

5912 True-rms Precision Kilovoltmeter



User Manual

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WARNING

THE APPARATUS DESCRIBED IN THIS MANUAL IS DESIGNED TO CONNECT TO AND MEASURE DANGEROUS VOLTAGES. USERS SHOULD OBSERVE STRICT SAFETY PRECAUTIONS AT ALL TIMES. ON NO ACCOUNT SHALL GNS ASSOCIATES PTY LTD BE LIABLE FOR LOSS DAMAGE OR INJURY ARISING FROM UNSAFE PROCEDURES, CONTRARY TO THE INSTRUCTIONS CONTAINED HEREIN AND/OR BEST INDUSTRY PRACTICE.

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5912 PRECISION KILOVOLT METER

1 OVERVIEW

Type 5912 Kilovoltmeter is a precision instrument intended for the true-rms measurement of power frequency ac voltages up to 12,000V rms.

The instrument is portable and battery powered. There are no operator controls requiring adjustment during operation. Readout is given on a bright 4½ digit LED display. Where required, the display is easily read at several metres distance. The embedded microcontroller automatically "trims" the internal measurement circuits for enhanced precision. To conserve battery energy, the instrument automatically enters a "snooze" mode if left inactive for several minutes. Return to normal operation is achieved by recycling the power ON switch.

2 FUNCTIONAL DESCRIPTION

The voltage to be measured is connected to a free-standing resistive divider unit. The divider has a nominal ratio of 6500:1 and an input resistance of 100MΩ. Stray capacitance effects are greatly reduced by a trimming capacitor in the base of the unit, and the divider performance is effectively independent of frequency over the specified range of operation.

The output from the divider is buffered and fed to a precision rms/dc converter, and thence to a 16-bit analog-to-digital converter (ADC). The digitised signal is transmitted in serial format to the microcontroller, which in turn controls the output display and all peripheral functions. The power supply provides all requisite internal voltage sources, including the very low-noise "clean" power required by the ADC and associated circuits.

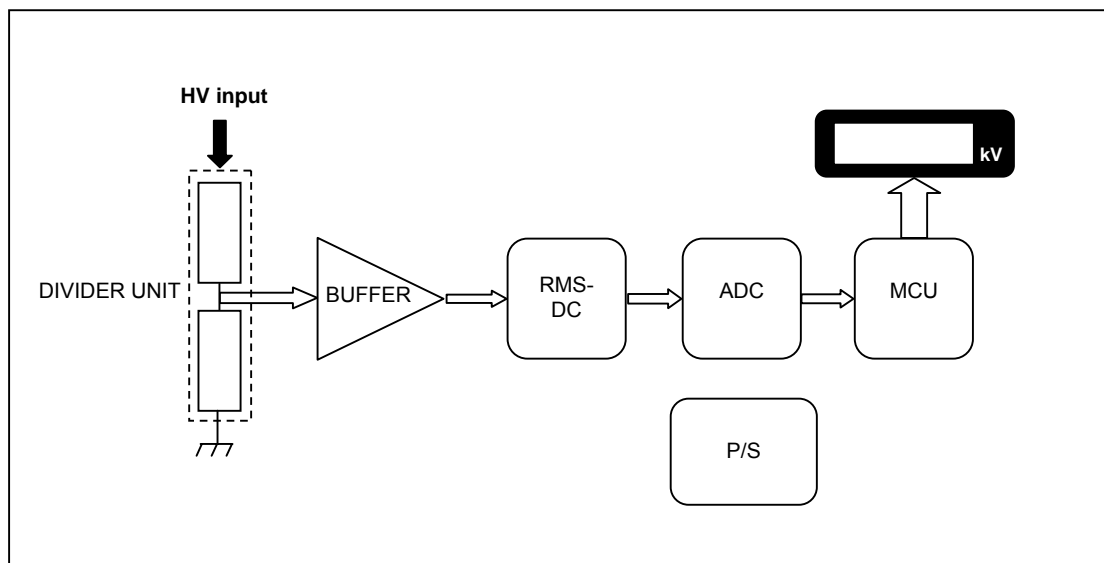


Fig1. - Simplified Block Diagram

3 OPERATING INSTRUCTIONS

CAUTION

BEFORE USING THIS INSTRUMENT ALWAYS CHECK THAT:-

- ALL RELEVANT SAFETY PRECAUTIONS ARE IN PLACE AND/OR READY FOR CORRECT IMPLEMENTATION¹;
- THE INTENDED MEASUREMENTS LIE WHOLLY WITHIN THE SPECIFIED RATINGS AND CAPABILITIES OF THE INSTRUMENT (SEE SECTION 5 - SPECIFICATIONS).

3.1 Setup

Ensure that the HV supply has the necessary electrical characteristics, consistent with the desired level of measurement precision and repeatability. Any jitter or instability in the power supply will have the same effect as background noise and will detract from the very high resolution of this instrument. It follows that unstabilised mains-powered apparatus (for example - a simple step-up transformer) is unlikely to give satisfactory results².

Place the divider unit in a safe and convenient position and connect the ground lead. Connect shielded cable 5912.02 between the divider and the instrument. Attach a safety chassis-ground to the \uparrow terminal at the rear of the instrument.

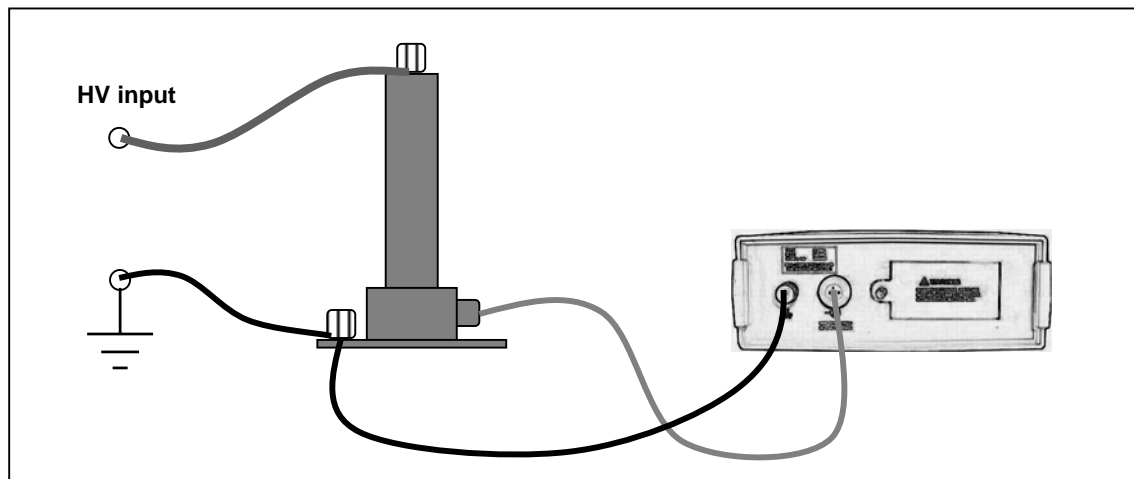


Fig. 2 - Typical Test Setup

Ensure that the high voltage (HV) supply is not energised and attach the active cable (5912.03 or equivalent). Ensure that the HV cable is supported well clear of other cables, low voltage circuits, and grounded metalwork. Also, keep the HV cable clear of the sides of the divider column, since unwanted capacitive coupling may affect the accuracy of high-precision measurements.

1. We recommend that all Users should draw up properly structured Safety Procedures governing the use of this equipment and associated facilities. For further advice on safety aspects contact GNS Associates.
2. For optimum results the HV supply should have short-term voltage stability **at least one-half order-of-magnitude better** than the instrument resolution, that is, stable to within $\pm 3 \times 10^{-5}$. For further advice on experimental techniques and performance requirements, please contact GNS Associates.

Keep cell phones and other wireless equipment well away since such apparatus can interfere with the sensitive circuits of the 5912.

Do not approach or handle the divider unit when energised.

3.2 Operation

1) Turn **ON** the instrument. Note that the automatic self-test is executed with indications as follows:-

- a) Display momentarily reads **18.888**;
- b) Display momentarily reads **5912**;
- c) Display momentarily reads **0.0XX**, where XX is the room temperature in °C;
- d) Display reads **0.000**.

***NOTE:** If the above sequence is corrupted or incomplete - or if any segments are missing from the LED display - refer to Section 4 - Troubleshooting.*

2) Ensure that all personnel are clear and energise the HV supply. Note the indicated potential in kilovolts;

3) Smoothly adjust the HV supply level and make voltage measurements as required;

***NOTE:** For high-precision measurements, allow not less than three (3) seconds settling time for each reading.*

4) When measurements are no longer required, **de-energise the HV supply and render all HV circuits safe.**

5) Turn **OFF** the instrument power switch.

6) If the instrument is to be stored for an extended period (1 month or more) remove the battery cells (see Section 3.5 below).

3.3 Over-range Indication

If at any time the applied voltage exceeds the specified maximum (15.999 kV) the over-range indication **1 -** will appear on the display. Immediately reduce the voltage when this indication appears.

3.4 Snooze Mode

When left switched **ON** for more than ten (10) minutes with an applied potential of less than 0.1kV, the instrument will automatically enter a **SNOOZE** mode to conserve battery energy. In this mode the display is turned off and certain internal circuits are reduced to micropower levels. A flashing blue LED on the front panel (which itself takes very little power) indicates that the instrument is merely "asleep" and not faulty.

To return to normal operation, simply turn the power switch **OFF** and then **ON** again.

3.5 Non-Sinusoidal Waveforms

Type 5912 will correctly indicate the true-rms value of distorted (non-sinusoidal) voltage waveforms, within the specified range of Crest Factors (see Section 5 - Specifications).

3.6 Battery Replacement

A LOW BATTERY condition is indicated by the red LED on the front panel. To replace the battery perform the following steps:-

- 1) **De-energise and disconnect the HV supply** and switch **OFF** the instrument;
- 2) Unscrew the thumbscrew on the rear panel and remove the battery cover;
- 3) Carefully withdraw the battery assembly and replace each of the four (4) cells in turn with new or recently-recharged NiMH cells of the correct size and capacity (see Section 5 - Specifications);

CAUTION: OBSERVE CORRECT POLARITY FOR ALL CELLS.

- 4) Re-insert the battery assembly and replace the cover. **Do not over-tighten** the thumbscrew.

PLEASE NOTE: The instrument will perform satisfactorily for some hours with the LO BATT indicator alight. However, the full rated accuracy is not guaranteed under these conditions. Also, persisting in this mode of operation carries some risk of damage to the battery.

4 TROUBLESHOOTING

WARNING

THERE ARE NO USER-ADJUSTABLE OR USER-REPAIRABLE ITEMS IN THIS EQUIPMENT. ANY ATTEMPT TO OPEN THE CASE OR OTHERWISE TAMPER WITH THE INSTRUMENT OR ITS PERIPHERALS WILL IMMEDIATELY VOID ALL WARRANTIES.

PROBLEM/SYMPTOM

ACTION REQUIRED

Power ON self-test corrupted or incomplete	Contact factory
No display	Recycle power ON switch Check/replace battery Contact factory
Display intensity varies (modulates)	Check/replace battery Contact factory

4 TROUBLESHOOTING (cont'd)

PROBLEM/SYMP TOM

Display gives unsteady reading

Display fails to respond when
external voltage ($\geq 50V$) applied

ACTION REQUIRED

Check HV supply (see Section 3.1)
Contact factory

Check all connecting cables
Connect optional test module *5912.05*
and follow instructions supplied with this
unit.
Contact factory

5 SPECIFICATIONS³

Parameter	Value	Units
5.1 Absolute Maximum Ratings		
Maximum instantaneous input voltage:	25	kV
Maximum sustained input voltage (>1s all waveforms):	16 20	kV (rms) kV (peak)
5.2 Electrical Characteristics		
Voltage measurement range	0.05 - 12.000	kV (rms)
Nominal Accuracy ⁴ (sinusoidal waveform only)	±(0.3% reading + 0.002) kV	
Display resolution	±0.001	kV
Frequency range	45 - 65	Hz
Crest factor range ⁵ (all waveforms):	1.0 - 2.0	
Input resistance to Divider Unit	100	MΩ
5.3 Environmental		
Operating temperature range	15 - 30	°C
Storage temperature range	0 - 45	°C
Humidity (non-condensing)	10 - 85	%
5.4 Power source		
Four (4) x NiMH rechargeable cells (AA size).		
Endurance in continuous operation (active mode):	20 (typ.)	h

3. All specifications relate to a sinusoidal voltage waveform and an ambient temperature of 25°C, except where otherwise noted.

4. Guaranteed for **six (6) months** from the date of initial despatch from the factory, provided always that no "exceptional events" have occurred during this period. For more information about accuracy limits and recommended re-calibration intervals, please contact the factory.

5. Crest Factor is defined by $K_C = U_{PEAK}/U_{RMS}$

6 MAINTENANCE

There are no regular maintenance items applicable to this system. Periodically clean the divider column and the instrument front panel with a clean damp cloth. Do not use abrasives or solvents.

For information about recommended calibration intervals and procedures please contact the factory.

7 ELECTROMAGNETIC COMPATIBILITY

Type 5912 is designed for full compliance with the requirements of Australian and New Zealand Standards for electromagnetic compatibility (EMC).

8 ORDERING INFORMATION

5912SX: Precision kilovoltmeter, complete with divider unit, connecting cable, and instruction manual.

5912.01: Divider unit.

5912.02: Shielded connecting cable.

5912.03: Silicone-insulated high voltage test cable (5m length - unterminated).

5912.04: Battery charger for NiMH batteries.

5912.05: Test module.

5912M: User manual (The pdf version is available for download from our website).

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