



USER'S MANUAL 121GW MUI TIMETER

Last Revised 11 December 2017

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CONTACT

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If you have a warranty claim, you can contact us at the following email address:

sales@eevblog.com

This multimeter and accessories can be purchased from:

www.eevblog.com

Community Support for the meter is provided on the EEVblog Forum:

www.eevblog.com/forum

Phone:

Ph: +61(2)86268743

GLOSSARY OF TERMS

IEC

(International Electrotechnical Commission)

An organisation that publishes various international standards relating to electrical, electronics and related technology.

ANSI

(American National Standards Institute).

Americas non-profit standards organisation that oversee the development and use of standards in various domains.

ETL

(ETL Testing Laboratories)

The compliance certification mark of Intertek Group in Europe.

OP

(Overload Protection)

The voltage that a function of the Multimeter than withstand.

Accuracy

The closeness of a measured value to a known standard.

Low Burden™

Provides low burden voltage when measuring current compared with typical multimeters, minimising impact on your in-circuit current measurements.

CHANGE LOG

The following represents the changes made to the manual:

Date	Description
11/12/17	Original Release

GENERAL

FCC/IC INFORMATION

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This device complies with Part 15 of the FCC Rules and CAN ICES-3(A). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operations.

INFORMATION TO THE USFR

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in an installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

WARNING

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

INTRODUCTION

Congratulations on purchasing the EEVblog 121GW multimeter. It's one of the most feature packed small form factor meters on the market, designed to provide maximum functionality in as little bench space as possible. It provides many unique features not found on other multimeters, like low burden voltage measurement and display, simultaneous voltage and current (VA power) measurement, 15 V diode test voltage, Bluetooth built-in, and Micro SD card data logging.

You've made a wise choice buying this instead of some questionable quality cheapie, it should return the favour with many years of safe and accurate service.

That ETL logo you see stamped on the back of the meter ensures that the meter design has been *independently* tested to the latest IEC/UL/EN61010-1 3rd edition safety standard by Intertek.

With a genuine 600 V CAT III rating and proper 1000V HRC fuses and MOV+PTC protection you can feel confident and safe that you can use this meter on most high energy mains rated equipment.

And remember, don't turn it on, take it apart! This meter is hackable, go for it.

Have fun.
Dave Jones
www.eevblog.com

FEATURES

Summary

- True RMS sensing up to crest factor 10 (AD8436 chipset)
- 600 V CAT III ETL Listed Rating
- 1000 V HRC fuses.

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- High voltage 15V diode test mode
- Dual 50,000 count display
- Relative Mode
- 1ms Peak Capture
- MIN, MAX or AVG on all functions
- Low Burden[™] current measurement feature
- OPEN and CLOSED continuity testing (for wire breaks)
- Temperature, Capacitance, Frequency and Duty Cycle
- Unique burden voltage measurement & display in current mode
- Simultaneous voltage and current measurement and VA calculation
- Low Z input mode eliminates ghost voltages
- Automatic touch measurement data hold
- Audible and visual incorrect input jack warning
- Closed case calibration of individual ranges

Logging Capabilities

- Bluetooth LE (Low Energy) Communication
- Data logging onto a Micro SD card (CSV format)

Mechanical

- Compact size
- Backlit display

Software

• Android, and Windows 10 support, [iPhone, Mac, Windows Phone]¹

• Updatable Firmware (via micro SD Card)

Batteries

- RTC Battery (CR1220)
- Main Battery (4 x AA)
- Long battery life of >500 hrs

¹ Under development

SPECIFICATIONS

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The following specifications are given in SI units with their accuracy notated as \pm (% of reading digits) + (number of digits) unless otherwise indicated.

GENERAL

The following table represents general specifications (at $23^{\circ}C \pm 5^{\circ}C$):

Item	Specification	
Display	4 ⅓ digits 50,000 counts, dual display	
Update Rate	5 times per second nominal	
Operating Temperature	0°C to 50°C (32°F to 122°F)	
Relative Humidity	< 75%	
Altitude	Operating below 2000 m	
Storage Temperature	-20°C to 50°C (-44°F to 122°F)	
Temperature	Temperature coefficient (Nominal):	
Coefficient	$T_c = 0.1 \times (Specified\ accuracy) / ^{\circ}C$	
RMS Sensing	True RMS sensing (AD8436)	
Ingress Protection	IP41	
Pollution Degree 2		
Safety	cETLus 3rd Edition, CAT III 600 V, CE Conformity,	
	IP41, RoHS Compliant, IEC/EN61010-1: 2010 3rd	
	Edition	
Drop Protection	1 m	
Transient Protection	6 kV 2 Ω, Pulsed Source	
E.M.C.	Commercial limits compliance with EN61326-1	
Bluetooth	BLE112 Class 2	
Chipset	Hycon HY3131	
	ST ARM STM32L152D	
Overload Protection		
mA and μA	400 mA / 600 V DC/AC	
	IR 10kA HRC FAST + DIODE	
A and 500mA	11 A / 1000 V DC/AC	
	IR 20 kA HRC FAST + DIODE	

V & Auto V	600 V DC/AC RMS PTC & MOV Protection
mV, Ohm & others	600 V DC/AC RMS PTC & MOV Protection
Low Battery Voltage	Below approx. 4.2 V
Battery Type	4 x 1.5 V AA alkaline battery
	(ANSI/NEDA 15 A or IEC LR6)
Current Consumption	5 mA Typical
Battery Life	500 hours typical on Alkaline
Dimension	84 mm x 165 mm x 57 mm
	(3.31" x 6.50" x 2.24")
Weight	485 g (17.1 oz.) with batteries
Accessories	Rubber Boot, Temperature probe, Test leads,
	Carry Case
Optional	Magnetic hanger
Purchase Accessories	

VOLTAGE MEASUREMENT

The following section provides the specifications

	Range	Resolution	Accuracy	Test Condition
DC V	50 ² to 500 mV	1 to 10 μV	±0.1% + 10	
	5 to 500 V	0.1 to 10 mV	±0.05% + 5	
	600 V	0.1 V	±0.1% + 10	
AC V	50 mV	1 μV	±1.2% + 15	45 to 400 Hz
True RMS	50 mV	1 μV	±2.0% + 20	0.4 to 5 kHz
Crest Factor < 10	0500 mV	10 μV	±0.8% + 10	45 to 400 Hz
	500 mV	10 μV	±1.5% + 10	0.4 to 5 kHz
	5 to 500 V	0.1 to 10 mV	±0.3% + 10	45 to 400 Hz
	5 to 500 V	0.1 to 10 mV	±1.5% + 10	0.4 to 5 kHz
	600 V	0.1 V	±0.5% + 10	45 to 400 Hz
	600 V	0.1 V	±1.5% + 10	0.4 to 5 kHz
AC V+ DC V	5 to 500 V	0.1 to 10 mV	±1.0% + 10	45 to 1000 Hz
True RMS	600 V	0.1 V	±1.0% + 10	45 to 1000 Hz

This channel has overload protection for up to 600 V.

The AC Bandwidth extends beyond 5 kHz, but the meter is only specified and calibrated at 5 kHz. The AD8436 used specifies an additional 1% error up to 65 kHz. Higher frequency is possible with additional error above that again.

² Using Relative Mode

CURRENT MEASUREMENT

The following section refers to the current measurement ranges and their respective performances. The current measurement module is protected by a 440 mA/1000 V HRC Fuse and an 11 A/1000 V HRC Fuse.

	Range	Resolution, Accuracy	Tested @	Burden Voltage³
DC A	50 ⁴ to 500 μA	1 to 10 nA, ±1.5%+15	N/A	100 μV/μΑ
	5 to 50 mA	0.1 to 1 μA, ±0.25%+5		2 mV/mA
	0.5 to 10 A	10 to 1000 μA, 0.75%+15		0.03 V/A ⁵
AC A	50 to 500 μA	1 to 10 nA, ±2.0%+20	45 to 1000 Hz	100 μV/μΑ
	5 to 50 mA	0.1 to 1 μA, ±1.0%+5	45 to 1000 Hz	2 mV/mA
	0.5 to 10 A	10 to 1000 μA, ±1.5%+15	45 to 1000 Hz	0.03 V/A ⁵

³ The measured burden voltage is displayed on the secondary display.

⁴ The following mode will use the x10 amplified and may have additional offset error that should be REL'd out before measurement.

⁵ The burden voltage can change with the type of fuse fitted.

RESISTANCE & CAPACITANCE MEASUREMENT

The following section outlines the specifications for the impedance ranges

	Range	Resolution	Accuracy
RΩ	$50~\Omega^6$	0.001 Ω	±0.5%+20
	500 Ω	0.01 Ω	±0.3%+5
	5 to 500 $k\Omega$	0.1 to $0.01~k\Omega$	±0.2%+5
	5 ΜΩ	0.1 kΩ	±0.3%+5
	50 ΜΩ	1 kΩ	±1.2%+20
CμF	10nF to 100 μF	$0.01~\text{nF}$ to $0.1~\mu\text{F}$	±2.5%+5
	9999 μF	1 μF	±3.0%+5 ⁷

This channel has overload protection for up to 600 V.

DIODE MEASUREMENT

	Range	Resolution	Accuracy
Diode V	3 V	0.001 V	Not specified
	15 V	1.4 mA Short Circuit	
		7 mA short circuit	

This channel has overload protection for up to 600 V.

A nominal 2.2 K resistor (includes PTC) is in series with the voltage source and is what limits the test current.

⁶ Using Relative Mode.

⁷ Accuracies depend on capacitor type.

FREQUENCY & DUTY CYCLE MEASUREMENT

	Range	Resolution	Accuracy
F ⁸	99.999 Hz to	0.001 to 10 Hz	±0.1%+3
Hz	999.99 kHz		
Duty	1 to 99 %	0.1 %	±0.2% + 5 +
Cycle ⁹			0.2/kHz
%			,

This channel has overload protection for up to 600 V.

This range has an apparent 99,999 counts.

VA MEASUREMENT

Specifications for the VA power measurement will be consistent with the corresponding ranges for the Voltage & Current ranges being used respectively. Congruent with the VA resolution provided for that range.

⁸ Sensitivity > 2.5 V RMS

⁹ 0.01 to 200 kHz, Pulse Width: >5 us, Sensitivity: > 2.5 V RMS

TEMPERATURE & CONTINUITY

	Range	Resolution	Accuracy
Temp °C	-200 to 1350°C K-Type	0.1°C	±0.5%+3°C
Continuity	$30~\Omega$ or $300~\Omega$ User Selectable OPEN or CLOSED	10 mΩ	Not Specified

This channel has overload protection for up to 600 V.

External temperature measurement uses a K-Type thermocouple.

Internal temperature measurement is inside a sealed case, so will have some thermal lag.

The continuity tester can be set for beep on CLOSED or beep on OPEN (for wire breaks) with a user adjustable threshold level.

BLUETOOTH SPECIFICATIONS

- The 121GW uses a BLE112-A Class 2 certified Low Energy Bluetooth module.
- This device complies with Part 15 of the FCC Rules.
- This device complies with Industry Canada licence-exempt RSS standard(s).
- This device complies with Japan MIC certification ARIB STD-T66.

Contains Transmitter Module FCC ID: QOQBLE112

Contains Transmitter Module IC: 5123A-BGTBLE112

The Bluetooth module is in conformity with the essential requirements and other relevant requirements of the CE RED(2014/53/EU).

The product is in conformity with the following standards and/or normative documents.

Essential Requirement	Applicable Standards / Specifications	
Safety Requirements	EN 60950-	
	1:2006+A11:2009+A1:2010+A12:2011+A2:2013	
EMC Requirements	EN 301 489-1 V2.1.1	
	EN 301 489-17 V3.1.1	
Radio Spectrum	EN 300 328 V2.1.1	

The BLE112 Bluetooth module is KCC certified with following certification numbers:

BLE112-A: KCC-CRM-BGT-BLE112-A

BLE112-E: KCC-CRM-BGT-BLE112-E

BLE112-N: KCC-CRM-BGT-BLE112-N

STANDARDS

This Multimeter complies to the following standards.

COMPLIANCE SYMBOLS

The device is marked with the following symbols, these have the following meanings:

Symbol	Definition		
	RCM, this is the Regulatory Compliance Mark. It indicates that		
)	the product is compliant to required Australian Standards.		
$C \in$	CE, this is the Conformité Européenne mark. It indicates that the		
	product complies with required European standards.		
(11)	ETL, the listed CUS Mark. It Indicates that the product is the		
Intertek	mark that indicates testing by Intertek.		

IFC STANDARDS

The product is Extra-Low voltage system, as per IEC 60038.

The product V_{AC} does not supply 50 or 120 V_{DC} .

The product is classified as IP41 as per IEC 60529 standards. Tested for IEC 60950-1 and IEC/EN61010-1: 2010 3rd Edition.

ANSI STANDARDS

Safety requirements tested as per ANSI 61010-1 and testing for hand-held equipment as per ANSI 61010-2.

CAT III rating as per ANSI. 61010-1.

SAFETY

This manual contains information and warnings that *must* be followed when operating the device. Following these instructions will protect you from damaging the device or risking your well-being. The device can only protect you up to a point and it should not be used in situations that do not comply with the devices ratings and the recommendations in this section.

The following symbols are used on the device and through this manual to indicate whether something is a warning or a precaution.

Symbol	Definition
4	Caution: Possibility of electric shock
	Caution: See explanation in section

WARNING

A condition or action that could result in serious injury or death to the user.

- 1. Using the device outdoors risks electric shock or fire. The device is not designed to operate in rain or moisture.
- 2. The product is rated IP41 and should be treated accordingly. This means that the product should not be exposed to liquids or dust.
- 3. Inspect leads and ensure that no defects or damage exists on the leads, connectors or probes. Defective parts must not be used and need to be replaced before use.
- 4. Only use UL Listed Probe Assemblies with ratings that are greater or equal to the meter rating.
- 5. CAT III & CAT IV test probe tips must be 4 mm (As per IEC 61010-031).
- 6. <u>All</u> accessories must possess a greater than or equal to CAT rating to that of the Multimeter.

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French:

Sécurité

Ce manuel contient des informations et des avertissements qui doivent être suivis lors de l'utilisation de l'appareil. En suivant ces instructions, vous protégerez d'endommager l'appareil ou de risquer votre bien-être. L'appareil ne peut que vous protéger jusqu'à un certain point et ne doit pas être utilisé dans des situations qui ne sont pas conformes à la note des appareils et aux recommandations de cette section.

Les symboles suivants sont utilisés sur le périphérique et par le biais de ce manuel pour indiquer si quelque chose est un avertissement ou une précaution.

Symbole	Définition
4	Attention: Possibilité de choc électrique
	Attention: voir l'explication dans la section

Attention

Une condition ou une action qui pourrait entraîner des blessures graves ou la mort de l'utilisateur.

- L'utilisation de l'appareil à l'extérieur risque d'être électrique ou d'incendie. L'appareil n'est pas conçu pour fonctionner sous la pluie ou l'humidité.
- Le produit est classé IP41 et devrait être traité en conséquence. Cela signifie que le produit ne doit pas être exposé aux liquides ou à la poussière.
- 3. Inspectez les câbles et assurez-vous qu'aucun défaut ou dommage n'existe sur les conducteurs, les connecteurs ou les sondes. Les

pièces défectueuses ne doivent pas être utilisées et doivent être remplacées avant utilisation.

- 4. N'utilisez que des ensembles de sonde homologués UL avec des valeurs nominales supérieures ou égales à celles du compteur.
- 5. Les pointes de la sonde de test CAT III et VAT IV doivent être de 4 mm (selon CEI 61010-031).
- 6. Tous les accessoires doivent posséder une valeur nominale supérieure ou égale à celle du multimètre.

CAUTION

A condition or action that could result in damage or malfunctions in the instrument.

- 1. **Before** changing functions, remove test leads from any measurement point.
- 2. **Before** any measurement, ensure test leads are connected to appropriate connector on the device and in an appropriate manner to the test points.

French:

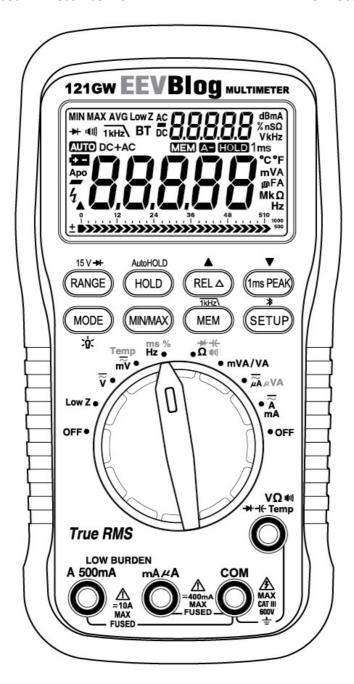
Une condition ou une action pouvant entraîner des dégâts ou des dysfonctionnements dans l'instrument.

- 1. Avant de modifier les fonctions, retirez les fils de test de n'importe quel point de mesure.
- 2. Avant toute mesure, assurez-vous que les fils de test sont connectés au connecteur approprié sur l'appareil et de manière appropriée aux points de test.

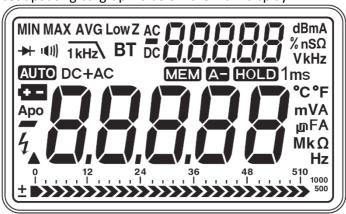
OPERATION

The following section will outline how to operate the device. This section utilises some symbols which are defined in the table below:

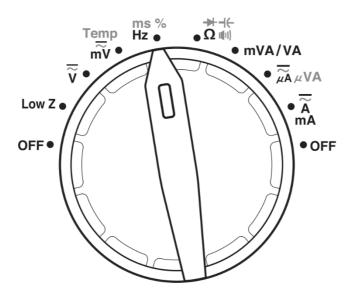
<u></u>	Dangerous Voltage	+•	Ground
~	AC Alternating Current	$\overline{\mathbb{A}}$	Warning or Caution
==	DC Direct Current		Double Insulation (Protection Class II)
I2	Either AC or DC	ф	Fuse
0	Not Applicable to Identified Model	Ŧ	Battery



Digital Display: Readings are displayed on dual 4 % -digit 50,000 count LCD display. One Primary and one smaller secondary function display. The secondary function display is only used when a function that requires it is selected. A fast updating bargraph is below the main display.



Rotary Switch: Used to turn the power off and on and select the test function. There are two OFF positions for convenience, both work identically.





RANGE Button: Used to swap between ranges of a function. This could be moving the decimal point for the voltage range, swapping between 3 V or 15 V diode mode etc...



HOLD Button: Used to select the Auto HOLD function



REL Button: Used to select the relative measurement mode. Secondary use as the *UP* arrow key for setup selection. Holding down this button in AC mode selects the 1 kHz low pass filter.



1ms PEAK Button: Used to select the 1 ms peak capture mode. Secondary use as the *DOWN* arrow key for setup selection. Holding down this button turns on and off the Bluetooth data transfer functionality.



MODE Button: Used to select and cycle through the different function modes displayed in RED on the mode dial. Holding down this button will activate and deactivate the display backlight.



MIN/MAX Button: Cycles through and selects the MIN, MAX, and AVG measurement modes.



MEM Button: Holding down this button starts the SD card data logging. Pressing once allows viewing of the stored data.



SETUP Button: Displays the setup menu and cycles through the options. Press and hold the button when on the required option to edit that option.

A 500mA A / 500mA Jack: This input jack is used for the Amps and 500 mA current modes. It is 11 A HRC fused. An input warning alert functions for the is jack.

mA / μA Jack: This input jack is used for the 50 mA and μA current modes. It is 400 mA HRC fused. An input warning alert functions for the is jack.

COM

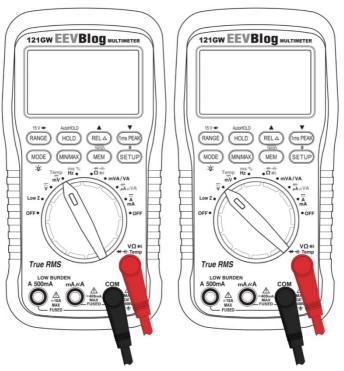
COM Jack: The negative common jack for all ranges and functions.



VΩ Jack: The positive input jack used for voltage, re-→ + - Temp sistance, capacitance, diode, continuity, and temperature functions. This input jack is PTC and MOV protected.

MEASURING

 $\mathsf{VOLTAGE}\ \overline{\widetilde{\mathbf{v}}}^{\,\mathsf{Temp}}_{\,\,\widetilde{\mathbf{m}}\widetilde{\mathbf{v}}}$





AC

When measuring AC voltages, you need to select the AC mode using the mode button. You will see the AC icon appear on the screen when you are in the correct mode.

DC

DC is the default mode for voltages and upon selecting the voltage range the DC icon will be shown on the screen.

Modes MODE

Pressing the MODE button will cycle through the following modes:

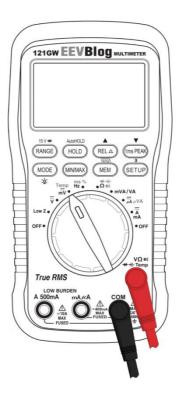
The following modes are available on the voltage range \widetilde{V} :

- 1. DC
- 2. AC
- 3. DC+AC

The following modes are available on the millivolts range $\frac{1}{m}$:

- 1. DC
- 2. AC
- 3. Temperature

TEMPERATURE $\stackrel{\text{Temp}}{\tilde{\mathbb{M}}}$

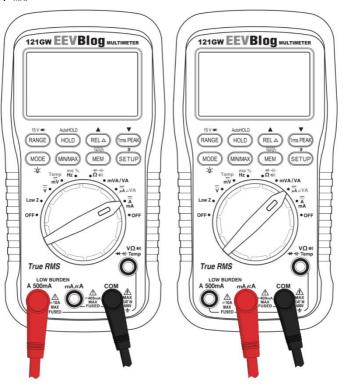


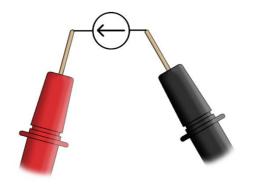


When measuring temperature be sure to have the leads connected as above and in the correct range.

To enter the temperature mode, press the mode button twice after selecting mV on the dial.

CURRENT $\overline{\tilde{A}} \overset{\sim}{\sim} \mu VA$





When measuring current be sure to have the leads connected as above and in the correct range, for higher currents ensure that the red lead is connected to the A 500 mA socket.

AC

When measuring AC current, you must press the mode button until the AC icon appears on screen.

DC.

The default mode will be DC measurement. If the DC icon is not shown on the screen press the mode button until it is.

Modes MODE

Pressing the MODE button will cycle through the following modes:

The following modes are available on the amp/milliamp range $\stackrel{\widetilde{\mathbf{A}}}{\mathrm{mA}}$:

- 1. DC
- 2. AC

- 1. DC
- 2. AC

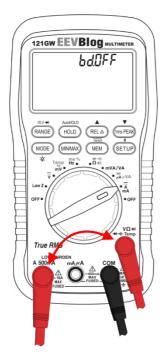
BURDEN VOLTAGE

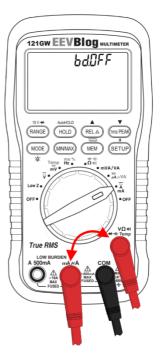
When measuring current on the multimeter there is a voltage drop across the resistor used to measure the current. This voltage is called the "burden voltage".

To measure the burden voltage, perform the following steps:

- 1. Press the SETUP button until bd.OFF appears in the secondary display (As shown in the figure below).
- 2. Hold setup to change the item, when it beeps release the button.
- 3. Press up (REL) or down (1ms PEAK) to toggle on or off the burden voltage.

To measure the burden voltage an additional lead is required, this should be connected between the active current terminal and the voltage input, as shown below:





RESISTANCEΩ™



When measuring resistance select the range as shown above with the leads connected as shown above.

Resistance is measured between the two leads.

Modes MODE

Pressing the MODE button will cycle through the following modes:

The following modes are available on the resistance range Ω $\stackrel{\frown}{=}$:

- 1. Resistance
- 2. Continuity tester
- 3. Diode tester
- 4. Capacitance measurement

CONTINUITY TESTING



When taking measurements, you must connect the leads as shown above.

To check if a short (Selectable <30 Ω or <300 Ω) exists you can use the continuity tester. To use this range, you need to press the *MODE* button once. To change the continuity threshold level between >30 Ω or >300 Ω , select the Continuity mode and:

- 1. Press SETUP until "UP xxx" or "dN xxx" appears on the small display.
- 2. Hold *SETUP* to change the mode.
- 3. Press the *UP* and *DOWN* buttons to toggle between continuity testing mode and cable break testing mode. Continuity mode is the "dN" mode, and you can select either **dN 30** or **dN 300** for 30 Ω or 300 Ω respectively.
- 4. Press *SETUP* to store the required mode.

CABLE BREAK TESTING THE



When taking measurements, you must connect the leads as shown above.

To check if a break exists (Selectable >30 Ω or >300 Ω) exists you can use the cable break tester. To use this range, you need to select the Continuity mode and:

- 1. Press SETUP until "UP xxx" or "dN xxx" appears on the small display.
- 2. Hold *SETUP* to change the mode.
- 3. Press the *UP* and *DOWN* buttons to toggle between continuity testing mode and cable break testing mode. Cable break mode is the "UP" mode, and you can select either **UP 30** or **UP 300** for 30 Ω or 300 Ω respectively.
- 4. Press SETUP to store the mode



When taking measurements, you must connect the leads as shown above.

To enter the capacitance mode, press the *MODE* button three times.

You can zero out the residual lead and meter capacitance with the *REL* function.

Ensure that the capacitor is discharged before measurement.

FREQUENCY $^{ m ms}_{ m Hz}$ $^{\%}$



When taking measurements, you must connect the leads as shown above.

Frequency measurement is the default mode for the dial position shown above.

Modes MODE

Pressing *MODE* will result in a change in the measurement mode. The following modes are available on the frequency range $^{ms}_{Hz}$:

- 1. Frequency
- 2. Pulse width
- 3. Duty Cycle

DUTY CYCLE $^{\mathrm{ms}}_{\mathrm{Hz}}$ %



When taking measurements, you must connect the leads as shown above.

To enter the duty cycle mode press mode twice after selecting the Hz dial position.

PERIOD Hz %



When taking measurements, you must connect the leads as shown above.

To enter the period measurement mode press *MODE* once after selecting the Hz dial position. The period in milliseconds will be displayed.

DIODE MEASUREMENT



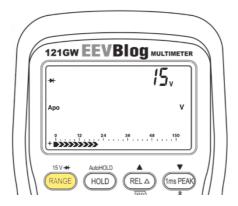
When taking measurements, you must connect the leads as shown above.

The diode measurement range also supports a high voltage mode (up to 15 V) that enables the measurement of Zener voltages, LED string arrays and other similar potentials.

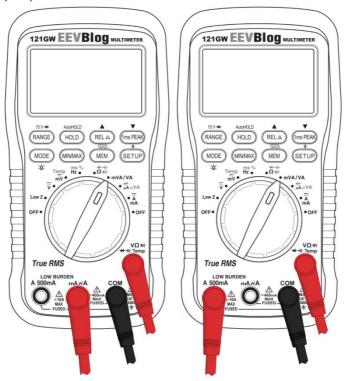
The output current is limited by the nominal 2.2 k Ω total PTC + Resistor protection devices, and the voltage mode selected. It is not a constant current generator, so take this into account when measuring devices.

Voltage mode is toggled between 3 V and 15 V by pressing the RANGE button after selecting the diode measurement mode, the secondary display will then show the maximum diode voltage measurable.

The voltage range is displayed on the secondary display as follows:

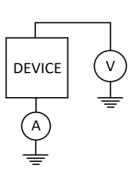


POWER (VA) **mVA/VA** $\overline{\widetilde{\mu}}$ A μ VA



Power measurements require measurements of both voltage and current, be careful to connect the system in a manner that the common terminal is common for both the voltage measurement and the current measurement.

An example is shown below:



DATA LOGGING

Data logging is started by holding the *MEM* button until a beep is heard and the *MEM* icon flashes on screen.



Logged data is stored to an internal Micro SD card which is accessible behind the battery cover. Data is by default recorded once per second.

The logging data is stored on the SD card in the following format as a CSV:

	Main			Secondary				
Sample	Function	Value	Units	Function	Value	Units		
1	DCV	0.0000	V	etc.	etc.	etc.		

The data that is recorded is taken from the currently displayed function, if you are measuring voltage then voltage is recorded. The number of accumulated logged data points is displayed on the secondary display.

To stop data logging press and hold the MEM button.

BACKLIGHT



To enable the backlight, hold the MODE button.

BLUETOOTH

To enable Bluetooth communications, hold the "1ms PEAK" button until BT is displayed on the LCD.

Ensure that Bluetooth is enabled on the host device before running the application on the remote computing device.

The multimeter will continue to functional as normal in Bluetooth mode, but the display data will be transmitted via the Bluetooth connection.

To disable Bluetooth mode press and hold the 1ms Peak button until BT is not displayed.

MEASUREMENT HOLD

There are two measurement HOLD functions.

1. Manual Hold

To pause the measurement on the main display, press the *HOLD* button. To resume measurement, you need to press the button again until A- and *HOLD* are no longer visible.

The bargraph display will continue to update in "live" mode while the captured value is held on the screen.

2. Automatic Hold

Press the HOLD button twice until A-HOLD is displayed.

This mode will wait for a stable reading and automatically lock that value on the display. A beep will be heard to indicate this capture.

It will continue to hold this value until the measurement changes significantly and a new stable reading is found. This mode is great for when you must keep your hands on the probes.

RELATIVE MEASUREMENT (REL)



If you are measuring something relative to another measurement or need to calibrate any non-zero error out you can press the *REL* button to zero, the currently displayed value.

All subsequent measurements will have this stored relative value subtracted from the result. The displayed measurement is the difference between the actual measured value and the stored relative value.

If is useful for example to cancel out the resistance of test probes in the ohms range.

MIN/MAX/AVG



To find the minimum and maximum value found during sampling you can use the MIN/MAX button.

This button also provides an average function AVG. This can be entered by pressing the button until the AVG symbol appears.

To capture min, max and average results press the MIN/MAX button until all three icons are shown on the LCD.

To exit out of these modes hold the button until a beep is heard, and the icons are cleared from the screen.

Pressing the MIN/MAX button will cycle through the displayed results of each measurement.

SETUP MENU



To configure and read settings for the multimeter you can press the *SETUP* button to view the settings. If you press the setup button multiple times you will cycle through the menu, the order of the menu is as follows:

- 1. Temperature
- 2. Battery Voltage
- 3. Auto Power Off (APo)
- 4. LCD Contrast
- 5. Year
- 6. Month-Day
- 7. Hour-Minute
- 8. Logging Interval (In 1)
- 9. Additional settings dependent upon the function selected.

TEMPERATURE

The multimeter has an internal temperature which can be used for rough ambient temperature measurement. Note that there will be thermal lag due to the sealed enclosure. It is displayed on the secondary display.

The displayed temperature can be changed from Celsius to Fahrenheit using the SETUP menu. To do this:

- Make sure the temperature is displayed
- 2. Press and hold SETUP
- 3. Use the *UP/DOWN* arrow keys to select the mode
- 4. Press SETUP to save and exit

BATTERY VOLTAGE

To check the status of the batteries in the multimeter press the SETUP button until "Bat" is displayed. The Low Battery icon will come in when the batteries reach approximately $4.2\ V$

It is recommended that you change the battery when the battery icon is displayed, as the unit's specifications are no longer guaranteed.

AUTO POWER OFF (APO)

With some measurements you may not want the multimeter to automatically power off. To disable automatic power off:

- 1. Navigate to the APo menu item using SETUP
- 2. Hold SFTLIP
- 3. Press UP/DOWN to toggle between "APO.oN" and "APO.oF"
- 4. Press SETUP to save and exit

APO is disabled in data logging mode.

LCD CONTRAST

If the multimeter has ghosted characters you may want to turn the contrast down, if the screen is not dark enough you may need to turn up the contrast.

This may need to be changed due to variations in ambient operating temperature.

To change the contrast:

- 1. Navigate to the menu item that says LCD X using the SETUP button
- 2. Hold SETUP
- 3. Press *UP* and DOWN to configure the screen contrast, change until the screen contrast is as desired.
- 4. Press SETUP to store the value and exit

DATE

There are three menu items that can be used to read and set the currently configured date. These are the following menu items:

Year "YYYY"
 Month-Day "MM-DD"
 Hour-Minute "HH-mm"

To change the date items:

- 1. Navigate to the menu item.
- 2. Hold SETUP
- 3. Press *UP* and *DOWN* to configure the date/time item.
- 4. Press SETUP again to save

LOGGING INTERVAL

The logging interval can range from 200 ms to 999 seconds. If you need to change the interval, then you should:

- 1. Navigate to the menu item "In x" using SETUP
- 2. Hold SETUP
- 3. Press UP and DOWN keys to configure the time interval in seconds. If "x" is set to zero the sample rate will be set to the ADC's maximum rate (approximately 200 ms).
- 4. Press SETUP again to store the value

MAINTENANCE

The 121GW maintenance is outlined in this section.



Before opening case for maintenance, disconnect test leads from the meter and turn off the meter.

DEBUGGING

- If a low battery alert appears on the device as indicated in the operation section, the back of the device must be opened to replace the AA batteries.
- 2. If the measurements fail to respond to changes in measured devices check the fuse, leads and test probe connections.

CLEANING AND STORAGE

The device should be kept in a clean condition, this requires periodic cleaning. The device should be cleaned slightly damp cloth with mild detergent. Do not use solvents or abrasives as they could damage the device.

When the device is placed into long term storage (>50 days) the batteries should be removed to reduce the risk of leakage or unnecessary drain.

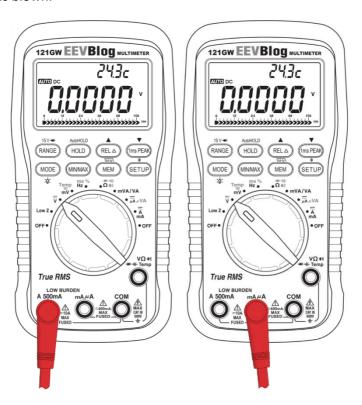
FUSE REPLACEMENT

To check whether you need to replace a fuse perform the following steps:

- 1. Switch to the voltage range and connect a lead as shown in the below diagram.
- 2. If the multimeter beeps the fuse is functioning, if it fails to beep it indicates that the fuse is blown.

If it beeps when connected to the "A" jack, then it is likely that the larger A fuse is blown.

If it beeps when connected to the "mA" jack, then it is likely that the smaller mA fuse is blown.



Last Revised: 11 December 2017 121GW User Manual

mA/μA current input fuse: 400 mA / 600 V DC/AC, IR 10 kA HRC FAST

Designed to UL 248-1

Dimension: 6mm x 32 mm

Recommended: ASTM HV610.0.4 400 mA (600V) or HV620.0.4 (1000V)

A/500 mA current input fuse: 11 A/1000 V DC/AC, IR 20 kA HRC FAST

Dimension: 10mm x 38 mm 5AG

Recommended: ASTM HV110.11A, Bussmann DMM-B-11A, or Littlefuse

FLU011

CALIBRATION

WARNING:

Entering the calibration mode can render your unit non-operational or out of specification. Factory calibration will be VOID if this function is used. This mode is only intended for those with the experienced knowledge and equipment necessary to calibrate their own equipment.

The calibration procedure can be performed for only one, or all desired ranges and functions. When complete, re-power the meter to exit calibration mode.

It is possible to recalibrate a single range and function if desired, there is no need to calibrate all ranges once started.

The calibration values are stored in EEPROM and are not affected by firmware updates.

CALIBRATION MODE

To enable calibration mode the following procedure must be followed: Turn off the meter

- 1. Press and hold the MODE button.
- 2. Turn on device.
- 3. If the screen says, "CAL 1". Press REL button, enter calibration mode.
- 4. The secondary screen will display "CAL" when the device is in calibration mode.
- 5. Switch to the function mode you want to calibrate as per normal meter operation. (voltage, current, resistance etc)
- 6. Press the RANGE button to enter the range you need to calibrate. To double check the current range notice the SI units displayed and the position of the decimal point. Calibrating the incorrect range could ruin your day.
- 7. After selecting the range and mode you can perform calibration, see next section.

NOTE: Calibration should be performed in this order:

- 1. Offset calibration
- 2. Scale calibration

ZERO OFFSET CALIBRATION

To calibrate the offset of a mode and range the following procedure must be followed:

- Follow the steps shown in the section "Calibration Mode".
- Disconnect or short the input that would result in a zero reading as required for that function:

Mode	Action
Low Z	Open Circuit
Voltage DC/AC	Short Inputs
Capacitance	Open Circuit
Current DC/AC	Open Circuit
Resistance	Short Inputs with Low Z Shunt
Temperature	Pending Procedure
Frequency	N/A. Factory Calibrated

- 3. Press the SETUP button to begin offset calibration
- 4. Hold your breath, cross your fingers, and don't make any sudden movements that could frighten the meter. Beard stroking is allowed.
- 5. There will be a timer countdown. When the timer reaches zero the zero-offset calibration will complete and will be stored.

NOTE: If you do not setup the leads prior to starting the offset calibration then the final calibration value will be affected. If at any time during the timer countdown the measurement is interrupted the offset calibration procedure should be restarted.

FULL SCALE GAIN CALIBRATION

Before attempting any full-scale gain calibration, you need to be sure that you have the required reference values for the ranges that calibration is needed. These values are given in the calibration table.

To calibrate the full-scale gain of a range the following procedure must be followed:

 Follow the steps shown in the section "Calibration Mode".



- Connect a reference generator with the test parameter value as outlined in the following calibration table for the specific range. Ensure that appropriate and desired uncertainly and traceability conditions are met.
- 3. Hold your breath, cross your fingers, and don't make any sudden movements that could frighten the meter or calibration equipment. Beard stroking is allowed.
- 4. Press the MEM button to begin gain calibration.
- 5. There will be a timer countdown. When the timer reaches zero the gain calibration will complete and will be stored.

NOTE: If you do not setup the leads prior to starting the offset calibration then the final calibration value will be affected. If at any time during the timer countdown the measurement is interrupted the offset calibration procedure should be restarted.

CALIBRATION REFERENCE TABLE

		Calibration Procedures & Button Operations									
	TAP Mode Start : Press "HOLD & MEM" button when turning the Meter on, and then press "SETUP							press "SETUP"			
	Cal Mode Start: Press "MODE" button when turning the Meter on, and then press "R										
	Cal Mode		SET : "SET		GAIN:	"MEM		nermist		"MEM" Long	
	Range	R0	R1	R2	R3	R4	R5	R6	0FFSET	GAIN	Mode
0	Low-Z	600.0V	* "REC" & "	Manual"	feature	es are	not av		×	x	
1	DCV	5.00007	50.000V	500.00	600.00				07	All	AD1
2	ACV	5.00007	50.000V	500.00	600.00				10%	All	RNS/AD2
	PeakHold	*ACmy & ACV	: Calibrate	e 0.3V (Offset a	& 3V G	ain at	AC5V Ra	0.37 @57	3V @5V	PEAK
3	DCmV	50.000mV	500.00mV						OmV	All	AD1
4	ACmV	50.000mV	500.00mV						10%	All	RNS/AD2
5	Temp.	- 200.0° C~ 1350.0° C						ntc 23°C	OmV:NTC Temp.	50mV 1233.5'C + NTC Temperature	TC:AD1 TH:MPU
6	Hz/mS/%	99.999Hz	999.99Hz	9.9999 KHZ	99.999 KHZ	999.9 9 <u>KH</u> z			x	150KHz	CNT
7	Resisto▶	50.000Ω	500.00Ω	5.0000 ΚΩ		500.0 0 KΩ	5.0000 ΜΩ	50.000 MΩ	0Ω	R0~R5:50000 R6:40.000M Ω	AD1
8	Beep	500 Ω	Under3OΩ/Over3OΩ/Under3OOΩ/Over 3OO⊳					0Ω	500 Ω	AD1	
9	Diode	3.07	37 / 157	3V / 15V Selectable					х	3.0V	AD1
10	Capacito	10.00nF	100.0nF		10.00 长	100.0 uE	10.00 贬		R1 :	R0~R4:1000 R5:1mF Gain	CNT
11	<u>ACuVA</u>	(50uA*50V) 2500.0uVA	(500uA*50V) 25000uVA						0	50uA+50Y/50Hz 500uA+50Y/50Hz	RNS/AD2
12	ACmYA	(5mA*50V) 250.00mVA	(50mA*50V) 2500.0mVA	at 50Hz					0	5mA*50V/50Hz 50mA*50V/50Hz	RM8/AD2
13	ACVA	(500nA*50Y) 25000nYA	(10A * 50V) 500.00VA						0	500mA*50Y/50Hz 10A*50Y/50Hz	RNS/AD2
14	<u>ACuA</u>	50.000uA	500.00uA						10%	All	RNS/AD2
15	DCuA	50.000uA	500.00uA						0	All	AD1
16	<u>ACmA</u>	5.0000mA	50.000mA						10%	All	RNS/AD2
17	2.4	5.0000mA	50.000mA						0	All	AD1
18		500.00mA	5.0000A	10.000A					10%	All	RMS/AD2
19	DCA	500.00mA	5.0000A	10.000A					0	All	AD1
20	<u>DCuVA</u>	(50uA*50V) 2500.0uVA	(500uA+50V) 25000uVA						0	50uA*50V 500uA*50V	AD1
21	DCmVA	(5mA*50V) 250.00mVA	(50mA+50V) 2500.0mVA						0	5mA*50V 50mA*50V	AD1
22	DCVA	(500må+50V) 25000mVå	(10A + 50V) 500.00VA						0	500mA*50V 10A*50V	AD1

FIRMWARE UPDATE

The 121GW features updatable firmware that enables upgrades to be performed by the user from the SD card. To perform a firmware update, follow the following procedure:

- 1. Turn off the multimeter.
- Insert an SD card into the multimeter with the latest EEVblog.bin firmware file.
- 3. Press and hold the HOLD and MEM buttons simultaneously.
- 4. Switch on the multimeter.
- 5. If "IAP" appears on the screen, then press SETUP to enter firmware upgrade mode.



6. Once you are ready to begin the upgrade press SETUP again to begin.



7. The multimeter will restart itself once the update is complete, do not do this manually.

NOTE: Do not disconnect the SD card or power down the multimeter until the upgrade is complete. The bootloader should be robust enough to handle this, but just don't, ok!

WARRANTY

The 121GW is warranted to be free from defects in materials and workmanship for a period of one year from the date of purchase. If within the warranty period your instrument should become inoperative from such defects, the unit will be repaired or replaced at the company's option.

This warranty covers normal use and does not cover damage which occurs in shipment or failure which results from alteration, tampering, hacking, accident, misuse, abuse, neglect or improper maintenance.

Batteries and consequential damage resulting from failed batteries are not covered by warranty.

Any implied warranties, including but not limited to implied warranties of merchantability and fitness for a purpose, are limited to the express warranty. The company shall not be liable for loss of use of the instrument or other incidental or consequential damages, expenses, or economic loss, or for any claim or claims for such damage, expenses or economic loss.

A purchase receipt or other proof of original purchase date will be required before warranty repairs or replacement will be rendered.