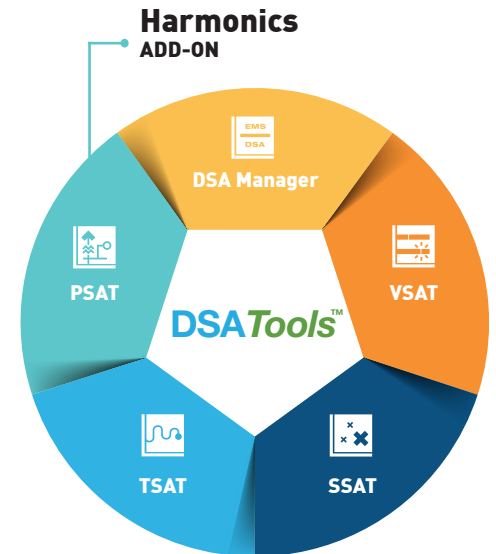


Harmonics Harmonic Analysis

The Harmonics module is an add-on module to PSAT that enhances the software to perform power quality analysis of a power system.



The Harmonics module uses various industry standard indices to analyze harmonic distortion due to particular equipment in a system:

- Total Harmonic Distortion (THD)
- Total Power Factor (TPF)
- Individual Harmonic Distortion (IHD)

Frequency Scan Analysis is used to observe any harmonic resonance at a bus or in the transfer impedance between two buses.

APPLICATION SCOPE

The principal applications of the Harmonics module are to determine the impact of harmonic sources on a power system, including:

- Identifying potential risks due to particular harmonic current and voltage.
- Verifying whether harmonic distortion levels comply with IEEE 519-1992 standard.
- Identifying resonance frequencies and locations of dangerous resonance paths.
- Facilitating design of harmonic mitigation measures such as harmonic filters.

Bar charts and plots are utilized to visually compare harmonic components and impedances at various frequencies. This module complies with the IEEE 519-1992 standard.

APPROACH

The Harmonics module uses two methods:

- **Harmonic Powerflow.** This method is applied for:
 - network harmonic distortion assessment (THD, TPF, IHD).
 - harmonic limit compliance verification.
 - equipment rating selection.
 - equipment de-rating calculation.
- **Harmonic Frequency Scan.** This method is mainly for:
 - identification of resonance frequencies.
 - determination of network components that contribute to resonances.

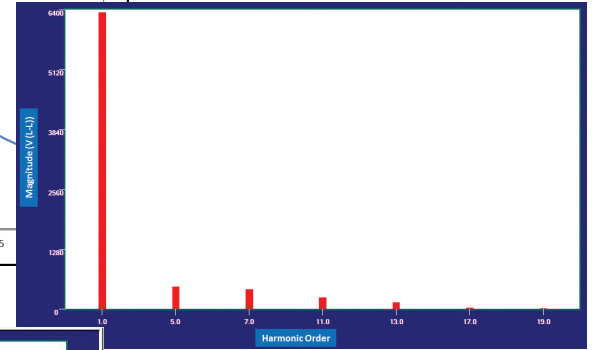
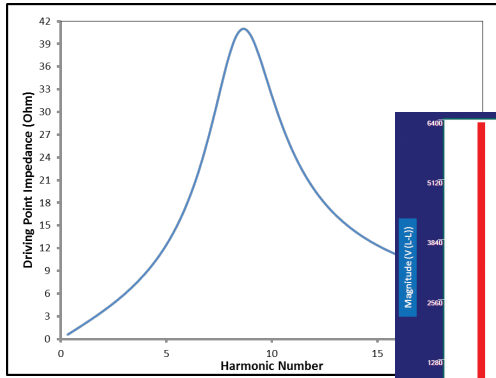
PRODUCT FEATURES:

- *Identify risks due to particular harmonic current and voltage*
- *Verify harmonic distortion level compliance with IEEE standard*
- *Identify resonance frequencies and the location of dangerous resonance paths*
- *Facilitate design of harmonic filters*

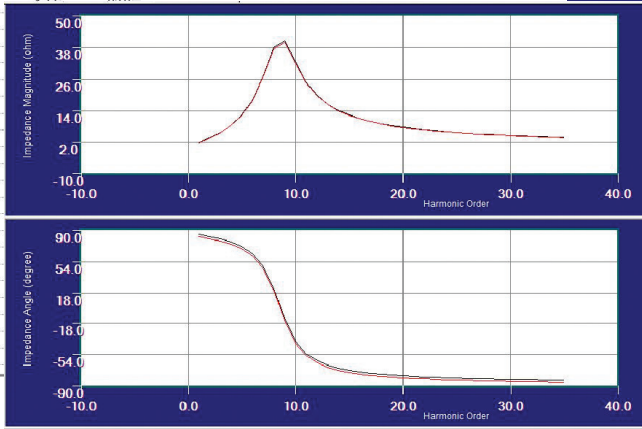
Harmonic Analysis

SAMPLE RESULTS

The plots here shows the Frequency Scan results from the Harmonics module for the example included in the IEEE 519-1992 standard.



Bus	Generator	Load	Shunt	Branch	WPT	Bar Chart	Freq. Scan		Bus 1000		Bus 1001	
							Frequency	Harmonic	Magnitude	Angle(deg)	Magnitude	Angle(deg)
							Hz	Order				
1							60.00	1.000	1.79	85.3		
2							120.00	2.000	3.71	83.1		
3							180.00	3.000	5.94	80.4		
4							240.00	4.000	8.75	76.7		
5							300.00	5.000	12.57	71.5		
6							360.00	6.000	18.22	63.3		
7							420.00	7.000	26.96	49.1		
8							480.00	8.000	38.08	23.2		
9							540.00	9.000	40.61	-12.0		
10							600.00	10.000	32.58	-38.2		
11							660.00	11.000	25.06	-52.7		
12							720.00	12.000	20.02	-60.9		
13							780.00	13.000	16.65	-66.0		
14							840.00	14.000	14.28	-69.4		
15							900.00	15.000	12.53	-71.9		
16							960.00	16.000	11.18	-73.7		
17							1020.00	17.000	10.12	-75.2		
18							1080.00	18.000	9.26	-76.4		
19							1140.00	19.000	8.54	-77.3		
20							1200.00	20.000	7.93	-78.1		
21							1260.00	21.000	7.41	-78.8		
22							1320.00	22.000	6.96	-79.4		
23							1380.00	23.000	6.57	-79.0		



SPECIFICATIONS AND REQUIREMENTS

- Runs on MS Windows 7/10/server 2012 R2/server 2016
- Requires PSAT to run

OTHER POWERTECH SERVICES

- Licensing of the power system analysis software package DSATools™
- Licensing of other software products for utility applications
- Implementation of on-line dynamic security assessment (DSA) systems
- Development of custom software systems
- Development of models for use in power system analysis
- Generator field testing, model development and validation
- Training
- Technical consultancy studies including
 - Development of power system base cases
 - System planning and operation studies
 - Facility (including renewables) interconnection studies
 - Compliancy studies (such as NERC TPL, CIP, UFLS, etc.)
 - Post-mortem analysis of system disturbances

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ABOUT POWERTECH LABS

Powertech Labs Inc. is one of the largest testing and research laboratories in North America, situated in beautiful British Columbia, Canada. Our 11-acre facility offers 15 different testing labs for a one-stop-shop approach to managing utility generation, transmission and distribution power systems.

Outside of the utilities industry, Powertech provides routine testing capabilities, product development, research and consulting services to support an array of industrial-type operations, electrical equipment manufacturers and automotive original equipment manufacturers.

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