



TRENCH®

THE PROVEN POWER.

TRENCH LIMITED
HARMONIC MONITORING DEVICE

CVT Harmonic
Monitoring

CVT Harmonic Monitoring

Coupling Capacitor Voltage Transformers with Harmonic Monitoring Terminals

The study of harmonics in power systems is an area that is recently receiving a great deal of attention. This is mainly due to the increasing number of non-linear elements and electronic devices connected to the power systems, including AC conversion of green energy generation.

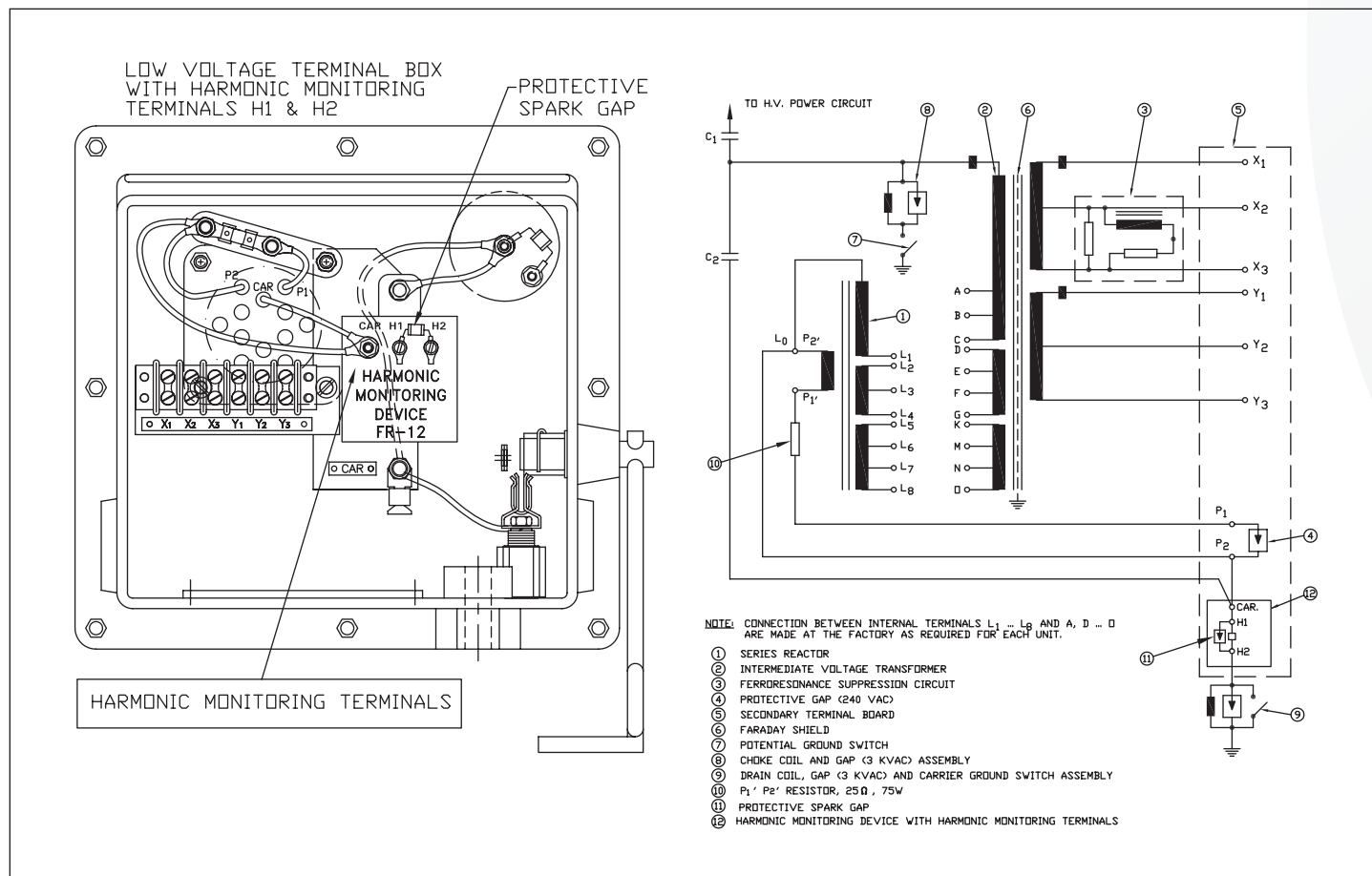
Over the last few years, operation of the power system has undergone a dramatic change, driven by two factors: the increasing need for energy conservation and the emergence of low-cost power semiconductors. The combination of these forces has resulted in a large number of nonlinear loads being connected to the power systems. These nonlinear loads generate distorted currents, which contain higher-than-normal frequencies (harmonics). Power system harmonics are integer multiples of the fundamental power system frequency.

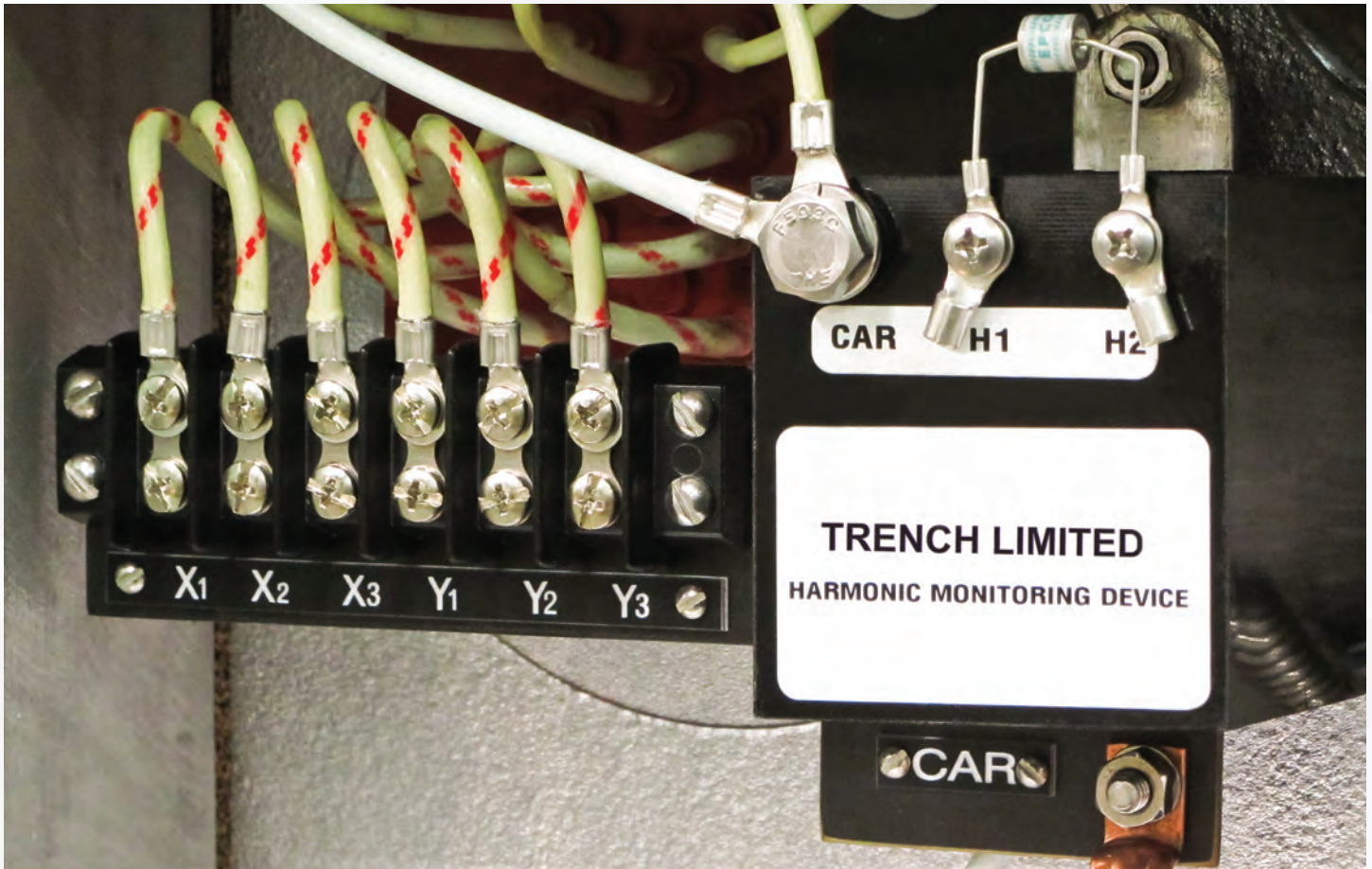
In addition to making voltage measurements difficult, the high levels of harmonics in power systems can also cause transformer

and capacitor failures, electronic equipment malfunctions and relay malfunctions. Considering the objective of the electric utility is to deliver sinusoidal voltage at fairly constant magnitude throughout the system, there is a growing need to measure harmonics in high voltage power systems and, whenever possible, eliminate them.

Trench Limited specializes in the design and manufacture of Capacitor Voltage Transformers (CVT) with features that enable accurate measurements of harmonics in high voltage power systems. For this application, the CVTs are provided with an additional voltage tap (H1-H2) located in the low voltage side of the capacitor voltage divider.

In addition to having regular functions in metering, relaying and power line carrier (PLC) applications, CVTs with this feature can produce reduced power frequency voltages with waveforms that are true replicas of their primary waveforms (typically 80 to 120 volts with an accuracy of $\pm 5\%$).

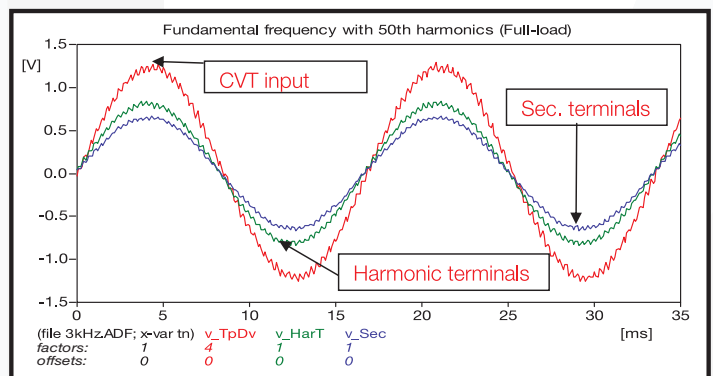




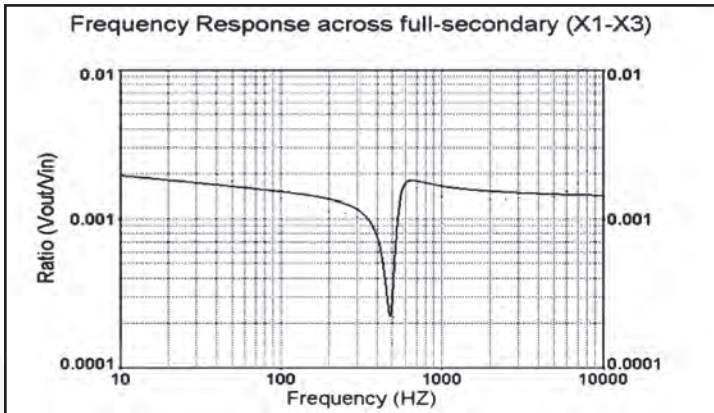
Inside view of secondary box with harmonics monitoring terminals - 245/170kV CVT.

The harmonics monitoring device does not contain any electronic or electromagnetic parts and is mounted in the low voltage terminal box.

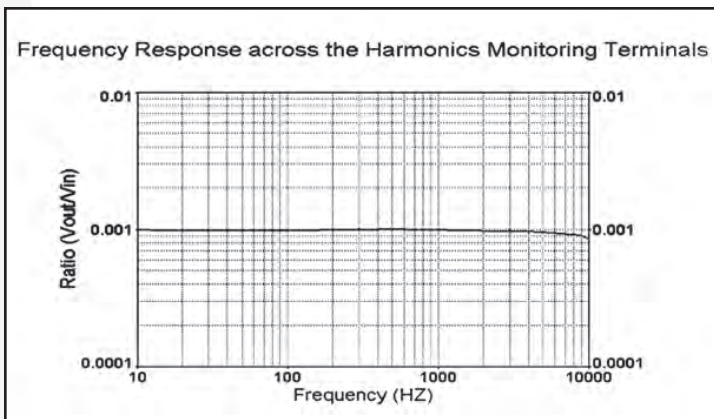
Through the H1-H2 terminals of the CVT, harmonics can be measured by instruments with input impedance **greater than 1 Mega-Ohm.**



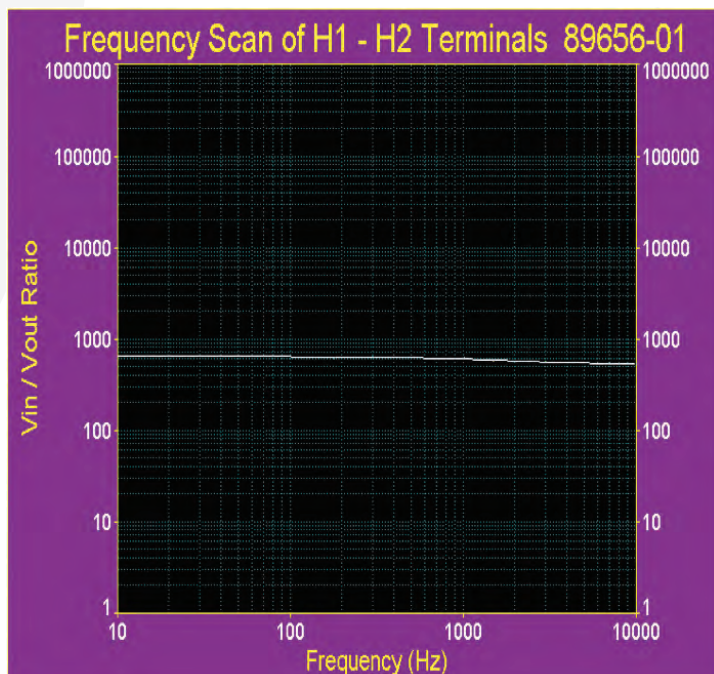
The operating principle makes use of the linearity of capacitor voltage dividers in CVTs at frequencies of up to and beyond the 50th harmonic



If conventional CVTs are used to measure harmonics, the primary to secondary voltage ratio of the CVT is not linear in the frequency range from power frequency to 10 kHz.



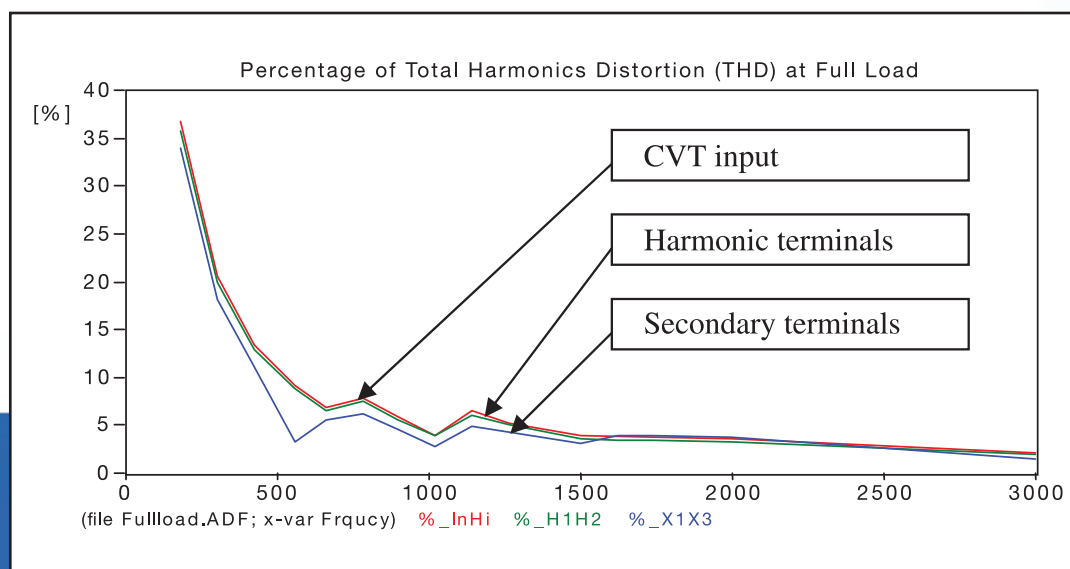
CVTs originally equipped at the factory or field retrofitted with H1-H2 harmonics monitoring terminals, provide a high fidelity reproduction of primary (High Voltage) to secondary (H1-H2) low voltage in the frequency range from power frequency up to 10 kHz.



Actual frequency scan measurements using the H1-H2 harmonics monitoring terminals.

Total Harmonic Distortion (THD) – Lab measurements - 145 kV CVT with 200 VA Secondary Load

Secondary load - 200VA		
	Oscilloscope Input 1	Oscilloscope Input 2
Frequency	CCVT Input	Harmonics Monitoring Terminal
(Hz)	THD (%)	THD (%)
180	36.76	35.70
300	20.50	19.93
420	13.35	12.86
560	9.15	8.83
660	6.84	6.51
780	7.86	7.50
900	5.87	5.50
1020	3.99	3.87
1140	6.50	6.03
1260	5.29	5.03
1500	3.86	3.66
1620	3.80	3.46
1740	3.68	3.35
2000	3.56	3.24
3000	2.06	1.90



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