

## **Fault and Disturbance Data Management and Analysis**

**Wavewin™ Universal**  
(Product Description, October 10<sup>th</sup>, 2010)

### **I - Executive Summary**

**1) Product:** Wavewin™, with over 20 years of proven performance, is a universal program for management and analysis of digital fault records (waveform signatures resulting from real or simulated power system fault and disturbance conditions). The program supports formats from many types of protection and monitoring devices such as numerical relays, digital fault recorders, and power quality meters (hereinafter, smart devices). The program is equipped with powerful analysis routines designed for close inspection of fault signatures from various types of major substation equipment such as breakers, transformers, phase angle regulators, capacitor banks, and so forth.

**2) Uniqueness:** The universal nature of the program is unique in the power industry. It is the only known program that can manage and analyze fault records from most types of smart devices used today. The program has acquired a large user base including a considerable number of utilities in the United States and was cited by the North American Electric Reliability Commission (NERC) as being “indispensable in the blackout investigation of August 14<sup>th</sup>, 2003”.

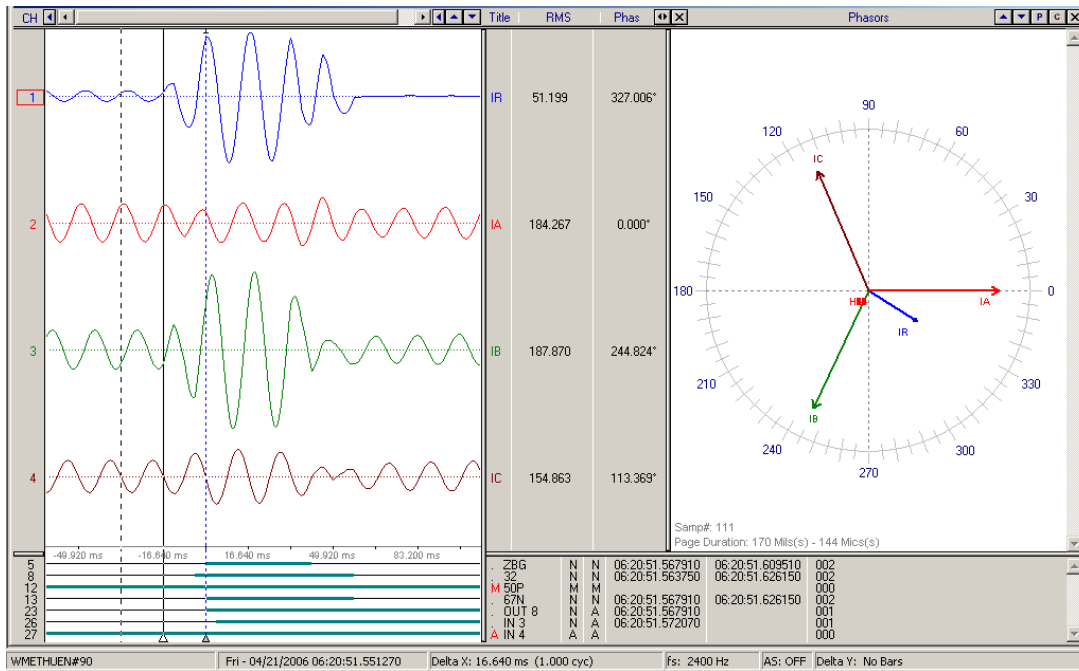
**3) Benefits:** Utilities spend considerable amounts of manpower and financial resources upgrading and maintaining their smart devices. The program provides enhancements in these areas that are extra ordinary. It helps equipment and protection engineers expose failures and root causes in a timely and accurate manner and form a common platform, and it provides the benefit of helping catch potential failures before they occur (predictive maintenance). Such benefits help utilities increase power system reliability, reduce engineering and maintenance time, extend the service life of major substation equipment, and restore services faster.

**4) Implementation:** Deployment is by design user friendly. A copy of the program is installed on each user computer and a shared drive on the company network is used to store and maintain fault records. High level descriptions of the basic program interfaces and installation requirements are provided in the following sections along with a detailed listing of the available support services.

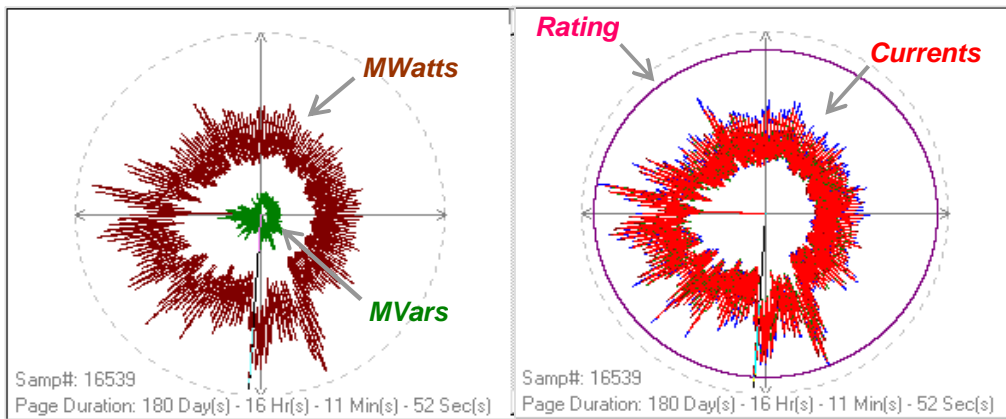
### **II - Program Interfaces**

The program is composed of two integrated systems: the analysis interfaces, and the fault records database interfaces. The following subsections provide a high level description of these systems:

**1) Analysis Interfaces:** The interfaces are used by equipment and protection engineers to analyze digital fault records from both real and/or simulated events (transient and steady state conditions). The program provides multiple types of interfaces, a select subset of these interface is shown in Figures 1 thru 4.



**Figure-1, Fault & Disturbance Analysis Interface (Transient Data)**



**Figure-2, Evolving Loads & Seasonal Averages (Steady State Data)**

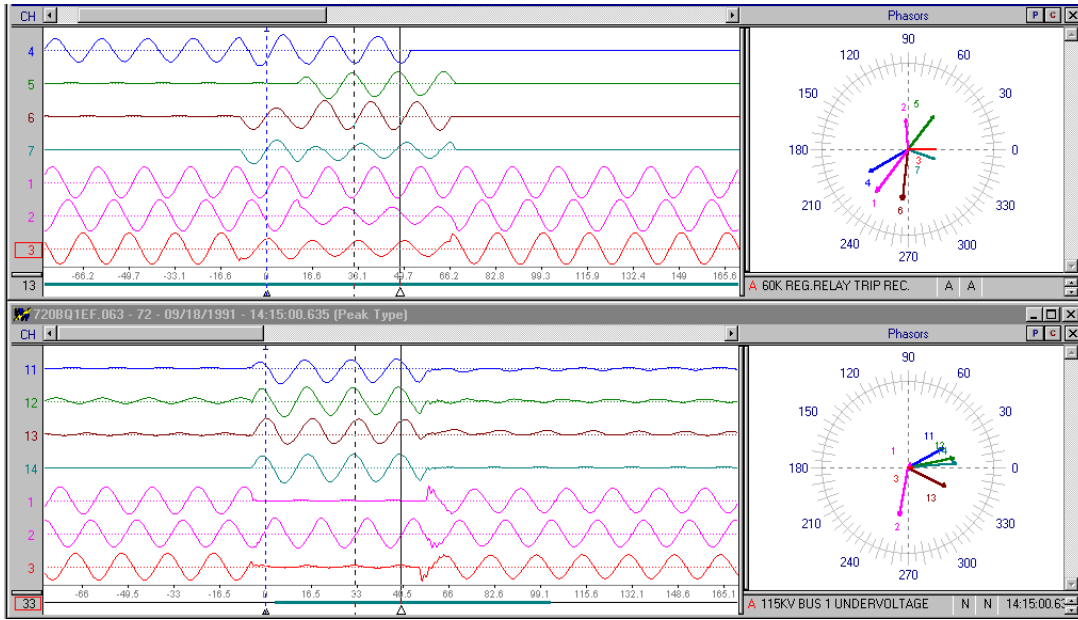


Figure-3, End to End Analysis (Data Synchronization)

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* File Information:
* -----
      Station: EXAMPLE 1 - SEL151
      Device: SEL 151
      File-Name: C:\Faultlib\910918,141500625000,+3S,EXAMPLE 1 - 151, 151,ARKEY ELECTR:
      File-Size: 5541 Bytes
      Prefault-Time: 9/18/91 14:15:00.562510
      Fault-Time: 9/18/91 14:15:00.625000
      Save-Time: 06/04/2004 09:46:02
      Process-Time: 01/03/2006 22:48:50
      Start Date & Time: 09/18/1991 14:15:00.562510
      End Date & Time: 09/18/1991 14:15:00.741648
      File Duration: 179 Mils(s) - 138 Mics(s)
      Sampling Frequency: 240.000000, 4166 Microsecond Reading
      Line Frequency: 60.000000

* Fault Information:
* -----
01 - Event : AG T      Location: 3.30      Shot: 3      Targets: INSTAQN
      Currents (A pri), ABCQN: 2229      0      0      2229      2212

* Highest/Lowest Analog Peaks Chart:
* -----
> Max-Val      Min-Val      LPeak-Up      LPeak-Dn      OneBit      pUnits      Description
3131.069      -3131.069      675.994      -77.782      0.0010      Amps      1-IR
3153.696      -3153.696      685.894      -84.853      0.0010      Amps      2-IA
0.000      0.000      0.000      0.000      0.0010      Amps      3-IB
0.000      0.000      0.000      0.000      0.0010      Amps      4-IC
14570.642      -14570.642      14570.642      -14570.642      0.0010      Volts      5-VA
15792.523      -15792.523      15792.523      -15792.523      0.0010      Volts      6-VB
17249.163      -17249.163      17249.163      -17249.163      0.0010      Volts      7-VC

* Events/Sensors Activity Summary:
* -----
> Fst Lst      Fst-Change      Lst-Change      Changes      Description
N N 14:15:00.608336 14:15:00.683324 002      1-P51
N N 14:15:00.625000 14:15:00.674992 002      3-P50H
N N 14:15:00.608336 14:15:00.683324 002      5-Q51
    
```

Figure-4, Fault Summaries (Type, Location, and Sequence of Events)

**2) Fault Records Database:** The program is designed to maintain large numbers of fault data records on a shared drive on the company network. The fault data records are considered legal data records and are always maintained in their original proprietary formats. Immediate and secure access to the fault records is concurrently available to all users on the network.

Fault records have complex inter-relationships (multiple events can be in one record, or one event can span multiple records). Fault records are also generated using various types of data formats and naming conventions. To that extent, the program uses a specialized browser equipped with an inference engine for identifying date/time of fault occurrence and type of originating device. The inference engine is supported with fast search, sort, and query engines that operate based on both required and/or optional fields as defined in IEEE Std. C37.232-2007. The database browser is depicted in Figure-5.

File Name	F-Type	Size	Fault Date	Fault Time	Driver	Save Date
.	.	0			Root Dir	11 / 03 / 2005
040523.142810670000.+3S.ABB.MDAR...	REL	5449	05 / 23 / 2004	14 : 28 : 10 . 670	Previous Dir	11 / 03 / 2005
040523.143230570000.+3S.ABB.MDAR...	REL	5449	05 / 23 / 2004	14 : 32 : 30 . 570	REL 300/3...	09 / 07 / 1999
080HG3CD.B26	8	58240	06 / 12 / 1997	12 : 13 : 11 . 260	REL 300/3...	05 / 02 / 2004
030120.091095435.+3S.TOWNVILLE#5...	28	0	01 / 20 / 2003	09 : 10 : 55 . 435	DFR IJIIJIB	06 / 12 / 1997
030122.150510525.+3S.TOWNVILLE#5...	28	0	01 / 22 / 2003	15 : 05 : 10 . 525	HATH-DFR	01 / 28 / 2003
73001E1F.063	72	110980	09 / 18 / 1991	14 : 15 : 00 . 630	DFR IJIIJIB	10 / 02 / 1995
910918.141500635000.+3S.BARTIN.RA...	72	0	09 / 18 / 1991	14 : 15 : 00 . 630	DFR IJIIJIB	10 / 02 / 1995
040907.172921447000.+3S.DRAVDSBU...	001	32768	09 / 07 / 2004	17 : 29 : 21 . 447	Rochester...	10 / 12 / 2004
040907.172921447000.+3S.DRAVDSBU...	002	32768	09 / 07 / 2004	17 : 29 : 21 . 447	Rochester...	10 / 12 / 2004
040907.172921447000.+3S.DRAVDSBU...	003	32768	09 / 07 / 2004	17 : 29 : 21 . 447	Rochester...	10 / 12 / 2004
040907.172921447000.+3S.DRAVDSBU...	004	32768	09 / 07 / 2004	17 : 29 : 21 . 447	Rochester...	10 / 12 / 2004
040907.172921447000.+3S.DRAVDSBU...	005	32768	09 / 07 / 2004	17 : 29 : 21 . 447	Rochester...	10 / 12 / 2004
040907.172921447000.+3S.DRAVDSBU...	006	32768	09 / 07 / 2004	17 : 29 : 21 . 447	Rochester...	10 / 12 / 2004
040907.172921447000.+3S.DRAVDSBU...	007	32768	09 / 07 / 2004	17 : 29 : 21 . 447	Rochester...	10 / 12 / 2004
040907.172921447000.+3S.DRAVDSBU...	008	6144	09 / 07 / 2004	17 : 29 : 21 . 447	Rochester...	10 / 12 / 2004
dau-def	<N>	102400			ASCII	03 / 10 / 2005
dau-key	<N>	512			ASCII	03 / 10 / 2005
dau-type	<N>	256			ASCII	03 / 10 / 2005
011115.131908826000.+3S.CHECKFIEL...	DEV	27891	11 / 15 / 2001	13 : 19 : 08 . 826	SEL-Short	02 / 10 / 2002
011130.150642055000.+3S.SEL-CKT 40...	CEV	29442	11 / 30 / 2001	15 : 06 : 42 . 055	SEL-Short	02 / 10 / 2002
040219.062250673000.+3S.DC.BKR FA...	CEV	95206	02 / 19 / 2004	06 : 22 : 50 . 673	SEL-Short	02 / 19 / 2004
DATA1013.CTL	CTL	13099			ASCII	01 / 09 / 2000
DATA1068.CTL	CTL	17631			ASCII	01 / 09 / 2000
26673.dat	dat	512			ASCII	10 / 12 / 2004
010701.173211096000.+3S.S-LAKE RD ...	EVE	17459	07 / 01 / 2001	17 : 32 : 11 . 096	SEL-Short	07 / 06 / 2001
011121.075247771000.+3S.Station A.Re...	EVE	61890	11 / 21 / 2001	07 : 52 : 47 . 771	SEL-Short	11 / 21 / 2001
330EVENT1_R.EVE	EVE	18745			SEL-Short	07 / 06 / 2001
330EVENT1_U.EVE	EVE	24033			SEL-Short	07 / 06 / 2001
SEL-421.EVE.EVE	EVE	95246			SEL-Short	11 / 21 / 2001
020309.183724207.-5S.HNS5.Transcan...	MEH	458584	03 / 09 / 2002	18 : 37 : 24 . 207	Transcan...	03 / 09 / 2002
020310.053937194.-5S.ALBR.Transcan...	MEH	720720	03 / 10 / 2002	05 : 39 : 37 . 194	Transcan...	03 / 10 / 2002
020507.062749959.-5S.WARD.Transcan...	MEH	1048192	05 / 07 / 2002	06 : 27 : 49 . 959	Transcan...	05 / 07 / 2002
930311.122322400000.+3S.Baron Cente...	OSC	45206	03 / 11 / 1993	12 : 23 : 22 . 400	DLP Relay	09 / 06 / 1996
961203.175009073000.+3S.CEDAR GR...	OSC	44316	12 / 03 / 1996	17 : 50 : 09 . 073	DLP Relay	02 / 11 / 1999
040907.172921447000.+3S.DRAVDSBU...	PRE	512	09 / 07 / 2004	17 : 29 : 21 . 447	ASCII	10 / 12 / 2004
DATA1013.RCD	RCD	327680	01 / 09 / 2000	03 : 29 : 18 . 000	Faxtrax II	01 / 09 / 2000

Figure-5, Fault and Disturbance Database Browser (IEEE Std. C37.232)

### III - Program Requirements

Each user needs a copy of the program installed on his/her computer. The program is a compact application that requires minimal installation and is designed to maximize reliability and availability. It is non-intrusive in nature meaning it does not modify any operating system files or registries. The minimum requirements are:

- Windows 2003, NT, XP, Vista, 7, or embedded NT/XP operating systems
- 16 Mbytes of available hard-disk space
- 512 Mbytes of available RAM

- Read/Write access to local and shared drives.

#### **IV - Support Services**

**1) Technical Support:** Toll free numbers and web addresses are provided to answer questions and as needed provide data sheets, quick start manuals, tutorials, and any other type of documentation that is necessary for the proper operation of the program.

**2) Web Support:** Unlimited access to a password protected web site ([www.wavewin.net](http://www.wavewin.net)) is provided for downloading the latest upgrades and documentation. New upgrades are made available at a frequency of about once per quarter.

**3) Field Support:** Softstuf has a qualified team of developers, engineers, and technicians that are willing and ready to travel to field locations as specified and provide installation, configuration, and/or troubleshooting services.

**4) Training:** Softstuf provides classes for hands-on training on acquisition, collection, management, and analysis of fault data records. The classes can be offered at the Softstuf training facility in Philadelphia, PA or at field locations as specified or can be provided electronically via the web.

**5) Customization & Development:** Softstuf will work closely with users to make sure that all of the available features are up to standards and will add newly requested features and functions in a timely manner. New features are normally developed based on a mutual time frame that is in line with the natural evolution of the program.

**6) Warranties:** Softstuf provides full coverage for as long as the users continue to use the program. Deficiencies, if any, will be corrected by Softstuf in a reasonable time frame and without charge.

**7) Users Group:** Softstuf provides all users with access to the user group forms and the minutes of the annual meetings.

#### **V – Additional Information**

For additional information please visit [www.softstuf.com](http://www.softstuf.com), or contact:

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