

## Automatic Capacitance and Power Factor Field Test Set 12 kV – 2.4 kVA

### Type FT-12

Description – Technical Data – Features – Accessories – Options



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## 1. General

### 1.1 Features



- Measurement and operation according IEEE standard 62
- Screened HV supply with ground capacitance lower than 1 pF
- Measurement of grounded and ungrounded objects without any reconnection
- Built-in extremely stable standard capacitor 100 pF / 12 kV
- Built-in automatic interference suppression
- Fully automatic measurements
- Measurement of capacitance, tanDelta, Power Factor, Specimen current (real, imaginary, absolute), Powers (apparent, active, reactive), Inductance, Quality Factor, Test Voltage, Frequency.
- Highest resolution
- Data storage feature (internal NVRAM)
- RS 232 interface for data download as standard
- The system with the lightest weight on the market
- Complete system including all cables
- Large number of options
- Including test certificate with traceability to international standards

## 1.2 Technical Description

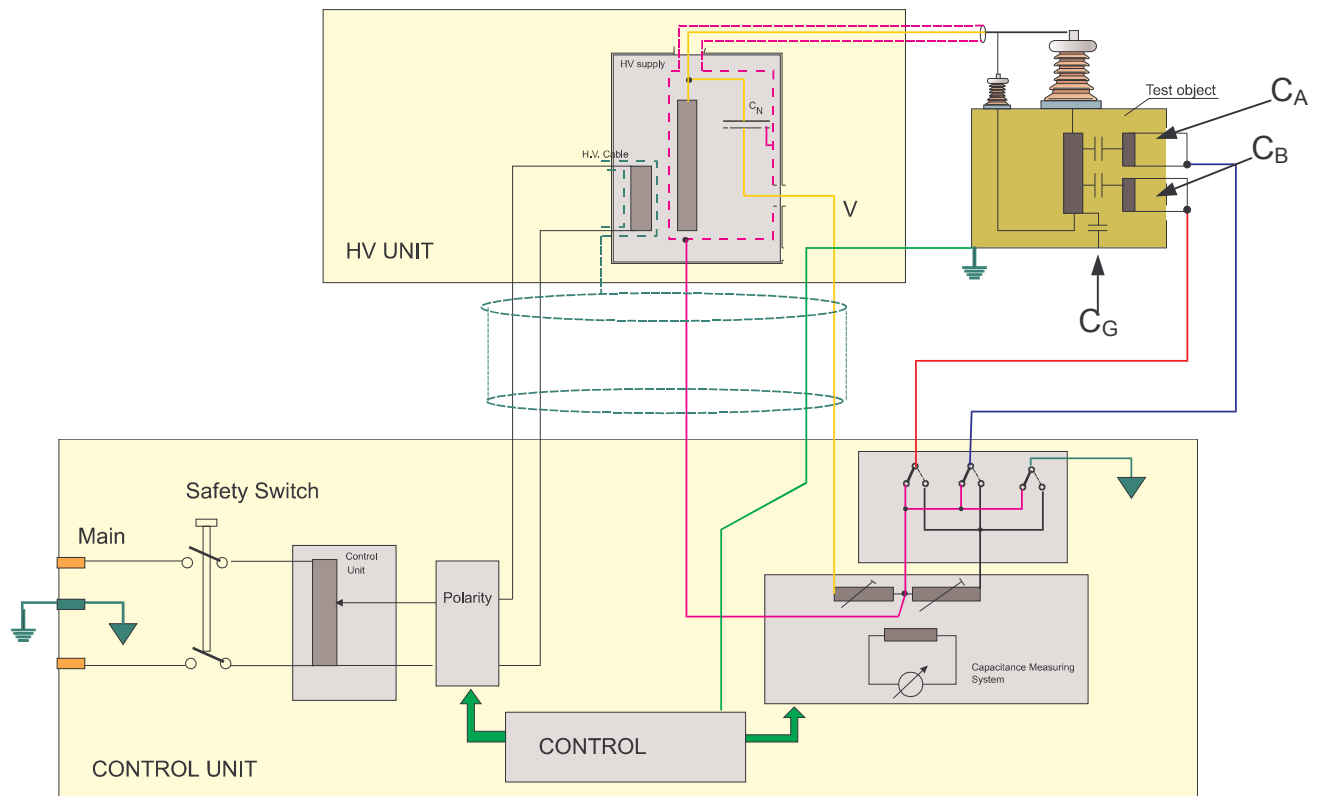


Fig.1.

The field test set is intended to make capacitance and power factor measurements on not grounded and grounded test specimens. From the mains power a variable transformer and a special HV transformer produce max. 12 kV and 200 mA. The capacitance measuring system processes the capacitive currents from the test object. The microprocessor controlled Processor Module transforms the classical measuring system into an automatic test apparatus with user-friendly features.

The set has two basic unit:

- the Control Unit (CTR) and
- the High Voltage (HV) unit.

In the CTR unit integrated are the main switch, the manually operated regulating transformer and the polarity switch. Some of these switches are monitored by the processor. The voltage set by the regulating transformer is fed to the high voltage unit. The HV transformer is double screened, therefore the measurement of grounded object can be made without earth-capacitance corrections down to less than 1 pF. In the HV unit a compensated 100 pF solid state standard capacitor is also integrated.

The capacitance measuring system receives the capacitive currents from the standard capacitor and from the test object. The measuring circuit is a balanced current comparator bridge with 0.1 ppm balancing resolution and 100 ppm measuring uncertainty. The balancing procedure is automatic and controlled by the processor. A modified Newton-Rawson convergence algorithm is used.

A processor-controlled switch group allows all combinations of measurements according the ANSI/IEEE Standard 62 (see Fig. 1 on previous page) :

- UST A : Ungrounded specimen test channel A, capacitance measured =  $C_A$  , ( $C_B$  and  $C_G$  guarded)
- UST B : Ungrounded specimen test channel B, capacitance measured =  $C_B$  , ( $C_A$  and  $C_G$  guarded)
- UST A+B : Ungrounded specimen test channel A + B, capacitance measured =  $C_A + C_B$
- GST A+B: Grounded specimen test, channel A + B, capacitance measured =  $C_A + C_B + C_G$
- GSTgA: Grounded specimen test with guarded A (connected to "V"), capacitance measured =  $C_B + C_G$
- GSTg B: Grounded specimen test with guarded B (connected to "V"), capacitance measured =  $C_A + C_G$
- GSTg A+B: Grounded specimen test with guarded A and B (connected to "V"), capacitance measured =  $C_G$

The measurement results are displayed on a graphic LCD display. The display helps the user to perform tests with minimal steps of operation.

The measurement results can be stored in the RAM of the processor for a later download to a PC. The data storage feature allows to store up to 10 Files with up to 50 measurement records each.

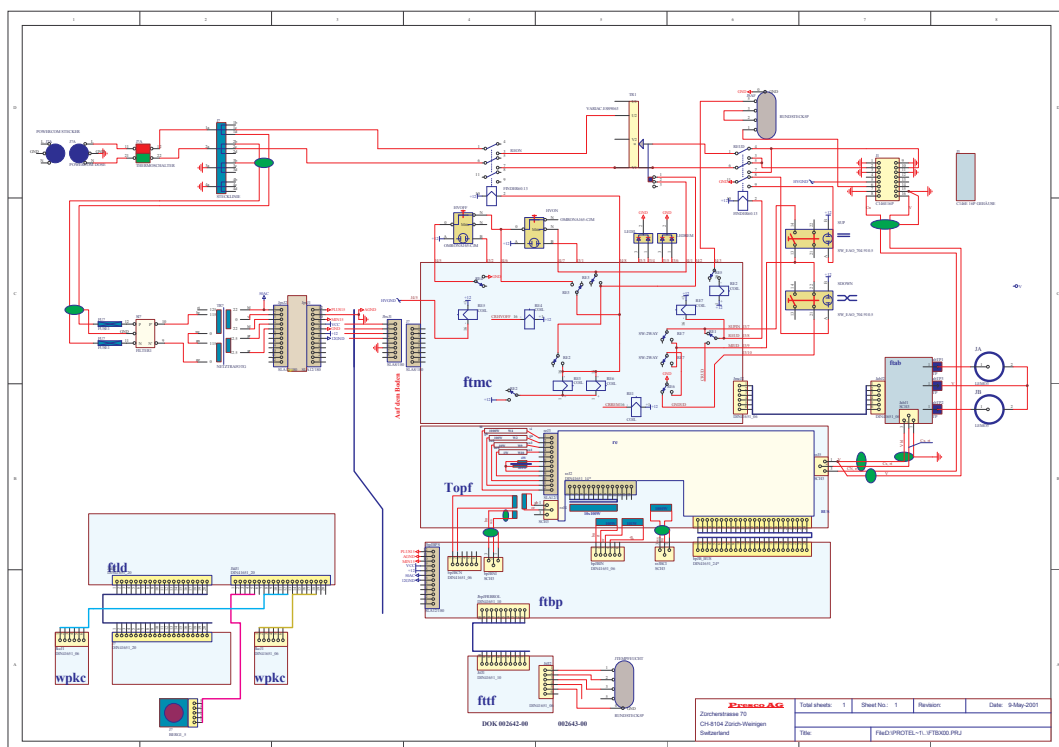


Fig.2. Block Diagram

The power relays are supervised by a relay control unit. This unit observes the safety loop and the also the grounding control: a correct grounding (from mains and HV ground connected to ground (e.g. the tank of a transformer) ) and pushing the safety switch enables the high voltage to be switched ON. The HV output can be switched on only manually and the

this switch ON can be inhibited by the processor but the processor cannot switch ON the HV. The main current comparator and the N and X current transformer are protected by a permalloy screen.

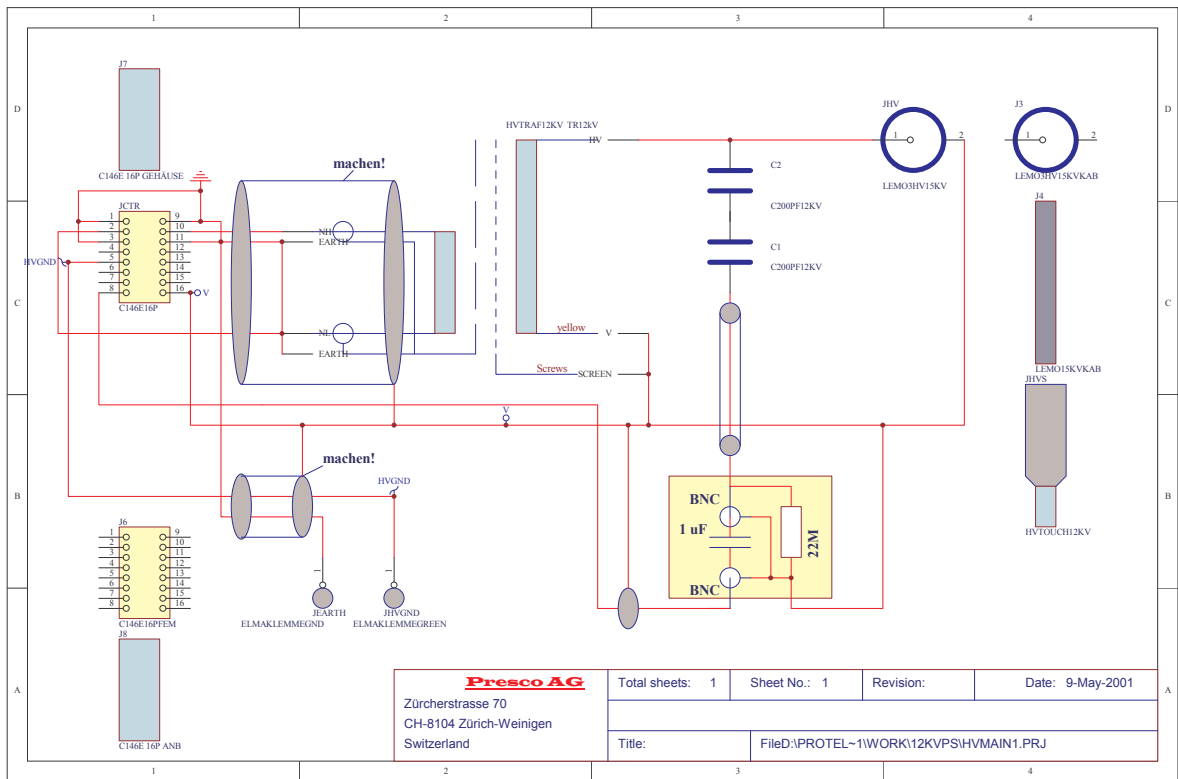


Fig. 3 HV Unit

The HV unit is fully screened in order to enable the system to measure against ground (earth). The screen is connected to the guard ("V") terminal

## 2 Technical Data

### Power Factor

Range	-0.995 - + 0.995
Resolution	0.0001
Uncertainty	± 1% of rdg ± 1 ... 2 digits

### Dissipation Factor

Range	0 – 10 (1'000%)
Resolution	$1 \times 10^{-4}$ (via software $1 \times 10^{-6}$ )
Uncertainty	± 1 % of rdg ± 1 ... 2 digits

### Capacitance

Range	0 - 1 $\mu$ F
Resolution	0.01pF
Uncertainty	± 0.1% of rdg

### Inductance

Range	10H-1000 kH
Resolution	0.1 mH
Uncertainty	± 0.2 % of rdg

### Test voltage (peak/ $\sqrt{2}$ )

Range	0-12 kV
Resolution	1 V
Uncertainty	± 1 % of rdg

### Test Current (absolute, real part and imaginary part)

Range	0-35 A
Resolution	1 nA
Uncertainty	± 1 % of rdg

### Active Power

Range	0-999.9 kW
Resolution	0.1 nW
Uncertainty	± 1.5 % of rdg

### Active Power (recalculated for 10 kV)

Range	0-999.9 kW
Resolution	0.1 nW
Uncertainty	± 1.5 % of rdg

### Reactive Power

Range	0-999.9 kVar
Resolution	0.1 nVar
Uncertainty	± 1.5 % of rdg

### Apparent Power

Range	0-999.9 kVA
Resolution	0.1 nVA
Uncertainty	± 1.5 % of rdg

**Frequency**

Range 45-65 Hz  
Resolution 0.1Hz  
Uncertainty  $\pm 1\%$  of rdg

**Measuring modes**

UST A, UST B, UST A+B, GST A+B, GSTg A, GSTg B, GSTg A+B

**Automatic Noise Suppression**

Suppresses interference up to 30 times of measuring signal (automatically)

**Safety Features**

Zero Start Interlock  
Hand Held Safety Switch with indication  
Ground Loop Check with indication

**High Voltage Supply**

Continuously adjustable from near Zero up to 12 kV  
Output Current 200 mA 5 Min. on, 15 Min. off  
Output Current 100 mA continuous  
Reversal switch  
Built-in extremely stable standard capacitor 100 pF / 12 kV  
Earth capacitance of the high voltage < 1 pF

**Additional Features**

Built-in RS232 interface  
Data Storage Feature : Possibility to save up to 10 files with up to 50 measurement records each for later download to PC  
List function to display the internally stored records as a table  
Selectable Power factor display : as tanDelta, Power Factor, direct, in percent or permil  
Rugged construction, built-in robust flight cases, no need for additional transport boxes. Includes a box for cables / accessories  
Test certificate with traceability to international standards included

**Download Software**

this software is compatible with Windows

functions:

down load of data  
processing the measurements  
displaying the measurements  
printing  
saving  
transfer to Excel  
data transfer via RS232 interface

**Reference conditions**

Minimal current through standard capacitor	35 $\mu$ A
Temperature	23° C $\pm$ 2° C
Humidity, non condensing	45 ... 75%
Altitude (pressure)	101.3 kPa

**Rated range of use**

According IEC 359	
Temperature	5° C ... 40° C
Humidity, non condensing	20 ... 95%
Altitude (pressure)	70 ... 106 kPa

**3. Applicable Standards**

IEEE C57.12.90-1987	test code for liquid-immersed distribution, and regulating transformers and guide for short circuit testing of distribution and power transformers
IEEE Std 62-1978	IEEE Guide for Field Testing Power Apparatus Insulation
IEC 348	Safety requirements fro electronic measuring apparatus
IEC 359	Expression of the performance of electrical and electronic measuring equipment

**4. Physical**

Dimensions HV unit	432 x 266 x 330 mm, 17 x 10.5 x 12.9 inch
Dimensions CTR unit	432 x 266 x 330 mm, 17 x 10.5 x 12.9 inch
Weight of HV unit	aapprox. 28 kg
Weight of CTR unit	approx. 23 kg
Rugged construction, built-in robust flight cases, no need for additional transport boxes. Includes a box for cables / accessories	

## 4. Scope of Supply / Options

### 4.1 Included Accessories

Shielded measuring cables	2 pcs., 20 m each
Shielded HV cable with hook	20 m
Large alligator clips	2 pcs.
Small alligator clips	2 pcs.
Ground cable with large alligator clip	20 m
Cable with safety switch	20 m
Power supply cable	1 p.
Instruction manual	1 p.
Calibration Certificate	1 p.
Download software	1 p.

### 4.2 Options

#### Resonating Inductor

**Type FT-12RI**

For range extension of type FT-12 Capacitance and Power Factor Field Test Set

Rated Voltage	12 kV
Max. current	4.5 A
Max. reactive power	50 kVar
Range extension @ 50 Hz	up to 1.1 $\mu$ F
Range extension @ 60 Hz	up to 880 nF

With current indication for easy tuning  
 Provision for safety interlock  
 With built-in over temperature protection

Weight	approx. 85 kg
Dimensions (W x D x H)	approx. 350 x 480 x 700 mm

#### Unit for measurement of short circuit impedance of transformers

**Type FT-12CI**

to be used together with FT-12 CT

Nominal output	0 ... 200 V, max. 10 A 0 ... 60 V, max. 20 A 0 ... 20 V, max. 25 A 0 ... 2 V, max. 35 A
Rating	1 min on 2 min. off
Input voltage	0 ... 230 V, 50 or 60 Hz
Built-in standard capacitor	100 nF Remark : the specified value of the standard capacitor is matched to the respective measuring ranges.
Inductance measurement range	0.1 mH ... 100 H fully auto ranging
4 terminal measurement	
Weight	app. 25 kg
Dimensions w x d x h	432 x 266 x 330 (in mm), 17 x 10.5 x 12.9 (in inch)

**Oil Test Cell****Type OT-SCL12**

Measurements according to IEC 250 and IEC 247

Volume of oil sample	approx. 0.75 l
Inter electrode distance	9 mm
Capacitance of the empty cell	approx. 60 pF
tanδ of the empty cell	< 1 * 10 <sup>-4</sup>
Maximum voltage for empty cell	5 kV
Test voltage of empty cell	10 kV / 1 Min.
Maximum voltage for filled cell	10 kV
Test voltage filled cell	12 kV / 1 Min.
Field strength at 10 kV	10 kV / cm
Connector	LEMO 3
Weight	approx. 4.2 kg
Dimensions	approx. 330 mm height x 185 mm diameter

**Calibration Standard****Type TG-CAL**

Nominal Voltage	10 kV
Nominal capacitance	100 pF
tanDelta values	0, 0.1, 0.05, 0.01, 0.005, 0.001 (0, 10%, 5%, 1%, 0.5%, 0.1%). other values possible upon request
Dimensions :	approx. 150 x 150 x 300 mm
Weight	approx. 4 kg

**Reference conditions**

minimal current through standard capacitor	35 µA
temperature	23° C ± 2° C
humidity	45 ... 75%
altitude (pressure)	101.3 kPa

**Rated range of use**

according IEC 359	
temperature	5° C ... 40° C
humidity, non condensing	20 ... 95%
altitude (pressure)	70 ... 106 kPa

**Adapter for ext. Standard capacitor****Type FT-12AD**

To be used instead of the FT-12 HV together with an external HV Power Supply

Connectors :	LEMO 3 for Standard Capacitor
	Banana socket for Standard Capacitor (in parallel with the LEMO3)
	banana socket for GUARD
	banana socket for EARTH

incl. over voltage protection