

DME Data Reporting from CCA Devices with Wavewin

Functional Description – January 12th, 2018

I – Summary

The Wavewin software is used for automatic collection of fault and event data from various types of disturbance monitoring equipment (DME) such as fault recorders and digital relays.

The DME data collection process includes periodic polling for the latest:

- Fault records (FR)
- Sequence of events records (SER)
- Disturbance records (DDR)
- Maintenance records (MR) (such as communications, settings, clock, commissioning)

The process includes naming and formatting of the collected DME data into files in compliance with NERC PRC-002 requirements. The resulting DME data files are transferred over a secure RS232 communication link (one way file transfer) to a local data concentrator in compliance with all of the related NERC CIP security requirements. The local data concentrator then transfers the received DME data files to the DME data server in the office over a standard IT network connection.

In summary, the software allows for a secure journey of DME data files from the substation to the office without any possibility of remote access to any CCA devices (Critical Cyber Assets).

II – Architecture and Functionality

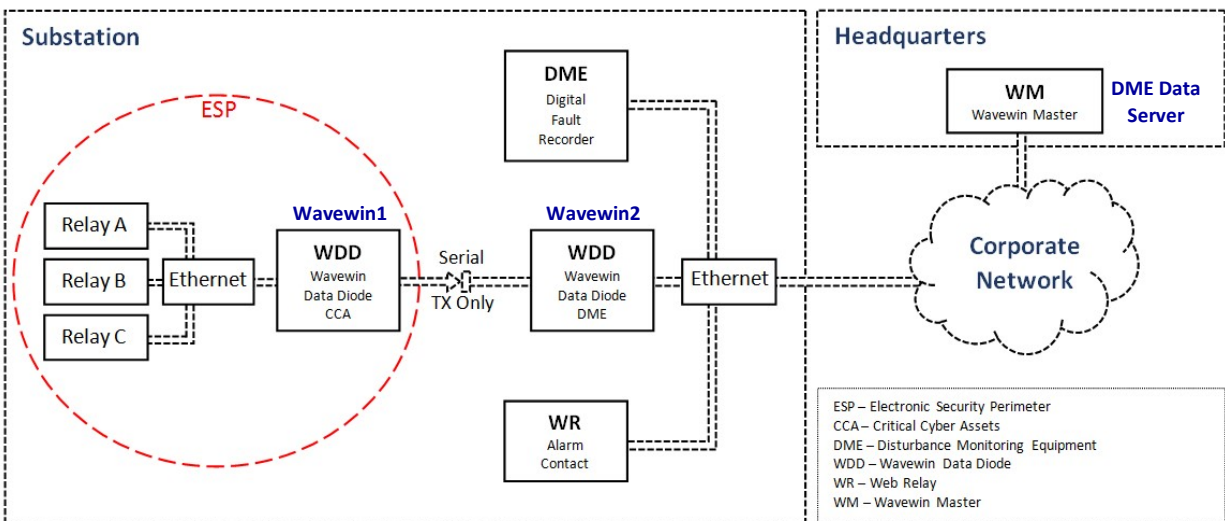


Figure – 1; Barebones Architecture

Highlights:

- Wavewin resides on two SEL-3355 data concentrators (Wavewin1 and Wavewin2)
- Wavewin1 collects the DME data files from up to 100 digital relays within the ESP
- Wavewin1 transmits the collected data files across the ESP to Wavewin2:
 - The transmission is over an RS232 link (one way transfer, a data diode)
 - Wavewin1 and Wavewin2 networks are completely separate (secure)
 - Access to the ESP devices from Wavewin2 is therefore not possible
- Wavewin2 transfers all of the received DME data files to the office DME data server:
 - The transmission is a proprietary Wavewin to Wavewin file transfer protocol
 - Only DME data files are allowed to transfer to the DME server (authentication)
 - The protocol includes CRC checking and Base50 encryption (verification)
- The DME data server saves the received files to a user defined folder structure

Relay Polling Functionality (Wavewin1):

- Periodically establish a TCP/IP client connection at port 23 (user defined period)
- Retrieve the latest FR data (in raw data format such as CEV)
- Retrieve the latest SER data (in raw data format such as SER)
- Retrieve the latest DDR data (in raw format as available/applicable)
- Retrieve MR settings data and alert on any changes (in raw data format such as SHO)
- Retrieve MR clock and commissioning data (in raw format such as IRI and STA)
- Name and save the retrieved data files locally (following IEEE C37.232 naming format)
- Save all communication errors, polling logs, and user access logs (to a local folder)

Reporting Functionality (Wavewin1):

- Periodically establish a serial RS232 connection to Wavewin2 (user defined period)
- For each saved DME data file:
 - Parse keys such as extension, time of occurrence, etc. (authentication)
 - Transmit parsed keys to Wavewin2 (proprietary protocol)
 - Transmit file contents to Wavewin2 (1024 KB blocks)
 - Transmit calculated CRC for the entire file in hex format (verification)
 - Delete the file upon acknowledgment from Wavewin2 (standard RS232 cable)
 - Or, retry 3 times and archive upon no acknowledgment (custom RS232 cable)

Receiving Functionality (Wavewin2):

- Open the RS232 port with exclusive ownership (access denied to any other program)
- For each received DME data file:
 - Confirm keys such as extension, time of occurrence, etc. (authentication)
 - Receive file contents and confirm transmitted CRC (verification)
 - Save the received file to a local folder (standard RS232 cable)
 - Or, create and overwrite the received file to the local folder (custom RS232 cable)

III – Links for Additional Information

Data Collection: <http://www.softstuf.com/Wavewin%20Device%20Manager%20Brochure.pdf>

Universal Viewer: <http://www.softstuf.com/Wavewin%20Universal%20Viewer%20Brochure.pdf>

Software Manuals: <http://www.softstuf.com/documents.html>

Training Classes: <http://www.softstuf.com/wavewinclasses.html>

IV – Examples of Collected DME Data and Wavewin Analytics

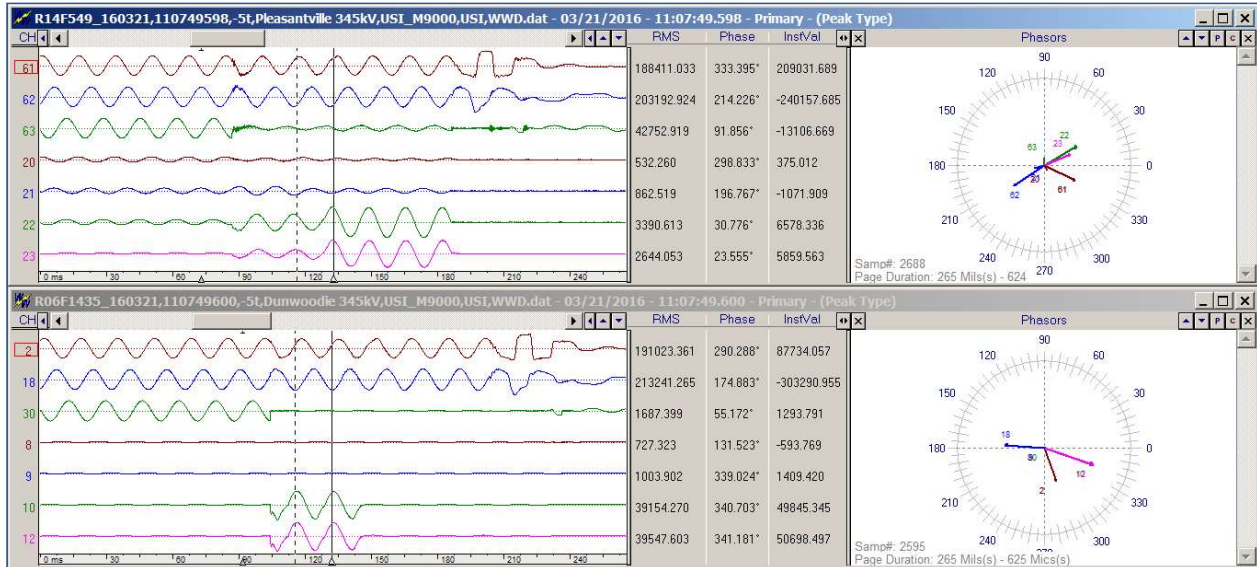


Figure – 2; Example FR data synchronized and displayed for end to end analysis

Sequence of Events Manager: SOE List									
Substation	Device	State	Trigger Date	Trigger Time	Chan. #	Channel Title			
DME-5052-L2	5052 (M871)#128	N	11 / 30 / 2016	09 : 50 : 30	468799	8	BKR F PRI DC TRIP BUS WC	161130.095034000-5.WAUGH CHAPE...	
DME-5052-L2	5052 (M871)#128	N	11 / 30 / 2016	09 : 50 : 30	465224	9	BKR F BU DC TRIP BUS WC	161130.095034000-5.WAUGH CHAPE...	
DME-5052-L2	5052 (M871)#128	A	11 / 30 / 2016	09 : 50 : 30	450268	8	BKR F PRI DC TRIP BUS WC	161130.095034000-5.WAUGH CHAPE...	
DME-5052-L2	5052 (M871)#128	A	11 / 30 / 2016	09 : 50 : 30	448771	9	BKR F BU DC TRIP BUS WC	161130.095034000-5.WAUGH CHAPE...	
DME-L5052	5052 (M871)#181	N	11 / 30 / 2016	09 : 50 : 28	661511	17	5052 PR TRIP	161130.095032000-5.CALVERT CLIFF...	
DME-L5052	5052 (M871)#181	N	11 / 30 / 2016	09 : 50 : 28	659818	1	5052 BU TRIP	161130.095032000-5.CALVERT CLIFF...	
DME-5052-L2	5052 (M871)#128	N	11 / 30 / 2016	09 : 50 : 28	657936	6	5052 (L2) BU RELAY TRIP WC	161130.095034000-5.WAUGH CHAPE...	
DME-5052-L2	5052 (M871)#128	N	11 / 30 / 2016	09 : 50 : 28	653835	5	5052 (L2) PRI RELAY TRIP WC	161130.095034000-5.WAUGH CHAPE...	
DME-L5052	5052 (M871)#181	N	11 / 30 / 2016	09 : 50 : 28	571709	3	5052 BU RCV POTT	161130.095032000-5.CALVERT CLIFF...	
DME-L5052	5052 (M871)#181	A	11 / 30 / 2016	09 : 50 : 28	539984	13	BKR 41 POSITION	161130.095032000-5.CALVERT CLIFF...	
DME-5052-L2	5052 (M871)#128	A	11 / 30 / 2016	09 : 50 : 28	540946	15	BKR 43 POSITION	161130.095032000-5.CALVERT CLIFF...	
DME-5052-L2	5052 (M871)#128	A	11 / 30 / 2016	09 : 50 : 28	530767	14	BKR F STATUS WC	161130.095034000-5.WAUGH CHAPE...	
DME-5052-L2	5052 (M871)#128	A	11 / 30 / 2016	09 : 50 : 28	530767	15	BKR E STATUS WC	161130.095034000-5.WAUGH CHAPE...	
DME-5052-L2	5052 (M871)#128	N	11 / 30 / 2016	09 : 50 : 28	506448	1	DME TROUBLE WC	161130.095034000-5.WAUGH CHAPE...	
DME-L5052	5052 (M871)#181	N	11 / 30 / 2016	09 : 50 : 28	505351	5	BKR 41 BU TR.BUS	161130.095032000-5.CALVERT CLIFF...	
DME-L5052	5052 (M871)#181	N	11 / 30 / 2016	09 : 50 : 28	505351	7	BKR 43 BU TR.BUS	161130.095032000-5.CALVERT CLIFF...	
DME-L5052	5052 (M871)#181	N	11 / 30 / 2016	09 : 50 : 28	508085	21	BKR 41 PR TR.BUS	161130.095032000-5.CALVERT CLIFF...	
DME-L5052	5052 (M871)#181	N	11 / 30 / 2016	09 : 50 : 28	508085	23	BKR 43 PR TR.BUS	161130.095032000-5.CALVERT CLIFF...	
DME-5052-L2	5052 (M871)#128	A	11 / 30 / 2016	09 : 50 : 28	504364	5	5052 (L2) PRI RELAY TRIP WC	161130.095034000-5.WAUGH CHAPE...	
DME-5052-L2	5052 (M871)#128	A	11 / 30 / 2016	09 : 50 : 28	503974	9	BKR F BU DC TRIP BUS WC	161130.095034000-5.WAUGH CHAPE...	
DME-5052-L2	5052 (M871)#128	N	11 / 30 / 2016	09 : 50 : 28	503974	12	BKR E BU DC TRIP BUS WC	161130.095034000-5.WAUGH CHAPE...	
DME-L5052	5052 (M871)#181	A	11 / 30 / 2016	09 : 50 : 28	503138	17	5052 PR TRIP	161130.095032000-5.CALVERT CLIFF...	
DME-L5052	5052 (M871)#181	A	11 / 30 / 2016	09 : 50 : 28	500404	1	5052 BU TRIP	161130.095032000-5.CALVERT CLIFF...	
DME-5052-L2	5052 (M871)#128	A	11 / 30 / 2016	09 : 50 : 28	500404	3	5052 BU RCV POTT	161130.095032000-5.CALVERT CLIFF...	
DME-5052-L2	5052 (M871)#128	A	11 / 30 / 2016	09 : 50 : 28	499222	6	5052 (L2) BU RELAY TRIP WC	161130.095034000-5.WAUGH CHAPE...	
DME-5052-L2	5052 (M871)#128	N	11 / 30 / 2016	09 : 50 : 28	497139	8	BKR F PRI DC TRIP BUS WC	161130.095034000-5.WAUGH CHAPE...	
DME-5052-L2	5052 (M871)#128	N	11 / 30 / 2016	09 : 50 : 28	496683	11	BKR E PRI DC TRIP BUS WC	161130.095034000-5.WAUGH CHAPE...	
SPRAIN BROOK	85-2B/Y49	N	03 / 27 / 2013	00 : 05 : 29	226333	174	320GE	SPRAINBROOK_85-2B_Y49_3-27-201...	
SPRAIN BROOK	85-2B/Y49	N	03 / 27 / 2013	00 : 05 : 29	226333	176	320E	SPRAINBROOK_85-2B_Y49_3-27-201...	
SPRAIN BROOK	85-2B/Y49	A	03 / 27 / 2013	00 : 05 : 29	229458	187	IN106	SPRAINBROOK_85-2B_Y49_3-27-201...	
SPRAIN BROOK	85-2B/Y49	A	03 / 27 / 2013	00 : 05 : 29	226333	224	*	SPRAINBROOK_85-2B_Y49_3-27-201...	

Figure – 3; Example SER data combined and sorted from multiple devices

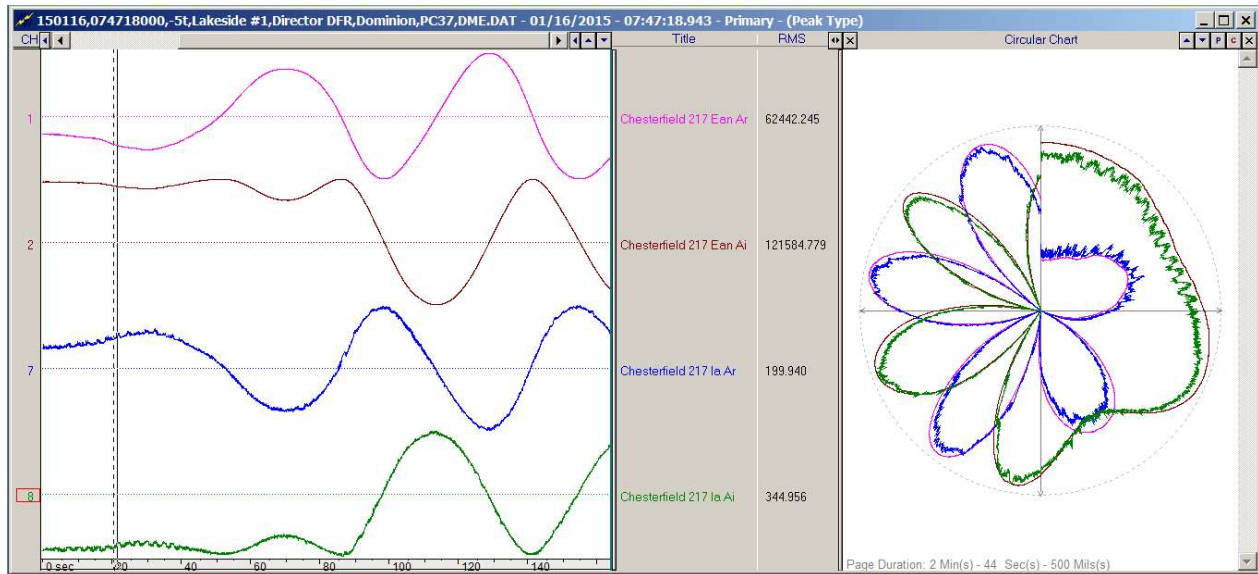


Figure – 4; Example DDR data with real and imaginary components on a circular chart

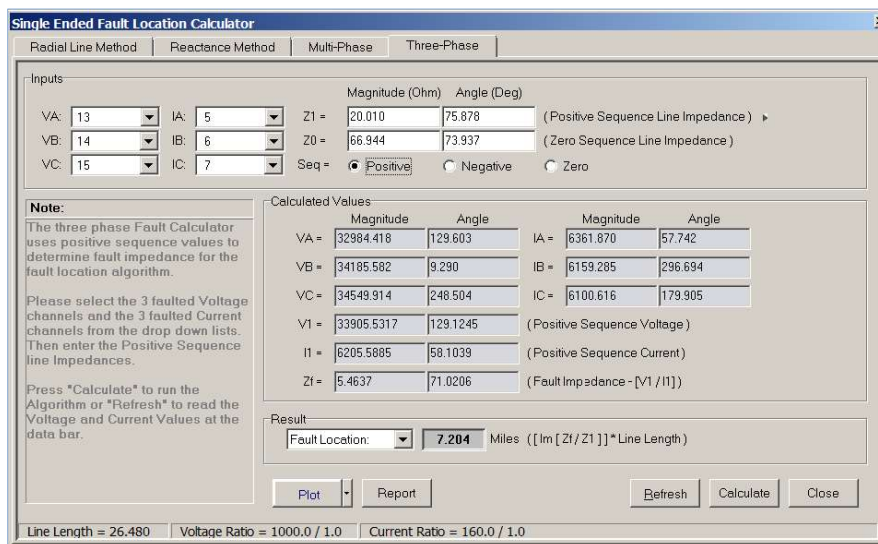


Figure – 5; Displays are equipped with single ended fault locators for ground and multiphase faults

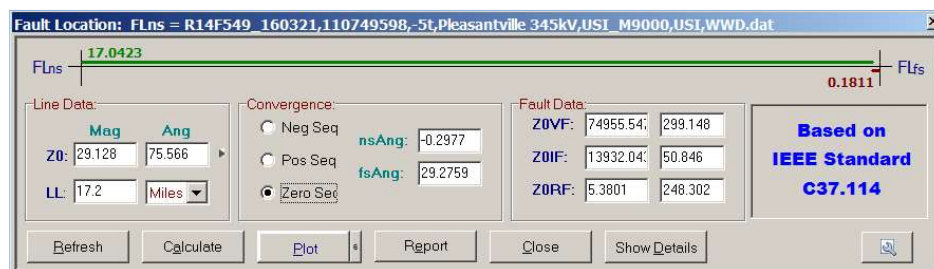


Figure – 6; Double ended fault locators are also available with multiple types of convergence algorithms

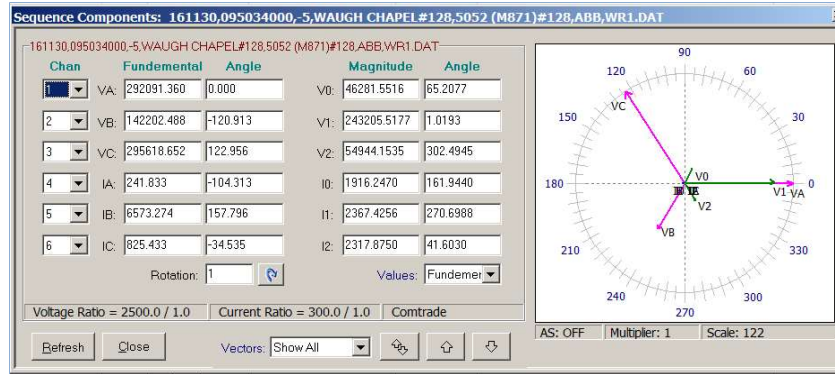


Figure – 7; Sequence components calculator with fundamental and harmonic filters

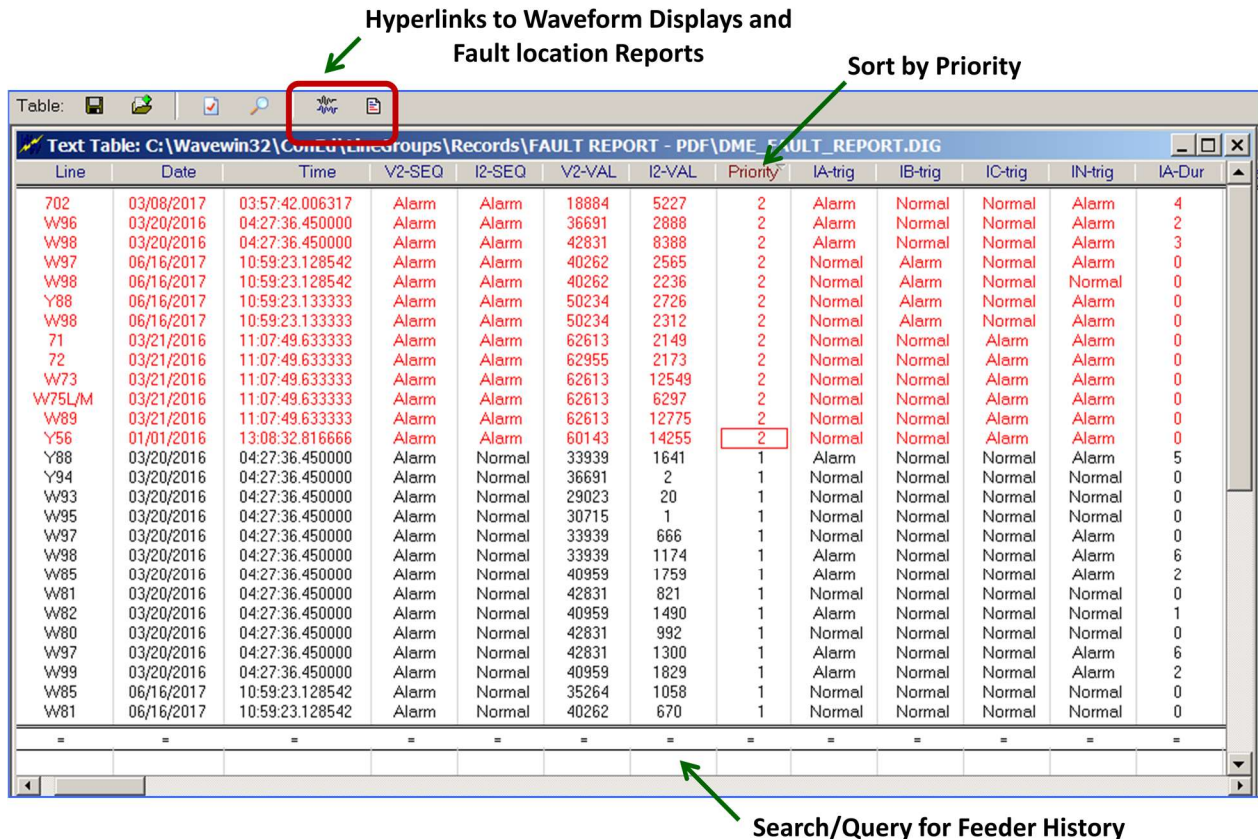


Figure – 8; FR data historian with hyperlinks to FR and SER data displays

V – Requirements and Services

Description:

- Wavewin is a universal program used for collection, management, and analysis of various types of DME data from various types of devices. The data are read using the original manufacture specific formats and the COMTRADE standard is supported (both ASCII and Binary formats including revisions 1991, 1999, and 2013).

Requirements:

- The software supports Windows 7, 8, 10 and 2008/2012/2016 servers, and can run on embedded platforms including Windows and Linux operating systems. The software requires 32MB of storage space and depending on usage may use up to 2GB of available memory. The software supports local and shared drives on the network, it is small in size, structured, and non-intrusive (does not modify any operating system files).

Support Services:

- Technical support is available at 800.818.3463 or at support@softstuf.com
- Configuration and customization services are provided remotely from Softstuf offices
- Installation, testing and commissioning services are provided at customer sites
- Training services with professional development credits are provided at customer sites
- Supplier: The supplier of the software and services is Softstuf, Inc.

Ownership:

- Softstuf has all rights, title, and interest in the Wavewin software. The software is copyright protected and is a registered trademark of Softstuf.

Warranties:

- Softstuf warrants that the software will substantially achieve the functionality as advertized and described in the Manuals. In the event any future deficiency is discovered in the software then Softstuf shall at its own sole expense make the changes necessary to correct said deficiency within a reasonable time of being notified.

New Devices:

- Softstuf will initially provide an extensive library of drivers for working with various types of event and fault data records from various types of fault recorders and digital relays. In the event new drivers are requested then Softstuf will develop them at rates and lead times that are mutually agreed upon.

VI – Contact Information

Amir Makki
609-338-7735 (Phone)
215-922-6880 (Office)
amir@softstuf.com