (representing 4ma, 0MW) and calibrate the offset.

6. Apply a 2.86VDC signal. You should read a primary value of 550MW for this MW channel.

10.4 Recommended Setup for MVAR Channels (Using 4ma-12ma-20ma Transducer)

➢ **To Complete the Recommended Setup for MVAR Channels**

1. Calculate the CT/PT value.
   For example, suppose the resistor used with the transducer is 143 ohms and the transducer full scale is - 400MVAR @ 4ma and +400MVAR @ 20ma. In this case, the calculation would be as follows:

   4ma (143 ohms) = 0.572V, which needs to equal -400MVAR

   12ma (143 ohms) = 1.716V, which needs to equal 0 MVAR

   20ma (143 ohms) = 2.860V, which needs to equal +400MVAR

   2.860V – 1.716V = 1.144V as does 1.716V-0.572V=1.144V

   400MVAR/1.144V = 349.650 which is the CT/PT that needs to be used in order to display proper primary values.

2. In the Point Assignment Record for this analog channel, enter q(MVar) for the Channel Type, enter 349.650 for the CT/PT value, and enter 5 for the Full Scale value (on the secondary 1V=1MVAR.) Click **Save** on the Point Assignment window.

3. In the APP Recorder, open the OScope (**File** menu, **Show OScope**). View the analog channel that has been set up for MVAR.

4. With no signals attached to this MVAR channel un-calibrate the offset and the slope.

5. Apply a 1.716VDC signal (representing 12ma, 0MW) and calibrate the offset.

6. Apply a 0.572VDC signal and you should read a primary value of -400MVAR in the offset meter box. The RMS meter box will read 400MVAR (no negative on RMS).

7. Apply a 2.86VDC signal. You should read a primary value of +400MVAR in the offset meter box. The RMS meter box will read 400MVAR.

10.5 Recommended Setup for a Current Channel using a 4ma-20ma Transducer (e.g. measuring generator field current)

To Complete the Recommended Setup

1. Calculate the needed shunt value.
   For example, suppose the resistor used with the transducer is 270 ohms (measure with an accurate meter) and the transducer full scale is 2000A @ 20ma. In this case, the calculation would be as follows:

   4ma (270 ohms) = 1.08V, which needs to equal 0 Amps

   20ma (270 ohms) = 5.40V, which needs to equal 2000 Amps

   5.40V – 1.08V = 4.32V

   thus 4.32V/2000A = 2.16 milliohms which is the shunt value that needs to be used in order to display proper values.

2. In the Point Assignment Record for this analog channel, enter C(Adc) for the Channel Type. Enter 1 for the CT/PT value, enter 2000 for the Full Scale value (ABS will automatically = 5000), and enter 2.16 milliohms for the external shunt value. Click **Save** in the **Point Assignment** window.

3. In the APP Recorder program, open OScope (**File** menu, **Show OScope**). View the analog channel that is being setup with this transducer.
4. With no signal attached to this transducer channel, un-calibrate the offset and the slope.
5. Apply a 1.08VDC signal (representing 4ma = 0 Amps) and calibrate the DC offset.
6. Apply a 5.40VDC signal. You should read a value of 2000A for this transducer current channel.

10.6 Recommended Setup for a Current Channel using a 0ma-1ma Transducer

To Complete the Recommended Setup

1. Calculate the needed shunt value.
   For example, suppose the resistor used with the transducer is 270 ohms (measure with an accurate meter) and the transducer full scale is 2000A @ 20ma. In this case, the calculation would be as follows:

   0ma (270 ohms) = 0V, which needs to equal 0 Amps

   1ma (270 ohms) = .27V, which needs to equal 2000 Amps

   .27V – 0V = .27V

   thus .27V/2000A = .135 milliohms which is the shunt value that needs to be used in order to display proper values.
2. In the Point Assignment Record for this analog channel, enter C(Adc) for the Channel Type. Enter 1 for the CT/PT value, enter 2000 for the Full Scale value (ABS will automatically = 5000), and enter .135 milliohms for the external shunt value. Click **Save** in the **Point Assignment** window.
3. In the APP Recorder program, open OScope (**File** menu, **Show OScope**). View the analog channel that is being setup with this transducer.
4. With no signal attached to this transducer channel, un-calibrate the offset and the slope.
5. With no signal applied 0 channel.
6. Apply a .27VDC signal. You should read a value of 2000A for this transducer current channel.