

# KAVOSH T22+

All-in-one Test Solutions



POWERTEST.IN



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 voltage 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 2200V).

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.

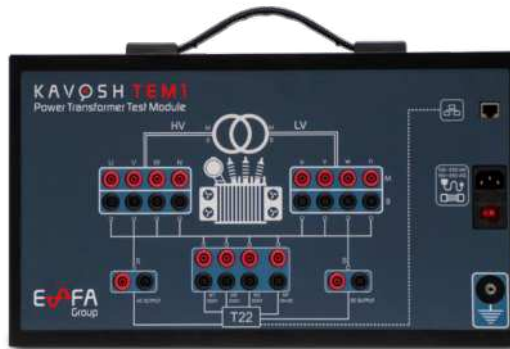


## Accessories Modules



**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

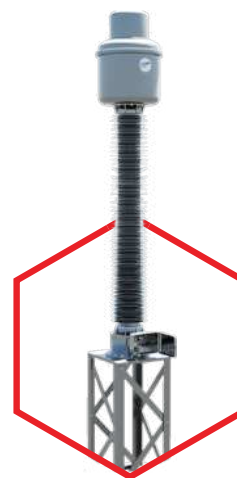


**Coupling Module (Cm1)**

- 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)

## Current Transformer Testing

- Capacitance and insulation 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

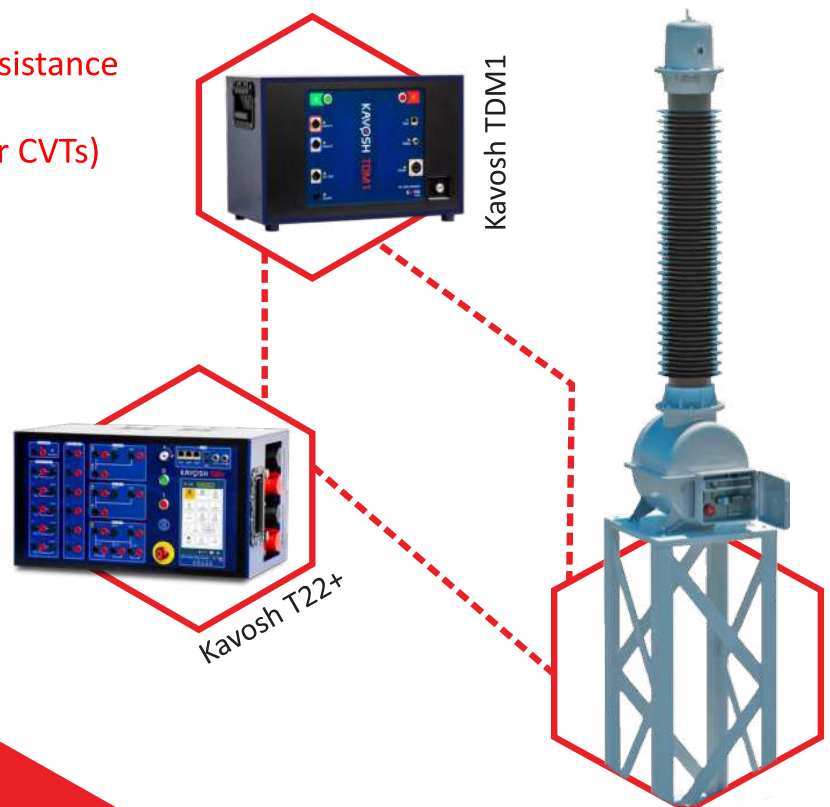


## Power Transformer Testing

- Switch box for automatic and quick performing tests on three-phase transformers (by “TEM1” external module)
- Capacitance and insulation 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

## Voltage Transformer (CVT, PT)

- Capacitance and insulation dissipation factor (Tan Delta) measurement (up to 12 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)

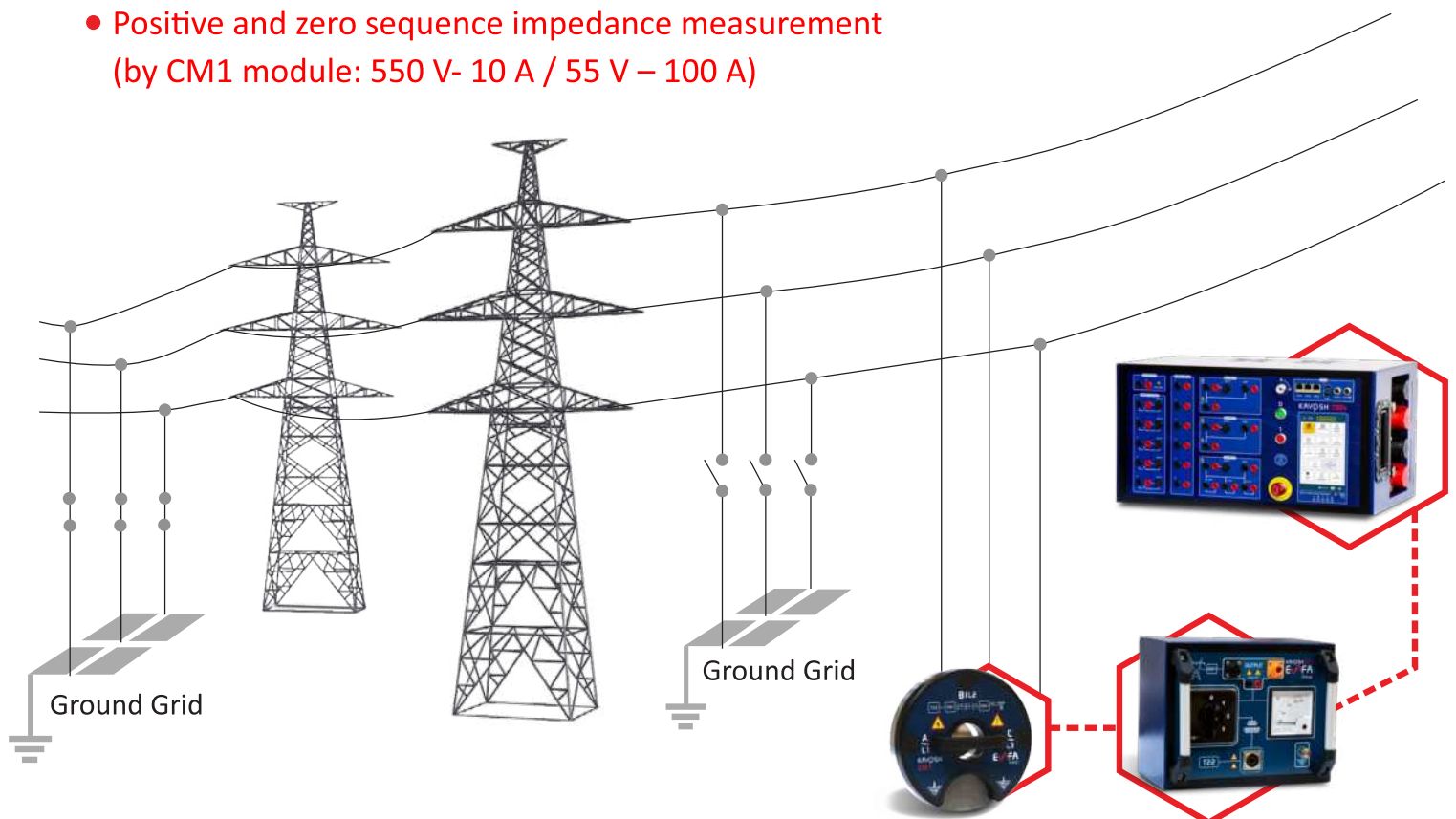
- Dual ground method (for time test under electromagnetic noises of in-service high voltage substations)
- Motor current and spring charge time monitoring (by using optional DC clamp-on ammeter)
- Trip/close coil minimum pickup voltage (up to 260 V DC/AC, 10 A)
- Time test (for various duty cycles such as C-O, O-C, C-O-C, O-C-O)
- 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)



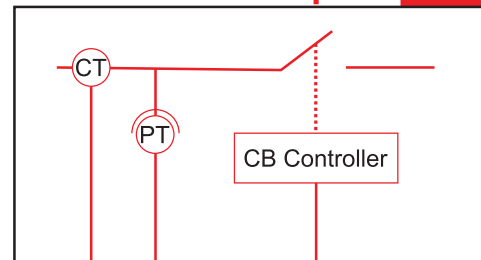
## Protection System

(Instrument Transformers, Relays, and Trip command circuit by injecting single-phase current and voltage)

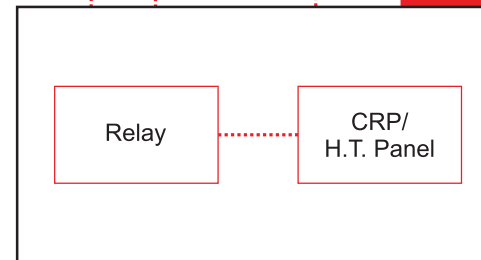
- High-impedance differential relay (including REF, busbar, motor, and generator)
- Low-impedance differential relay (including REF, busbar, motor, and generator)
- Distance relay (by “CM1” external module)
- Overcurrent and Earth Fault relays
- Directional overcurrent relay (DOC)
- Directional earth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



Kavosh T22+



HV Switchgear



Control Room

## 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)



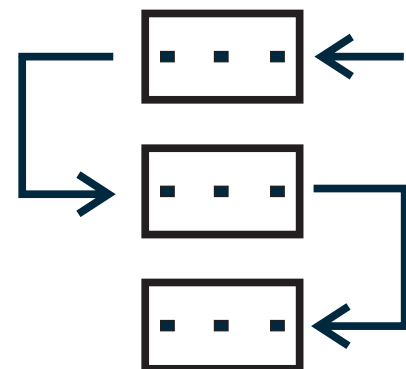
## Quick Mode

- 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.
- Triggering mode (using wet/dry binary inputs and analog input).
- Selecting measurement channels  
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.



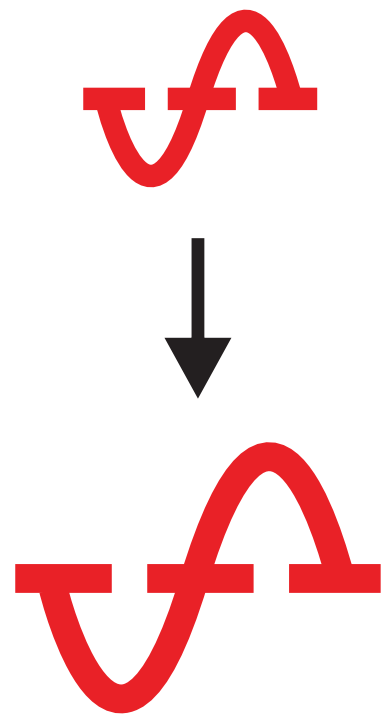
## State Sequencer Mode

- 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 measurement channels  
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 of 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+

- Internal Measurement of Outputs

Output	Range	Guaranteed accuracy			Typical accuracy		
		Amplitude		Phase	Amplitude		Phase
		Reading error	Full scale error	Full scale error	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 AC	—	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°
	10A	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+

### • Current Output

Output	Amplitude	t <sub>max</sub>	I <sub>max</sub>	Power	frequency
1000 V AC	1000 A	30 s	5V	5000 VA	15 ... 120 Hz
	500 A	10 min	5V	2000 VA	15 ... 120 Hz
	200 A	>2 h	5V	1000 VA	15 ... 120 Hz
400 A DC	400 A	2 min	5V	2000 VA	DC
	200 A	10 min	5V	1000 VA	DC
	100 A	>2 h	5V	500 VA	DC
10 A AC (rms)	10 A	10 min	260 V	2600 VA	15 ... 120 Hz
	3 A	>2 h	260 V	780 VA	15 ... 120 Hz
10 A DC	10 A	10 min	260 V	2600 VA	DC
	3 A	>2 h	260 V	780 VA	DC

### • Voltage Output

Output	Amplitude	t <sub>max</sub>	I <sub>max</sub>	Power	frequency
2000 V AC	0...260V	>2 h	3 A	780 VA	15 ... 120 Hz
	0...260V	10 min	10 A	2600 VA	15 ... 120 Hz
	0...760V	>2 h	1.5 A	1200 VA	15 ... 120 Hz
	0...760V	10 min	5 A	3800 VA	15 ... 120 Hz
	0...2260V	>2 h	0.5 A	1130 VA	15 ... 120 Hz
	0...2260V	1 min	1 A	2260 VA	15 ... 120 Hz
260 V DC	0...260 V	>2 h	3 A	780 VA	DC
	0...260 V	10 min	10 A	2600 VA	DC

# Technical Data KAVOSH T22+

## Measuring Inputs

Input	Impedance	Range	Guaranteed accuracy			Typical accuracy		
			Amplitude	Phase		Amplitude	Phase	
			Reading error	Full scale error	Full scale error	Reading error	Full scale error	Full scale error
Mx-300V peak	500 KΩ	300 V	0.10%	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°	0.07%	0.05%	0.1°
Mx-10A peak AC/DC	<0.1 Ω	10A AC	0.10%	0.10%	0.2°	0.07%	0.05%	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%	—
M2-10V.peak	1 MΩ	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°
M1-10V DC	—	500 mV	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%	—
M3-5V.peak	1 MΩ	3.5 V	0.10%	0.10%	0.2°	0.08%	0.08%	0.1°

## Environmental Condition

- Operating temperature-10 °C ... + 55 °C/+14 °F ... + 131 °F
- Storage temperature-20 °C ... +70 °C / -4 °F ... +158 °F
- Humidity range5 % ... 95 % relative humidity, no condensation
- EMCIEC 61326 -1, class A
- Environmental ReliabilityVibration and shock (IDC-STD-810, 2-direction)

## Mechanical Data

Module Name	Application	Weight	Dimensions
KAVOSH T22+	Main Module	36 kg	520 * 285 * 330 mm
Kavosh TDM 1	Capacitance and Disiipation factor Measurement Module	34 kg	520 * 285 * 330 mm
KAVOSH TEM1	3-Phase Power Transformer Test Module	5 kg	446 * 247 * 116 mm
KAVOSH Cm1	Line Impedance Measurement Module	23 kg	350 * 280 * 270 mm
KAVOSH Cb1	Circuit Breaker Test Module	3 KG	370 * 165 * 120 mm
KAVOSH Em1	Earthing Module	6 KG	260 * 260 * 120 mm

# 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 12 kV)
- Power frequency withstand voltage (up to 12 kV)



## Technical Data Tan Delta Module (TDM1)

High Voltage Output					
Terminal	Voltage	Frequency	Current	S	t <sub>max</sub>
High Voltage Output	0...12 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		

## 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.



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