

KAVOSH T22

All-in-one Testing Solution



ESFAgroup.com

KAVOSH T22 is a controllable single-phase current and voltage source with the rated output power of 5 kVA. This is designed and produced by ESFA Group which is suitable for performing various kinds of commissioning, periodic, and diagnostic tests.

KAVOSH T22 can be employed in high voltage substations, distribution substations, power plants, industrial plants, high voltage equipment manufacturer, research centers, and universities. The output voltages can be controlled in the range of 0~2200 V-AC and 0~260 V-DC.



In addition, its output current can be controlled in the range of 0~1000 A-AC and 0~400 A-DC. Moreover, the frequency of AC voltage and current is controllable between 15 and 120 Hz.

Furthermore, KAVOSH T22 can be synchronized with an external current or voltage source to generate either current or voltage with the same frequency, adjustable phase angle difference, and specified amplitude (up to 1000 A and 2200 V).

Applications of such a feature consist of amplifying an electrical signal, performing three-phase tests using three separate KAVOSH T22 devices, distance or directional relay function test by the primary injection method, and etc.





KAVOSH T22 is equipped with a built-in server to which every type of processing device with an internet browser can be connected (e.g., a laptop, PC, tablet, or cellphone). To do so, wireless communication (Wi-Fi) or direct connection by CAT 6 network cable can be utilized. Furthermore, a touch screen LCD mounted on KAVOSH T22 can be used to perform all tests without using an external processing device.

The software easily provides all the required reports and makes a database. Moreover, all the test results can optionally be sent to a server (ESFAnalysis software) by which they will be scrutinized based on standard guidelines, comparison to similar cases and historical test results, and theoretical analysis.

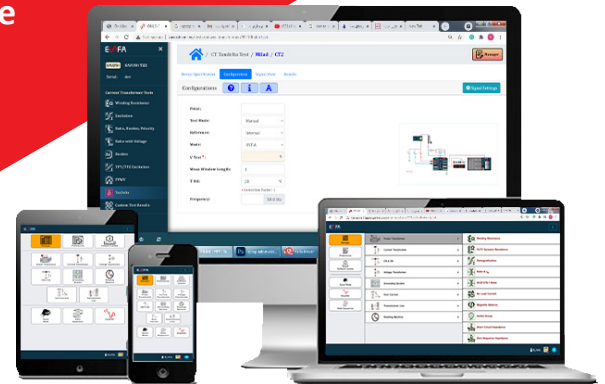
KAVOSH T22 has some software and hardware optional modules including

dissipation factor (Tan Delta) and capacitance measurement (TDM1 module), switch box for easily performing automatic tests on three-phase transformers (TEM1), coupling module for transmission line, cable, and grounding system testing (CM1), and circuit breaker test module (CB1).



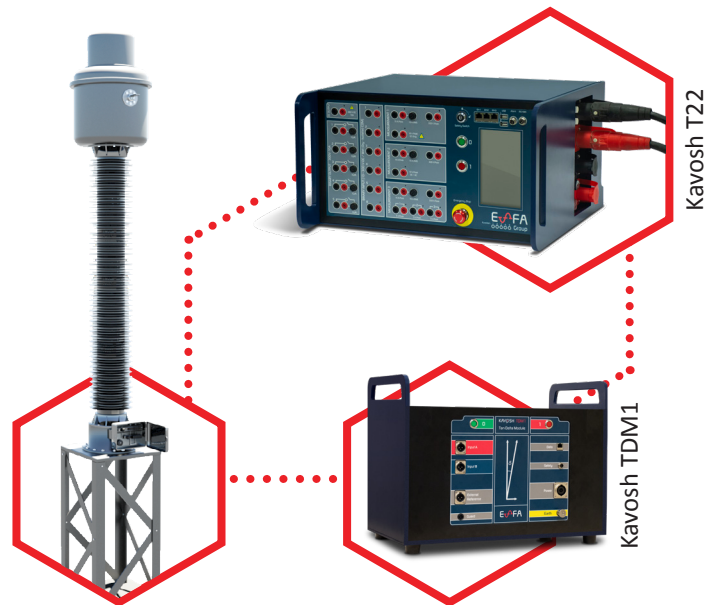
Software

- Web-based software eliminating need for installation and run on a computer, tablet and cellphone
- Specific test rooms with corresponding wiring diagrams depending on the set parameters
- User-friendly computer software supporting both Wi-Fi and Ethernet cable connections
- Touch LCD for handling tests with the same performance as the connected computer
- Aided software in all test steps automatically generating test results
- Online project management website: kavosh.online
- Manageable database



Current Transformer Testing

- Capacitance and dissipation factor (Tan Delta) measurement (up to 10 kV by TDM1 external module)
- Test and analysis of TPY- and TPZ-type CTs (magnetizing characteristic and ratio error)
- Excitation and Hysteresis Curves (up to 2.2 kV @ 50 Hz)
- Ratio and Polarity (by injecting current into primary side up to 1000 A)
- Ratio and Polarity (by applying voltage on secondary side up to 2.2 kV)
- Power frequency withstand voltage (up to 2.2 kV) for secondary side winding and circuit



- Secondary side DC winding resistance
- Secondary burden measurement
- Core demagnetizing

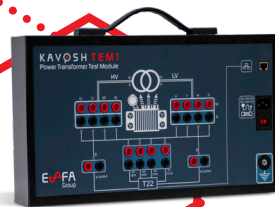
Power Transformer Testing

- Switch box for automatic and quick performing tests on three-phase transformers (by TEM1 external module)
- Capacitance and dissipation factor (Tan Delta) measurement (up to 10 kV by TDM1 external module)
- High voltage excitation current and loss measurement (up to 10 kV by TDM1 external module)
- Turn ratio test on both regular and phase shifting transformers (based on IEC61378-1 method)
- Winding resistance (by injecting DC current in the range of 0 to 10 A or 10 to 100 A, or applying DC voltage)
- **Dynamic resistance test of on load tap changers (up to 10 A DC)**
- **No-load current (excitation current) and loss (up to 2.2 kV)**
- **Short circuit and zero sequence impedance (up to 10 A)**
- **Magnetic core demagnetizing (up to 10 A DC)**
- **Magnetic balance (up to 2.2 kV)**
- **Vector group**

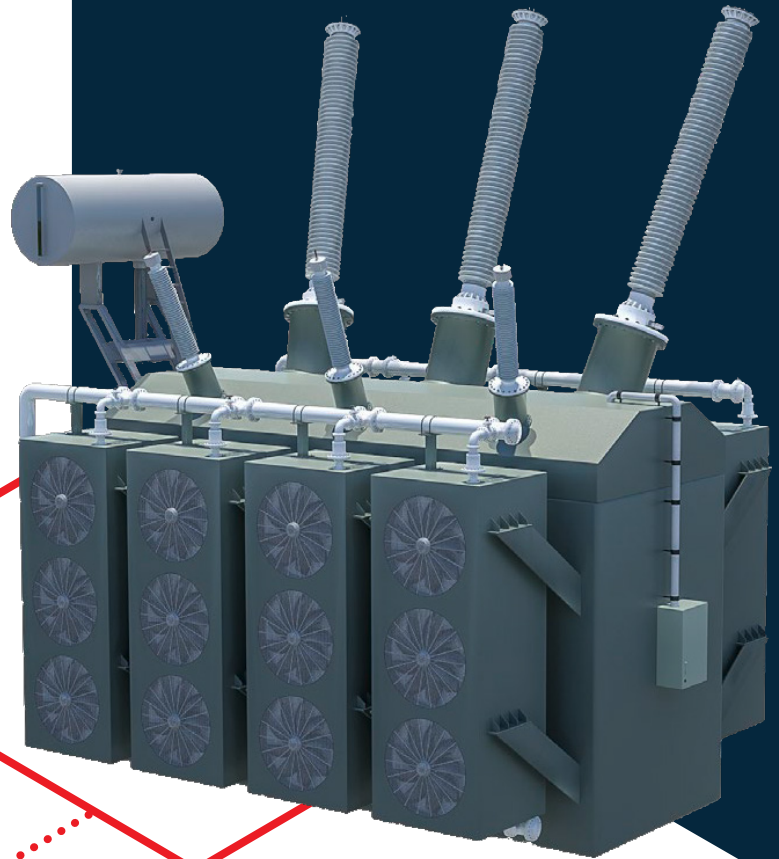
Kavosh TDM1



Kavosh T22

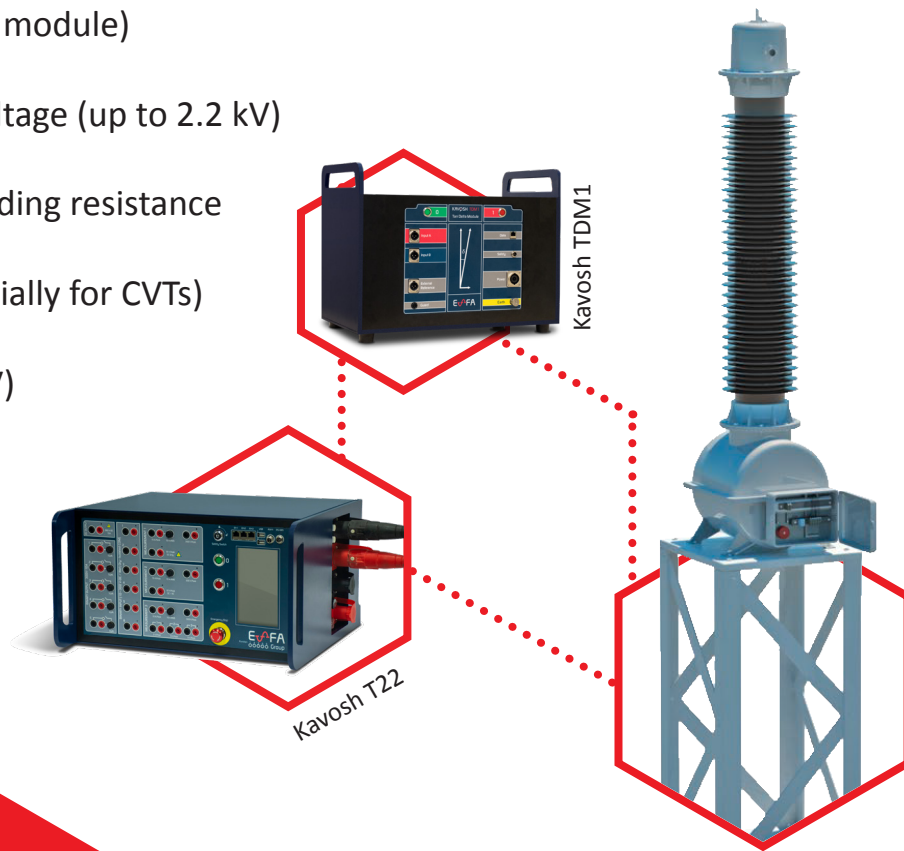


Kavosh TEM1



Voltage Transformer (CVT, PT)

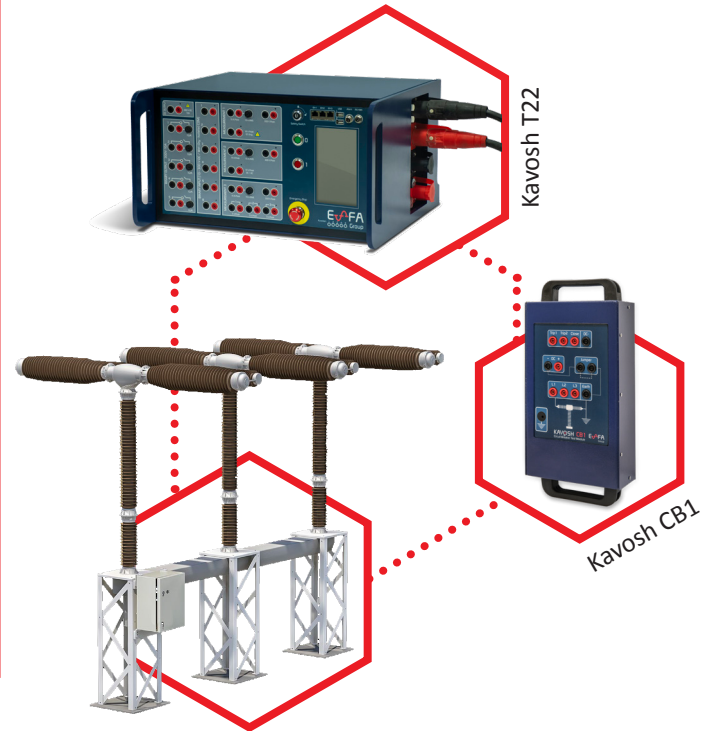
- Capacitance and dissipation factor (Tan Delta) measurement (up to 10 kV by TDM1 external module)
- Power frequency withstand voltage (up to 2.2 kV)
- Primary and secondary DC winding resistance
- Short circuit impedance (especially for CVTs)
- Ratio and polarity (up to 2.2 kV)
- Secondary burden



Circuit Breaker (CB)

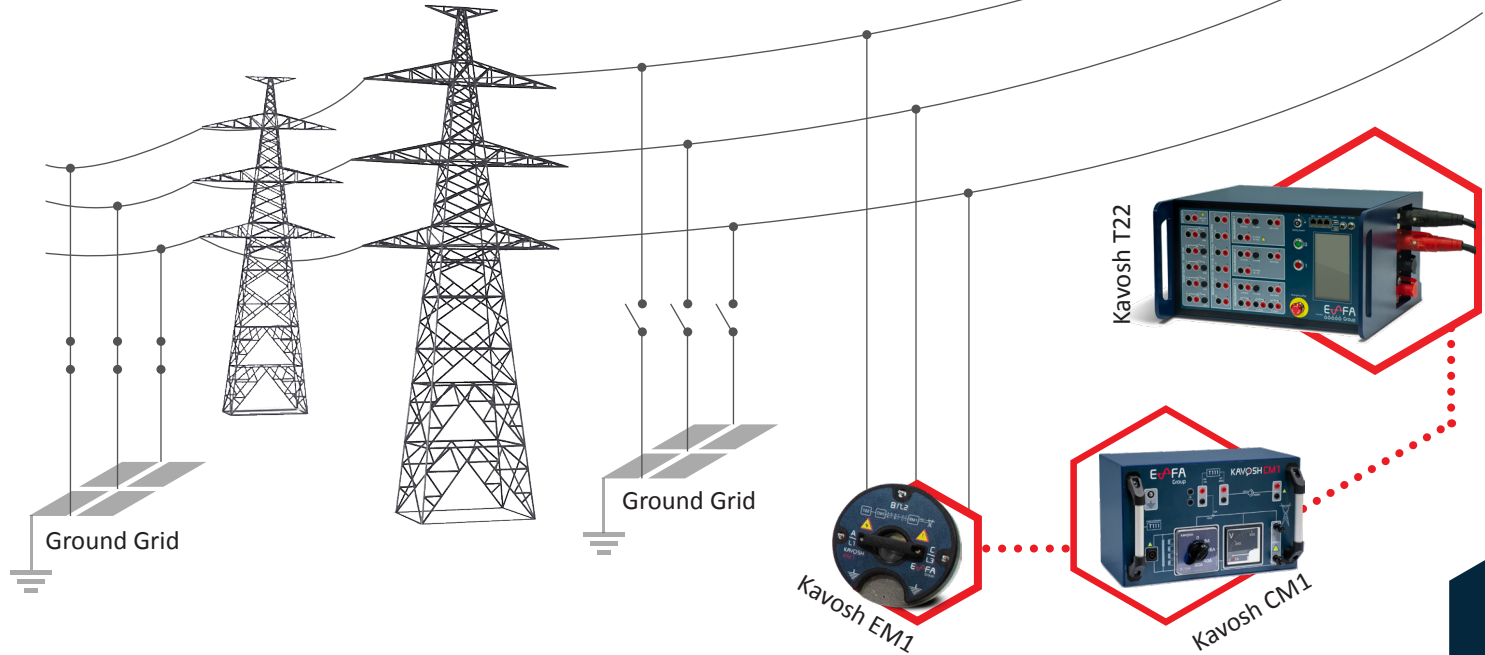
- Dual ground method (for time test under electromagnetic noises of in-service high voltage substations)
- Motor current and spring charge time monitoring (by using optional DC clamp-on ammeter)
- Trip/close coil minimum pickup voltage (up to 260 V DC/AC, 10 A)
- Time test (for various duty cycles such as O, C, CO, OC, COC, OCO)
- Static contact resistance (by injecting DC current up to 400 A)
- Power frequency withstand voltage (up to 2.2 kV)

- Trip/close coil current monitoring
- Pole discordance analysis



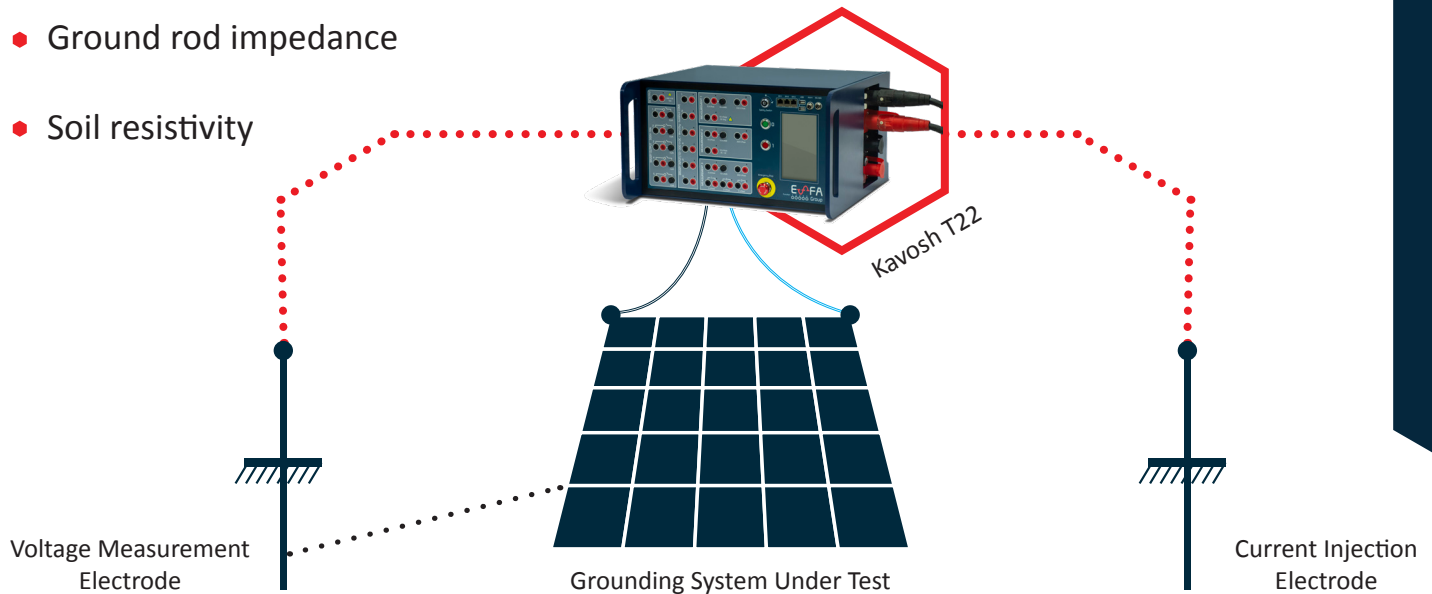
Overhead Line and Cable

- Positive and zero sequence impedance calculation
(by ESFAAnalysis software based on tower outline and conductor specifications)
- Positive and zero sequence impedance measurement
(by CM1 module: 550 V- 10 A / 55 V – 100 A)



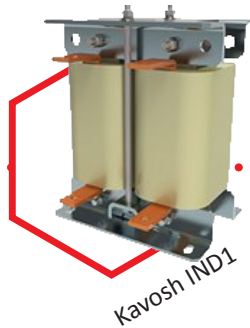
Grounding System

- Safety voltages including step, touch, transfer, metal-to-metal voltages (especially by using CM1 module)
- Ground connection integrity check (by injecting DC current up to 400 A)
- Ground grid impedance (separately resistance and reactance)
- Ground rod impedance
- Soil resistivity



Rotating Machine

- Capacitance and dissipation factor (Tan Delta) measurement (up to 10 kV by TDM1 external module)
- Capacitance and dissipation factor (Tan Delta) measurement (up to 25 kV by external module)
- Stator and rotor DC winding resistance
- Stator impedance



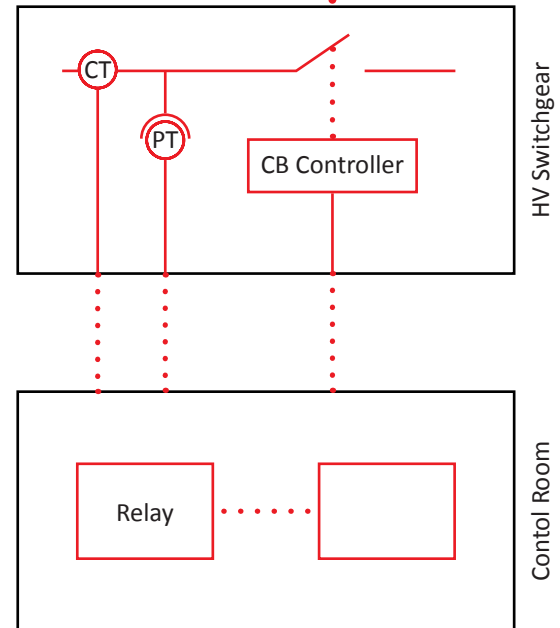
Entire Protection System

(Instrument transformers, relays, and trip command circuit by injecting single-phase current and voltage)

- High-impedance differential relay (including REF, busbar, motor, and generator)
- Low-impedance differential relay (including REF, busbar, motor, and generator)
- Distance relay (by CM1 external module)
- Overcurrent and Earth Fault relays
- Directional overcurrent relay
- Directional earth fault relay

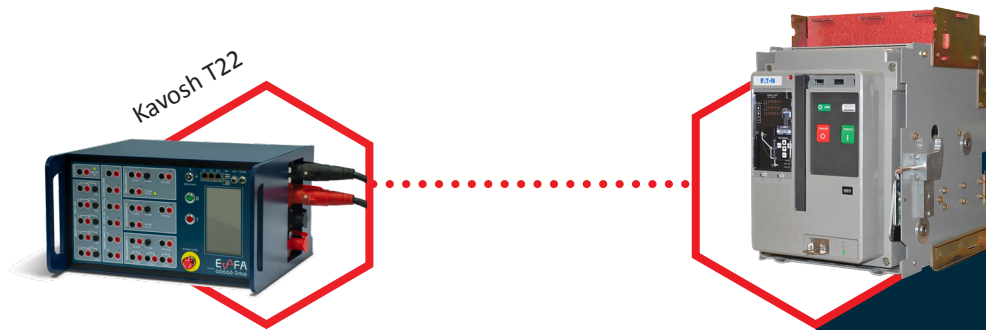


Kavosh T22



Low Voltage Breakers (MCB, MCCB, and ACB) and Fuse

- I-t characteristic (clearing time) for low-voltage, medium-voltage, and power fuses (by AC current injecting up to 1000 A)
- I-t characteristic for low-voltage circuit breakers (MCB, MCCB, and ACB)



Quick Mode

- Injecting current up to 1000 A AC (15 to 120 Hz) and up to 400 A DC
- Applying voltage up to 2200 v AC (15 to 120 Hz) and up to 260 V DC
- Adjusting limitations on test duration time, voltage, and current
- Setting triggering mode (using wet/dry binary inputs and analog input)
- Selecting measured parameter
M1 (300 V / 10 A / 10 V), M2 (300 V / 10 A / 10 V), and
M3 (300 V / 10 A / 5 V-A / 5 V-B / 5 V-C)

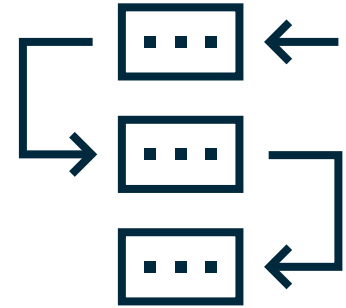
Calculating complex parameters including R / X / Z / L /

- C / P / Q / S based on measured signals



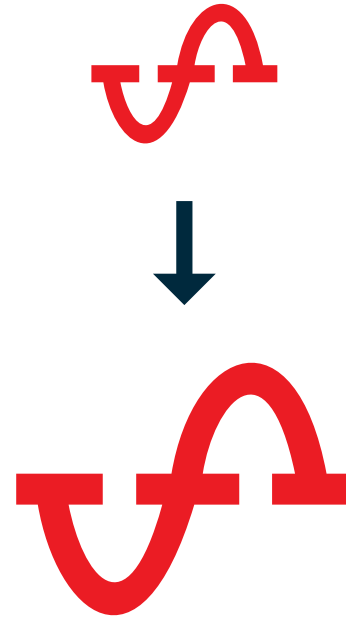
State Sequencer Mode

- Employing up to 10 sequences with different amplitude and measuring time difference between states
- Testing automatic reclosing circuit breaker performance
- Injecting current up to 1000 A AC (15 to 120 Hz) and up to 400 A DC
- Applying voltage up to 2200 v AC (15 to 120 Hz) and up to 260 V DC
- Adjusting limitations on test duration time, voltage, and current
- Setting triggering mode (using wet/dry binary inputs and analog input)
- Selecting measured parameter
M1 (300 V / 10 A / 10 V), M2 (300 V / 10 A / 10 V), and M3 (300 V / 10 A / 5 V-A / 5 V-B / 5 V-C)
- Calculating complex parameters including R / X / Z / L / C / P / Q / S based on measured signals



Amplifier Mode

- Operation in AC voltage / current mode
(15 Hz to 120 Hz variable frequency)
Up to 2200 V AC / 1000 A AC
- Synchronization with AC voltage or current
- Injection voltage / current signals with
amplification factor and phase shift relative
to the reference signal
- Synchronization of up to 3 KAVOSH devices
(with application of three-phase tests)



Technical Data KAVOSH T22

- Current Output

Output	Amplitude	t_{\max}	V_{\max}	Power	frequency
1000 A AC	1000 A	30 s	5 V	5000 VA	15 ... 120 Hz
	500 A	10 min	5 V	2000 VA	15 ... 120 Hz
	200 A	>2 h	5 V	1000 VA	15 ... 120 Hz
400 A DC	400 A	2 min	5 V	2000 VA	DC
	200 A	10 min	5 V	1000 VA	DC
	100 A	>2 h	5 V	500 VA	DC
10 A AC (rms)	10 A	10 min	260 V	2600 VA	15 ... 120 Hz
	3 A	>2 h	260V	780 VA	15 ... 120 Hz
10 A DC	10 A	10 min	260V	2600 VA	DC
	3 A	>2h	260V	780VA	DC

Technical Data KAVOSH T22

• Voltage Output

Output	Amplitude	t_{\max}	I_{\max}	Power	frequency
2000 V AC	260...0V	>2 h	3 A	780 VA	120 ... 15 Hz
	260...0V	10 min	10 A	2600 VA	120 ... 15 Hz
	760...0V	>2h	1.5 A	1200 VA	120 ... 15 Hz
	760...0V	10 min	5 A	3800 VA	120 ... 15 Hz
	2260...0V	>2h	0.5 A	1130 VA	120 ... 15 Hz
	2260...0V	1 min	2 A	2260 VA	120 ... 15 Hz
260 V DC	260...0 V	>2h	3 A	780 VA	DC
	260...0 V	10 min	10 A	2600 VA	DC

Technical Data KAVOSH T22

- Internal Measurement of Outputs

Output	Range	Guaranteed accuracy			Typical accuracy		
		Amplitude Reading error	Full scale error	Full scale error	Amplitude Reading error	Full scale error	Full scale error
1000 A AC	-	%0.20	%0.20	0.2°	%0.10	%0.10	0.1°
400 A DC	-	%0.30	%0.10	-	%0.10	%0.15	0.1°
2260 V AC	2000 V	%0.10	%0.10	0.2°	%0.08	%0.05	0.1°
	1000 V	%0.10	%0.10	0.2°	%0.08	%0.05	0.1°
	500 V	%0.10	%0.10	0.2°	%0.08	%0.05	0.1°
	10 A	%0.10	%0.10	0.2°	%0.08	%0.05	0.1°
	500 mA	%0.10	%0.10	0.2°	%0.08	%0.05	0.1°
260 V DC	300 V	%0.10	%0.15	-	%0.05	%0.08	-
	15 V	%0.10	%0.15	-	%0.05	%0.08	-
	10 A	%0.10	%0.15	-	%0.05	%0.08	-
	500 mA	%0.10	%0.15	-	%0.05	%0.08	-
Digital Output	8 A DC	%0.20	%0.25	-	%0.15	%0.20	-

Technical Data KAVOSH T22

Internal Measurement of Outputs

Input	Impedance	Range	Guaranteed accuracy			Typical accuracy		
			Amplitude Reading error	Full scale error	Phase Full scale error	Amplitude Reading error	Full scale error	Phase Full scale error
Mx300-V peak	500 k Ω	300 V	0.1 %	%0.10	0.2°	%0.07	%0.05	0.1°
		15 V	%0.10	%0.10	0.2°	%0.07	%0.05	0.1°
		750 mV	%0.20	%0.10	0.2°	%0.15	%0.05	0.1°
Mx10-A peak AC/DC	<0.1 Ω	10A AC	%0.10	%0.10	0.2°	%0.05	%0.07	0.1°
		500 mA AC	%0.10	%0.10	0.2°	%0.05	%0.08	0.1°
		10A DC	%0.05	%0.15	-	%0.05	%0.08	-
		500 mA DC	%0.05	%0.15	-	%0.05	%0.08	-
M10-2V.peak	1 M Ω	7 V	%0.10	%0.10	0.2°	%0.08	%0.05	0.1°
		350 mV	%0.10	%0.10	0.2°	%0.08	%0.05	0.1°
		20 mV	%0.20	%0.20	0.2°	%0.10	%0.08	0.1°
M10-1V DC	-	10 V	%0.05	%0.15	-	%0.05	%0.08	-
		500 mV	%0.05	%0.15	-	%0.05	%0.08	-
		25 mV	%0.10	%0.30	-	%0.10	%0.10	-
M5-3V.peak	1 M Ω	3.5 V	%0.10	%0.10	0.2°	%0.08	%0.08	0.1°

Tan Delta Module (TDM1)

- Tan Delta measurement (with uncertainty less than 0.01%)
- Capacitance measurement (100pF – 50 uF)
- Power transformer ratio and no-load current (up to 10 kV)
- Power frequency withstand voltage (up to 10 kV)



Technical Data Tan Delta Module (TDM1)

High Voltage Output					
Terminal	Voltage	Frequency	Current	S	t _{max}
High Voltage Output	0...10 kV	15...120 Hz	300 mA	3000 VA	30 s
			100 mA	1000 VA	> 60 min
Measurement					
Input	Range	Typical Accuracy			
Input A	0...5 A AC	Error < 0.2% of reading + 100nA			
Input B					
Earth					
Capacitance					
Range	Typical Accuracy				
100 pF...3 uF	Error < 0.2% of reading + 10 pF				
Dissipation Factor					
Range	Typical Accuracy	Conditions			
0...10 %	Error < 0.2% of reading + 0.01%	V test > 500 V			



HAFEZ

Art of Protection

Protection Relays

SARV

Decide with Confidence

Specialized Power System Software

PAYESH

Sense of Precision

Measurement and Automation Devices

KAVOSH

State of the Art in Diagnosis

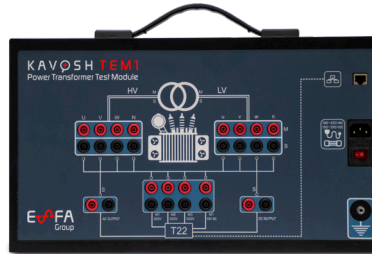
Diagnostic Test Tools

Complementary Modules



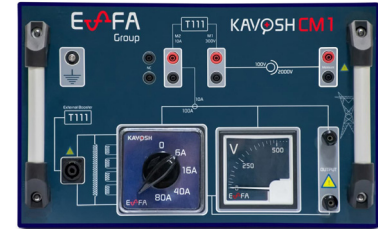
Circuit Breaker Test Module (CB1)

- Safe tests using dual ground method
- One wiring for all tests
- Fast mounting on main module to simplify tests



Three-Phase Transformer Automatic Test Module (TEM1)

- One wiring for all tests on three phases
- Wrong wiring detection
- Test duration reduction
- Easy and safe test performing



Coupling Module (CM1)

- Line impedance measurement in presence of induced voltage
- Grounding system tests in presence of source of errors
- Measurement of ground grid safety voltages (step, touch, metal-to-metal voltages)



Manufacturer of

- Protection Relays
- Diagnostic Test set
- Measurement and Automation Devices
- Specialized Power System Software

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