TRANSMILLE
SOLUTIONS IN CALIBRATION

8100 SERIES

ADVANCED 7.5/8.5 DIGIT MULTIMETER

OPERATION MANUAL

TRANSMILLE 8100 OPERATION MANUAL

ADVANCED PRECISION 7.5 / 8.5 DIGIT MULTIMETER

Version 1.0.1 - 18th June 2018

Warranty

Transmille guarantees this product to be free from defects in material and workmanship under normal user for a period of one (1) year from the date of shipment. This warranty does NOT cover any required re-calibration/adjustment or standard maintenance actions. This warranty extends only to the original end purchaser and does not apply to fuses, batteries, external cables or to the product if it has been modified, misused, altered or has been subjected to mishandling or misuse.

Transmille's obligation to warranty is limited to repair or replace the product after return to an authorized Transmille service centre within the warranty period and is subject to Transmille's investigation determining that the fault is not caused by misuse, alteration or through mishandling.

If failure occurs, send the product via pre-paid freight, to the service centre as informed by Transmille with a description of the fault only after receiving confirmation from Transmille. At Transmille's option, either repairs will be performed or a replacement unit of similar condition and age will be provided.

Transmille will return the product to the end customer or local distributor via pre-paid freight (with exception of any customs clearance fees).

Transmille accept no responsibility for damage during return shipping for warranty service.

Contents

Introduction

The 8100 Series Digital Multimeter is a high performance instrument capable of reading a wide range of input signals. Available as two models, accuracies of up to 4ppm, are available while maintaining an easy to use interface that is familiar to users of similar equipment.

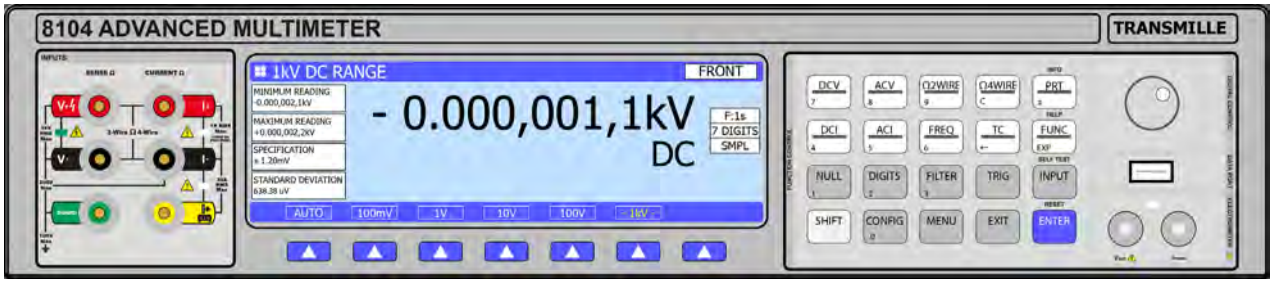
Key Features

- **AC/DC Volts to 1025V**
- **AC/DC Current to 30 Amps**
- **Dedicated Low Current inputs for high sensitivity measurements (8104 Only)**
- **2 and 4 Wire Resistance with selectable current**
- **High Resistance Measurement to 1 TOhm (8104 Only)**
- **Frequency Measurement**
- **Thermocouple Measurement with Automatic Cold Junction (8104 Only / Requires TCLEAD)**
- **PRT Measurement with conversion to ITC-90 and IEC751 (8104 Only)**
- **Electronically switchable Front and Rear Terminals (8104 Only)**
- **Multi Interface (RS232, USB, GPIB/IEEE 488, Ethernet**

Available Accessories

The 8100 Series has a full range of complimentary accessories to assist with getting the best out of the Instrument. Accessories include:

- **A Soft Carry Case for hand carried transit (8100-SCASE)**
- **A Hard Transit case, laser cut with storage areas for leads and accessories for shipping via courier (8100-TCASE)**
- **A comprehensive lead set that includes leads and accessories for making high performance measurements (8100-LEAD)**
- **Options for Rack Mount configuration (RACKTRAY and 8100-RACKCASE)**
- **Automated Cold Junction Measurement lead (TCLEAD)**



The 8100 Front Panel has been designed to be easy to operate with inputs located on the Left hand side and clearly labelled keys.

Input Terminals

Warning

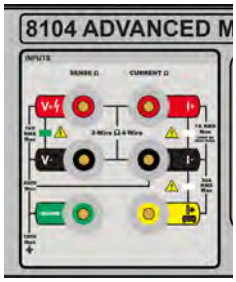
To avoid electrical shock, injury of death, never touch any lead connected (or terminal) of the multimeter unless certain that no dangerous voltages are present.

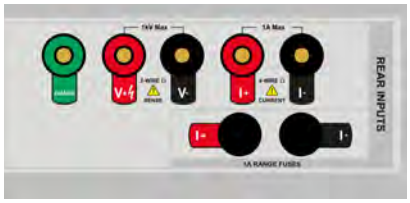
The 8100 Series Multimeter's offer Front and Rear (8104 Only) Terminals. The default set of terminals on start up is always the Front Panel Terminals. When front panel input is selected the active set of terminals are indicated with a green LED Indicator next to the terminals.

Take care to avoid overloading the inputs. Each input has the maximum input labelled next to the input, with more information available in the extended specifications.

The Front and Rear Inputs of the 8104 can be selected using the INPUT menu or over the remote interface. When the 8104 is using REAR panel inputs the indicator in the top right of the

screen will display ‘REAR’





Front and Rear Input Terminals

The function of each terminals is indicated as in the table below

Sense Ω		Current Ω	
V+	Voltage High Ohms High (2 Wire)	**I+**	Current High (Up to 1A) Ohms High (4 Wire)
V-	Voltage Common Ohms Common (2 Wire)	**I-**	Low Current (Below 1A) Common Ohms Common (4 Wire)
Guard		**I+**	High Current High (Above 1A) (*Front Only*)

4mm Terminals are provided on the front panel terminals for connection via both standard 4mm plugs as well as spade and bare wire connections.

On the 8104 rear panel connections are provided in the form of 4mm sockets.

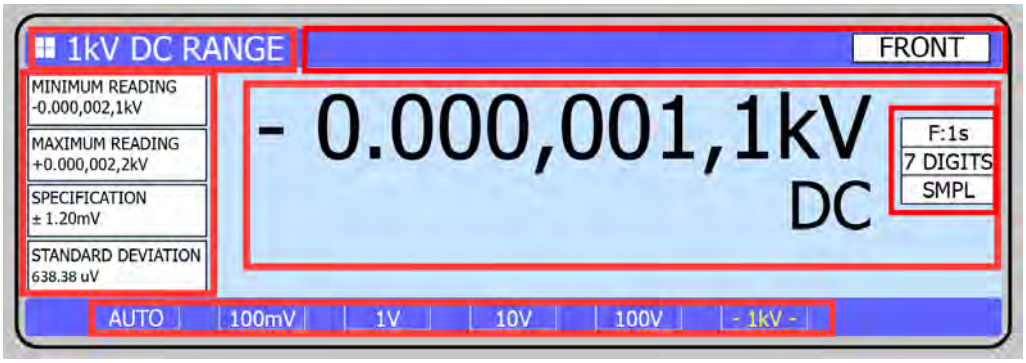
Display

The 8100 features a large full colour screen that displays measurements and menu screens.

The 8100 Screen is segmented into 5 main sections during use :

1. Measurement Display
2. Status Indication
3. Configurable Display Elements
4. Soft Key Text
5. Range / Function Indication

6. Configuration Information



Note : To ensure long life of the screen it is normal behaviour for the screen to go into screen saver and dim the backlight after a user configurable length of time

Measurement Display

The measurement display shows the last sample obtained by the multimeter, or when in maths or ratio functions the result of the user configured parameters.

In AC Modes the frequency will be displayed below the Main Measurement, where as in DC modes the DC indicator will be displayed

Status Indication

On the right hand side of the Measurement Display the current Filter speed, the Resolution and the sample indicator (SMPL) are displayed

The SMPL indicator will flash to indicate that a new sample has been obtained, and for longer sample times will provide a countdown to the next sample.

If MATHS functions such as Multiply have been enabled below the Status indicator text indicating the currently active maths function

Display Elements

The 8100 Series allows up to 4 user selectable ‘Display Elements’ to be visible on screen at any one time. The display elements can provide the user with additional insights to their measurement such as the Specification of the multimeter, the Uncertainty of the Measurement, Standard Deviation

and more.

Information on configuring the active Display Elements can be found on Page 21

Soft Key Text

The Soft Key Text depicts the function that the corresponding physical soft key (described on Page 16) will perform. This text will vary depending upon the current range and function as well as the menu that is currently active

Range / Function Indicator

The Range / Function indicator appears in the top left corner of the screen. This indicates the current range and function that is set on the multimeter, for example 1V DC Range, or HIGH Ω RESISTANCE

Configuration Information

Information regarding the current configuration of the multimeter such as the Input Terminals (8104), whether or not a Null is presently applied and the if the multimeter is in Manual or Auto Range state is displayed at the top of the measurement screen.

Further information regarding icons that appear in the Configuration Information portion of the screen can be found through this manual, however a summary of icons and their description can be found below

Icon Text	Description
FRONT or REAR	Indicates the currently active set of Terminals
NULL	Indicates that a Null is presently active for the selected Range and Input Terminal
COMP	Indicates that Ohms Compensation is presently active
REMOTE	Indicates that the multimeter is currently under Remote Operation. Input via the keyboard is disabled with exception of the LOCAL soft key
GPIB xx	Indicates that instruments GPIB address when in Remote Mode

On Screen Keyboard

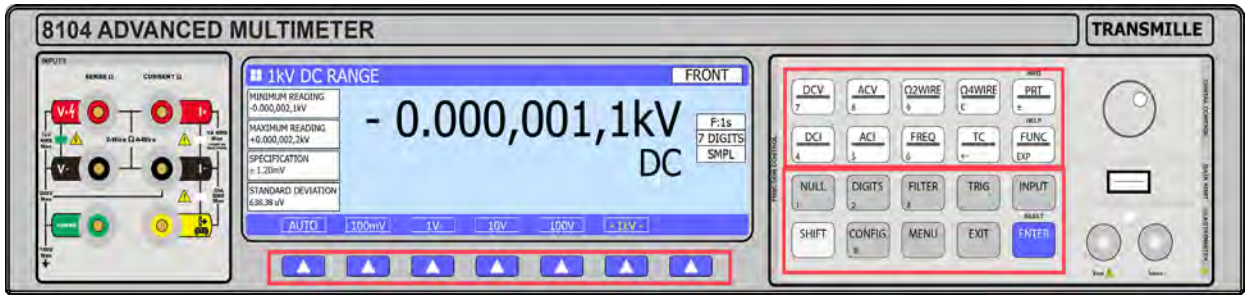
When Text entry is required (Such as entering the system password) an on screen keyboard is displayed on the screen.

Navigation is performed by using the DIGITAL CONTROL to highlight the desired key and then pressing the DIGITAL CONTROL or the ENTER key. When text entry is complete, the soft key labelled ENTER

Keyboard

The 8100 Series features 3 types of keys, separated into two main areas :

1. Major Function Keys
2. Menu / Parameter Keys
3. Soft Keys - These keys are context sensitive and the function changes depending upon the menu or function selected.



Major Function Keys

There are 8 Function Keys, which are white in colour. These keys provide direct access to functions and ranges, such as DC Voltage or DC Current.

Menu / Parameter Keys

There are 8 Menu / Parameter keys, which are grey in colour. These keys provide fast access to menus or measurement functions such as NULL, INPUT and DIGITS

In the Menu / Parameter keys section of the keyboard there are two special function keys, MENU and SHIFT. The MENU key is highlighted BLUE and the SHIFT key is clear, yet illuminates BLUE when selected.

Null

Pressing the NULL key will trigger a maths null function, in which the currently displayed measurement will be subtracted from subsequent measurements. A Message will appear indicating the value that has just been stored as the NULL value and the NULL indicator will appear at the top of the screen.

Pressing the NULL key a second time will disable the NULL on the present range. A message will be displayed to indicate that the null has been cleared.

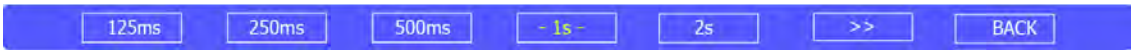
Digits

The DIGITS key displays the resolution menu, allowing the user to select the resolution of the measurement. The resolution is selectable using the soft keys below the desired resolution.

Depending upon the function and filter speed the resolution options will vary. The maximum resolution is 8 digits for the 8104 and 7 digits for the 8109.

Filter

The FILTER key displays the filter menu, allowing the user to select the filter / measurement / sample rate. The filter is selectable using the soft keys below the desired filter speed.



The range of filters / sample rate available will vary depending upon the resolution selected. Lower resolutions offer faster sample rates.

The FILTER menu is separated into two menus, the first listing filter speeds from 125ms to 2s, the second listing speeds 4s through 32s.

To switch between the two screens press the >> or << keys when displayed

Trig

The TRIG key displays the trigger menu, allowing the user to select the triggering method from the front panel. The trigger method is selectable using the soft keys below the desired trigger method.

When the trigger menu is displayed the user can perform a manual trigger event by pressing the MANUAL soft key

Input

The INPUT key displays the input menu, allowing the user to select the desired input terminals. The INPUT key also allows access to RATIO functions.

The desired input mode is selected using the soft keys to select the input mode.

On 8109 units this button will not display a menu as only front panel inputs are available.

Shift

The SHIFT key is a special function key that allows sub functions to be accessed. When the shift key has been pressed it will illuminate BLUE. The secondary text on the label then becomes

active instead of the printed text.

Examples of SHIFT key functions are SHIFT key followed by ENTER which triggers a reset to default start up conditions.

SHIFT key functionality is disabled after a key is pressed or by pressing the SHIFT key again

Config

The CONFIG key displays the configuration menu, this enables the user to configure function options, maths functions, display parameters or to reset measurement statistics.

The CONFIG menu is range and function sensitive, so the display will be different depending upon the range or function that is currently set.

Menu

The menu key displays the full screen menu allowing access to additional functionality and settings. The Main Menu is described in detail starting from Page 21

Exit

The exit key exists any full screen menu and returns to the main measurement screen

Enter

The enter key completes digit entry or selects the currently highlighted option in on screen menus

Soft Keys

There are 7 Soft Keys which are Blue in Colour. The function of these keys is function / menu sensitive. For example, when in DC Voltage the soft keys provide direct selection of ranges. When in the Input menu the keys offer selection of the currently active input.

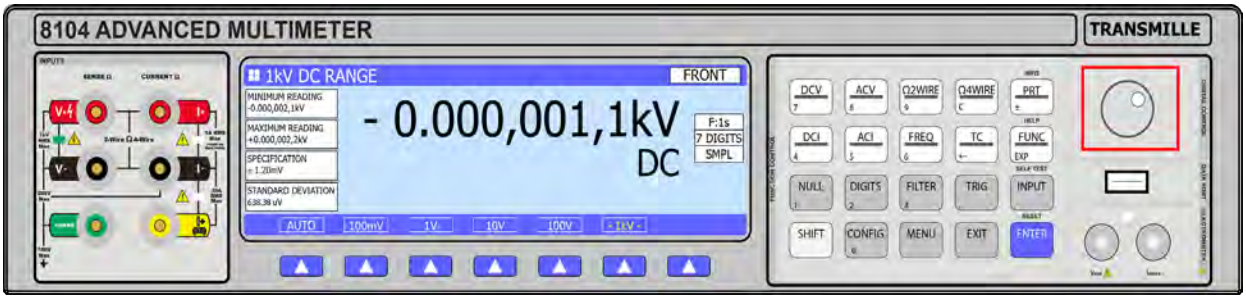
The number of selectable keys will vary depending upon the function.

Numeric Keyboard

When number entry is required the keyboard will automatically enter numerical entry mode. The numerical indicator at the bottom left hand side of keys will become active and when pressed will enter digits instead of the function / menu printed on the key.

Digital Control

The digital control provides a method of navigating through menus, selecting items as well as interacting with the on screen keyboard.



The Digital Control provides both Clockwise and Anti-Clockwise control as well as push to click functionality. The Digital Control offers a tactile feel to indicate that the position has been rotated by an increment

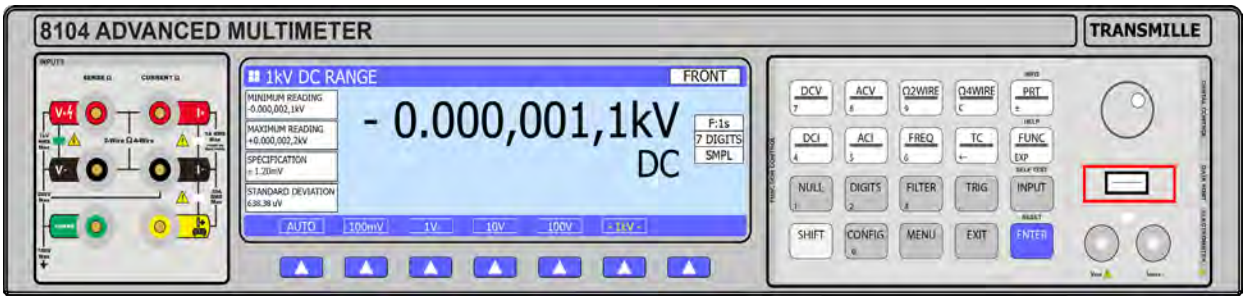
To navigate through a menu, a rotation in the clockwise direction results in the menu selection moving down one position, an anti-clockwise rotation results in moving up one position.

Pushing the Digital Control duplicates behaviour of the physical ENTER key or the SELECT key when in menus to speed up navigating through menus or data entry

Note - Care should be taken to not PULL on the Digital Control to avoid damage

USB Device Port

The USB Device Port enables the 8100 to Read and Write to USB Memory Sticks for application of firmware updates or offload of data (such as calibration backup files)

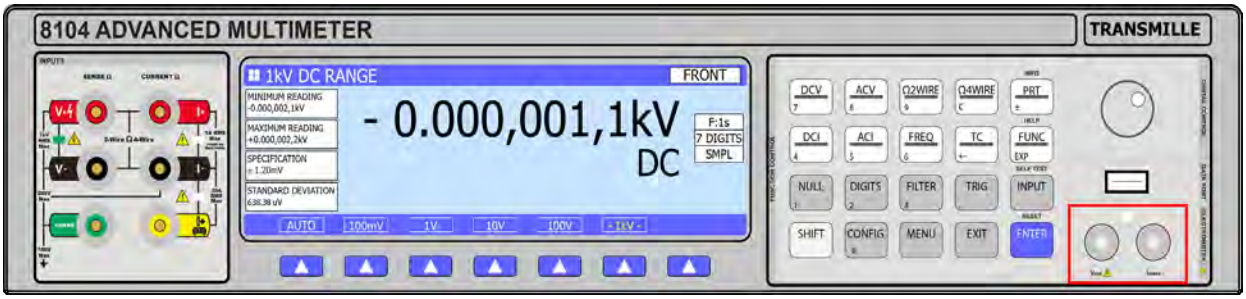


Note - This interface is not used for remote control of the 8100. Connection to a COMPUTER or CONTROL DEVICE through the use of adapters may cause damage to the USB port

Electrometer Terminals (8104 Only)

The 8104 Multimeter comes standard with Electrometer functionality, adding low current (10nA to 10uA Ranges) and High Resistance (up to 1TOhm / 300V) features.

To enable these extended ranges shielded connectors are required to minimise noise due to unscreened connections. The Electrometer function input is proved through two female BNC inputs on the right hand side of the Front Panel



No rear terminal functionality is available for the Electrometer Functionality

Warning - The Electrometer terminal marked Vout is capable of SOURCING 300V

Rear Panel

Power Inlet, Fuses & Voltage Selector

The power inlet of the 8100 is on the left hand side of the rear of the unit. The power inlet accepts a 3 pin C13 cable.

Below the power inlet is a fuse holder that holds the mains fuses for the unit and also provides voltage selection.

The units ON/OFF switch is contained within the integrated power inlet.

Warning : When replacing the fuse holder ensure that the orientation is for the appropriate mains input voltage. Failure to do so could result in damage to the instrument

Note : Any mains cable connected to the 8100 should have its earth pins connected to ground. Failure to do so could result in damage to the instrument

LAN Interface

The instruments LAN interface for remote control over Ethernet.

USB Interface

The instruments USB interface for remote control over USB. The 8100 will appear to the computer as a RS232 port for easy use in software, and is automatically detected by ProCal.

RS232 Interface

The Instruments RS232 interface for remote control over RS232 / Serial.

Note : The Instrument uses a straight through RS232 connection. The instrument will not communicate if a Null Modem cable is used

GPIB Interface

The Instruments GPIB interface for remote control over GPIB. The instruments GPIB interface is set via the front panel

Serial Number

The rear panel of the instrument is fitted with a label including the Serial Number of the unit

Rear Panel Inputs (8104 only)

The Instruments rear panel inputs are accessible at the rear right of the unit.

Note the orientation of terminals prior to making connections.

Current Fuses

Two fuses are provided for protection of current ranges below 1A. These fuse holders are opened with a flat bladed screwdriver.

Note : Take care not to damage the fuse holders using too small a screwdriver.

Power On Defaults

When power is applied to the multimeter and the mains input switch is in the ON position the multimeter will initiate power up. The multimeter takes approximately 1 minute to power on from an OFF condition.

The multimeter will power on with the following settings :

- **Function : DC Voltage**
- **Range : 1kV**
- **Auto Range : Off**
- **Resolution : 7 Digits**
- **Filter Speed : 1 Second**
- **Maths : Off**
- **Trigger Mode : Auto**
- **Input : Front Terminals**
- **Guard Configuration : Open**

Any Display Elements that have been configured by the user previously will automatically be applied on power up.

Menus

The 8100 Series features a fully featured menu system, with key operations accessible without entering a password. For advanced setup functions (such as entering calibration mode, adjusting date and time and system parameters) the system password must be entered to allow access.

Main Menu

The Main Menu is accessed by pressing the MENU key. The Main Menu consists of a scrollable menu with menu options that either perform dedicated functions or allow access to further sub menus.

For clarity the Main Menu is organised alphabetically.

CALIBRATION

Provides access to the Calibration Menu as described further in this chapter. Access to the Calibration Menu requires the system password to be entered.

COUPLING

Provides access to the COUPLING menu. The coupling menu allows selection of either AC Coupled (Default) or DC Coupled measurements when in AC Functions such as AC Voltage

DEFAULTS

Resets the multimeter to factory defaults (equivalent to RESET command) as well as restore all user configurations to factory default. This does not affect calibration or user configured PRT probes, however will reset all other parameters.

This function will also reset Language, Regional Settings, Default Temperature units.

DISPLAY ELEMENT CONFIGURATION

Provides access to the Display Element Configuration menu. The Display Element menu is explained on Page 29

ERROR LOG

Provides access to the Error Log Menu

FILTER

Provides access to the Filter Menu

FREQUENCY GATE

Provides access to the Frequency Gate Menu to allow configuration of the frequency measurement method used

FUNCTION

Provides access to the FUNCTION menu (also accessible via the FUNCTION key). This menu item allows access to the PRT / RTD, Thermocouple, AC/DC Shunt and Electrometer functions

GUARD

Allows configuration of the guarding mode, either Signal Low or Open

HELP

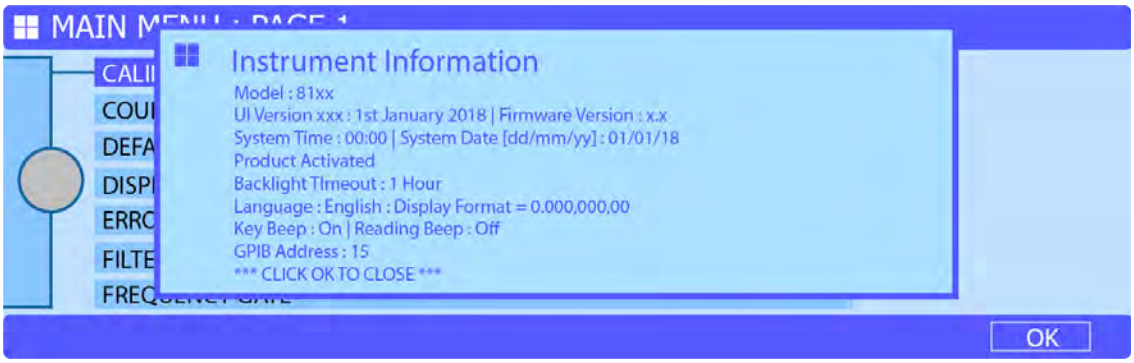
Provides an on screen hyper link to the Transmille support website (http://support.transmille.com)

INPUT

Provides access to the INPUT menu, allowing selection of FRONT or REAR Terminals.

INSTRUMENT INFORMATION

Displays information specific to the multimeter such as Serial Number, UI and PIC Version as well as displays configuration information such as current Language, Display Format etc.



INTERNAL TEMPERATURE

Displays the instruments internal temperature in °C

LIMITS

Enables configuration of PASS / FAIL limits based on the current input. Entry of HIGH and LOW limits are allowed

MATHS

Allows access to the MATHS Menu as described later in this chapter

OHMS COMPENSATION

Allows configuration of the Ohms Compensation function when in 4 Wire Resistance or performing a measurement using a 4 Wire PRT / RTD Probe

OHMS TEST CURRENT

Allows selection of the Ohms Test Current (High / Low) used for the 100 Ohm, 1k Ohm and 10 kOhm 2 and 4 Wire Resistance Functions

PRESET

Enables storing a user configured set of default conditions, as well as the recall of those settings.

Settings such as DISPLAY ELEMENTS, FILTER SPEED, OHMS COMPENSATION can be saved and recalled

To save a PRESET, configure the multimeter as required (such as Range, Resolution etc.) and navigate to the PRESET menu. Once in the preset menu select the STORE PRESET option. This will overwrite existing settings and store the new configuration.

To recall a PRESET, navigate to the PRESET menu and select the RECALL PRESET. The multimeter will return to the stored PRESET.

The default PRESET configuration will reset the multimeter to power on defaults

Note - As of UI Version 1.0.8 this functionality is under development. Free of charge updates will be released to add this functionality

RATIO CONFIGURATION

Allows access to the Ratio Configuration menu as described on Page 103

RESET

Resets the multimeter to power on defaults as detailed on Page 20

RESOLUTION

Allows access to the Resolution menu, in which the resolution of the current measurement can be configured

SELF TEST

Performs a self test of the multimeter and returns with PASS or FAIL. In the event of a FAIL result an error code will be provided

SHUNT CONFIGURATION

This menu provides access to the shunt configuration menu as described on

SPECIFICATION CONFIGURATION

Allows access to configure the specification that the unit uses to calculate the accuracy of the current measurement. This menu option allows users to select from the 90 Day, 180 Day, 1 Year or 2 Year specifications as well as choose the TCal (Temperature difference from calibration) allowance that the unit is operating to. This menu also allows the user to configure if the specification is displayed in measurement units (i.e. V) or as ppm or %

TEMPERATURE UNITS

Allows configuration of the default Temperature Units. The 8104 supports °C, °F and Kelvin.

This setting will be stored by the multimeter and become the new default, even after a reset.

TRIGGER MODE

Allows access to the Trigger Mode menu. The current trigger mode of the multimeter can be configured between AUTO TRIGGER in which measurements are performed constantly, or MANUAL TRIGGER where a single measurement is performed

UNCERTAINTY CONFIGURATION

Allows access to configure the uncertainty calculation configuration menu. This menu allows configuration of the number of samples that the noise and flicker (standard deviation) is based on, the confidence interval (95% or 99%) as well if the uncertainty is displayed in measurement units (i.e. V) or as ppm or %

Configuration Menu

The configuration menu provides access to multimeter configuration settings that are protected by a user configurable password.

To enter the configuration menu, press the CONFIG soft key or CONFIG key and enter the system password via the keyboard entry menu

Valid password entry is confirmed via a on screen message, after which the configuration menu will be accessibly by pressing the CONFIG soft key or CONFIG key.

Invalid password entry receives an error message on the screen and the entry to the configuration menu is disabled

DATE & TIME

Note - The Date & Time menu is only accessible on units that are fully activated

The Date and Time menu allows users to update the internal Date and Time on the multimeter.

To configure either option, select the appropriate option from the menu and update the settings from the menu.

Note - Date & Time must be entered in the format displayed on the screen.

FIRMWARE UPDATE [VIA USB DEVICE PORT]

The 8100 series features user update-able firmware to add new features and resolve issues without the need to return to a service centre.

Selecting the FIRMWARE UPDATE [VIA USB DEVICE PORT] will trigger an update sequence that will copy new system files from a USB Pen Drive connected to the front panel USB port

USB Drives must be formatted as FAT32 and have all other files removed prior to placing update files onto the root of the drive (i.e. not within any folders unless instructed). Update packages consist of a file called 8100 Update.exe as well as ancillary files with the .8100 extension when

required.

During an update a window indicating progress will appear as in the below image

Upon removal of the USB drive the multimeter will reset

Note - It is normal for the screen to turn off during the reset

Note - Please consult the following website prior to applying updates to ensure that your hardware / low level firmware revision is compatible prior to performing an update - http://support.transmille.com/solution/articles/9000143946

REGIONAL SETTINGS

The REGIONAL OPTIONS menu enables configuration of the display language of the multimeter as well as configuration of the Number formatting used on the display

To change Language, select the LANGUAGE option from the menu and then select the desired language from the list of available languages. The multimeter will update the language

Note - After changing the language the multimeter will need to be reset for all menus to update

There are 3 numerical display formats available :

- 0.000,000,00
- 0.000 000 00
- 0,000 000 00

To change the display format, select the SET DISPLAY FORMAT menu option and then select the desired formatting from the list.

REMOTE INTERFACE SETTINGS

The REMOTE INTERFACE menu option provides access to the remote interface menu.

Within this menu the multimeter GPIB address can be changed. To change the GPIB address, select the menu item and then enter the new GPIB address via the numerical keyboard entry window. On pressing ENTER a confirmation message will appear to confirming that the GPIB address has been changed.

SCREEN SAVER TIMEOUT

The SCREEN SAVER TIMEOUT menu option provides access to the available screen saver timeout period. To change the screen saver timeout, select a new option from the list and select the menu item.

SOUND

The SOUND menu option provides access to the Sound menu. In this menu the Key Beep and Reading Beep can be enabled or disabled.

SYSTEM PASSWORD

The SYSTEM PASSWORD menu allows users to update the system password.

The system password can consist of Letters and Numbers.

To set a new password, select the menu item and enter the new password using the on screen keyboard. On pressing the ENTER soft key a confirmation message will appear confirming that the system password was changed

Note - If the system password is forgotten Transmille can be contacted at support@transmille.com to request a master password which can be used to reset the user password back to default

Calibration Menu

The CALIBRATION MENU allows access to the calibration functions of the unit to perform adjustments.

CALIBRATION MODE

This menu option provides two purposes. Firstly it provides the option to either ENTER or EXIT calibration mode, allowing or preventing adjustments from being made. The second function is

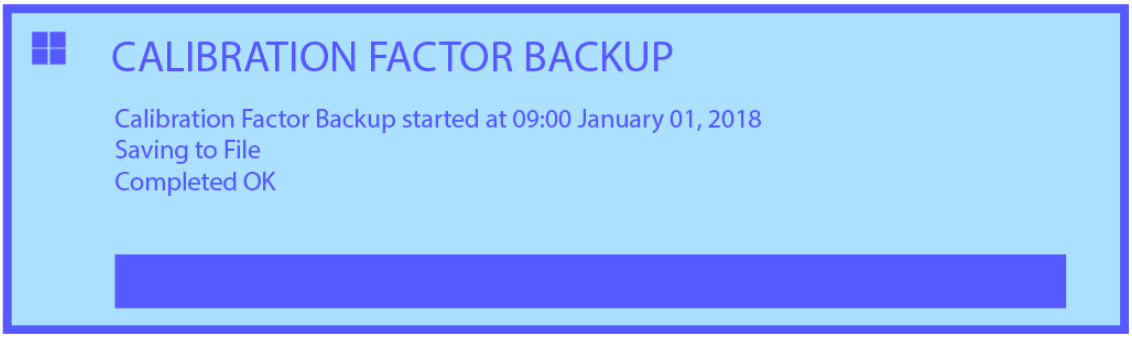
to indicate the current state of calibration mode.

If Calibration Mode is ENABLED the menu item will display CALIBRATION MODE [ON], where as if Calibration Mode is DISABLED the menu item will display CALIBRATION MODE [OFF]

BACKUP CALIBRATION FACTORS

This menu item allows the user to backup calibration factors, ideally prior to making adjustments or after a known good calibration has been performed.

After selecting this menu a message will appear indicating the a backup is currently being performed



Once the Calibration Factors have been backed up a final message will appear to indicate success, and then the menu will be accessible again.

Note - During a calibration factor backup the keyboard will be inoperable and the unit will not respond to commands over the interface

RESTORE CALIBRATION FACTORS

In the event of a miss-adjustment or a desire to return to factory calibration factors is desired, the RESTORE CALIBRATION FACTORS menu provides access to a list of all previously stored calibrations.

Select the desired backup from the list and press SELECT.

The unit will then restore calibration factors from the selected backup.

Display Element Configuration Menu

The Display Element Configuration menu allows the selection of up to 4 Display Elements to be displayed on the screen simultaneously through selection of the desired elements

Presently active Display Elements are indicated with “>>” in front of the menu item

To enable a display element, navigate and the desired menu item. The desired option will have “>>” appended to the front to indicate that this Element is now active.

To disable a display element, select a menu item with “>>” in the name. The “>>” will be removed and the element de-activated.

A maximum of 4 Elements can be configured at any one time, if more than 4 are selected an error message will appear when selecting the 5th.

Further information regarding the Display Elements functionality can be found on Page 11

Performing Measurements

General Guidelines

The 8100 Series is a high precision device and is designed for precision measurements. The user should take care of all maximum input ratings to avoid overloading the instrument.

Although the multimeter is designed with input protection on all inputs, overloading the inputs may result in incorrect readings or even permanent damage. For example, if a DC Voltage range is overloaded, a protection circuit ensures that the precision amplifier is not damaged by sinking the excess signal into protection resistors. This excess heat can cause errors in measurements even after the overload has been remove due to self heating in the protection circuits. This is typical of all precision equipment.

The instrument should be used for appropriate measurements, for example if the output voltage of an insulation tester is to be measured (typically low accuracy with high levels of overshoot) a more suitable piece of test equipment should be used such as a hand held meter or high voltage probe as the accuracy of a precision multimeter is not required for this measurement.

Note : When changing function, ensure that any active inputs to the multimeter are placed into standby.

Measurement Considerations

When performing measurements with high precision instrumentation the operator must be aware that there are many external factors that can affect the accuracy of the measurement system. Each interconnection and component of the measurement system must be used correctly to obtain

highly accurate measurements.

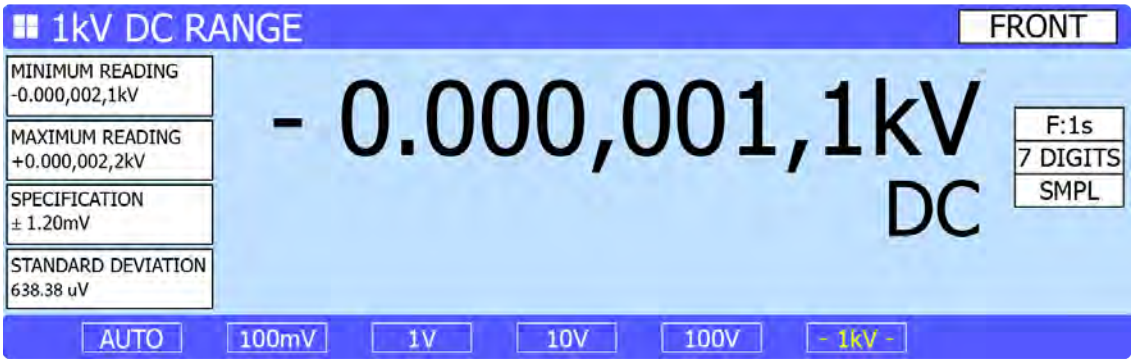
A table of measurement considerations can be found below including the measurement functions that each source of error will affect

Source Of Error	Techniques and Considerations to Minimise Errors
Thermal EMF Thermal EMF (Electro Motive Force) is the voltage that is generated when two dissimilar materials meet. For example, the interconnection of a gold plated lead to a nickel crocodile clip.	• Ensure that all connections are made from high quality, gold plated copper connectors • Minimise draughts around equipment • Try to avoid thermal gradients throughout your measurement system, i.e. do not place lead connections on top of other instrumentation • After making connections allow the measurement system to reach thermal equilibrium. • Avoid using connectors with large thermal masses as these take a long time to reach thermal equilibrium.
Lead Leakage Leakage is caused by insufficient insulation around interconnections allowing current to find alternative paths to ground. This is most noticeable when measuring high value resistance above 10 MOhms.	• When measuring high value resistance avoid the use of low cost cables. PTFE cables offer high insulation resistance but are inflexible. • Ensure that interconnecting leads are clean and free of dirt and grease • Ensure that surfaces of measuring equipment / UUT's are clean • The use of screened cables (i.e. BNC) increases the insulation resistance from the conductor to leakage paths
Electrical Noise Electrical noise can be picked up in measurement systems that are in electrically noisy environments.	• Avoid leads that are longer than necessary. • Use screened leads for low level (< 1V / 1mA) as this provides additional noise rejection • If screened leads are not available, twist leads together to reduce pickup
Lead Resistance Excessive lead resistance can cause voltage drop along the length of cable. This can cause issues when measuring sources with high output impedance, such as voltage dividers or KVD's.	• Ensure that leads of suitable thickness/ construction are used when measuring high currents. This also reduces self heating in the wires • Keep all leads as short as possible to minimise the risk of lead resistance.

DC Voltage

The 8100 Series can be used to measure DC Voltages from 0V to ± 1000V. Measurement capability is provided on Front and Rear (8104 only) terminals.

To enter DC Voltage mode, press the DC Voltage key from the function section of the Keyboard. The multimeter will change to the DC Voltage function (with an audible click), and the measurement screen will update to indicate available ranges.



The bottom menu indicates the current range by highlighting the text in YELLOW. The current range is also displayed in the top bar.

Selecting A Range

The Range menu is the default menu, and is accessed by pressing the DCV key or waiting for the sub menu to close automatically.

Selecting a range is performed by pressing the BLUE soft keys at the bottom of the screen. Pressing a the key directly under the text on the screen will set the range.

To configure the multimeter to auto range, press the AUTO soft key (left most key). The multimeter will automatically select the most appropriate range for the measurement, however it is best practice that when measuring voltages greater than 10V to manually select the range prior to applying any voltage.

Measurement Resolution

Pressing the DIGITS key will display the resolution menu. The resolution menu shows the available resolutions for the function, up to 8 Digits (8104) / 7 Digits (8109).

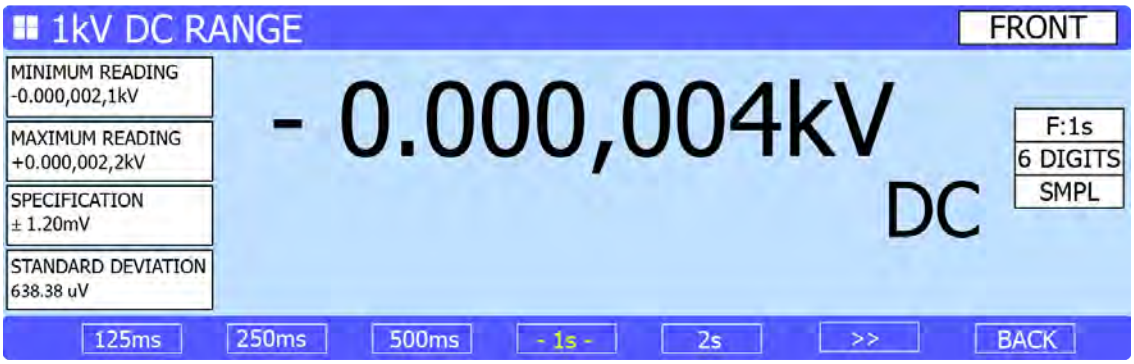
To select the desired resolution, press the BLUE soft key under the desired resolution.

Note - The measurement speed is limited by the resolution of the measurement. The higher the resolution of the measurement, the longer each measurement sample will take.

Configuring Sample Rate

Pressing the 'FILTER' key will display the filter speed menu. The filter menu shows the available measurement speeds for the configured measurement resolution and range

NOTE : Faster sample speeds will result in a higher standard deviation due to fewer samples making each individual measurement



To select the desired filter speed, press the BLUE soft key under the desired selection.

Note - The filter speeds available are dependant upon the current resolution. Refer to extended specifications for valid resolution and filter speed settings.

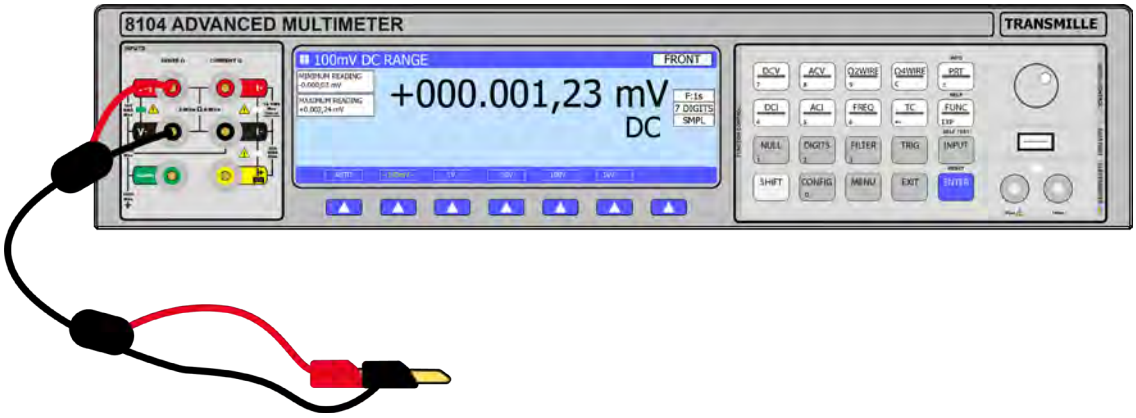
Performing A Null

Performing a Null or Zero is an important part of preparing for a DC Voltage measurement. It is quite normal for a measurement system to display an offset if a zero has not been performed that will

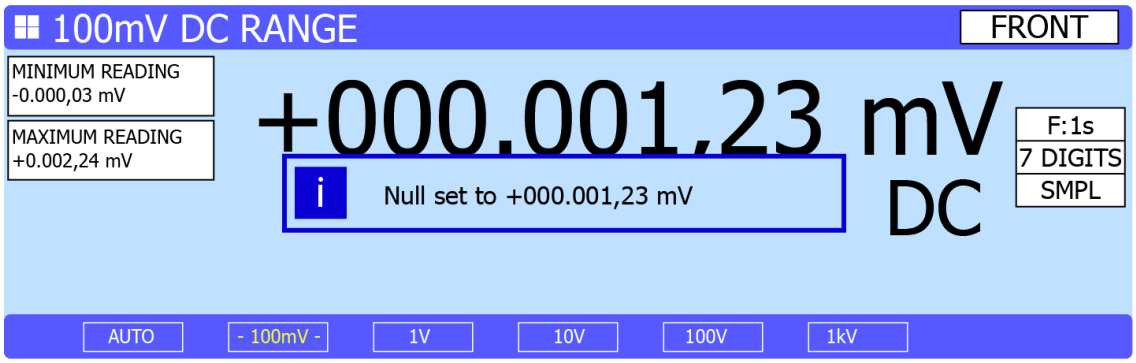
cause all measurements to be incorrect.

The process of performing a zero removes any pre existing voltage offsets from interconnections so that the multimeter indicates only the input signal rather than the input signal and voltage offsets.

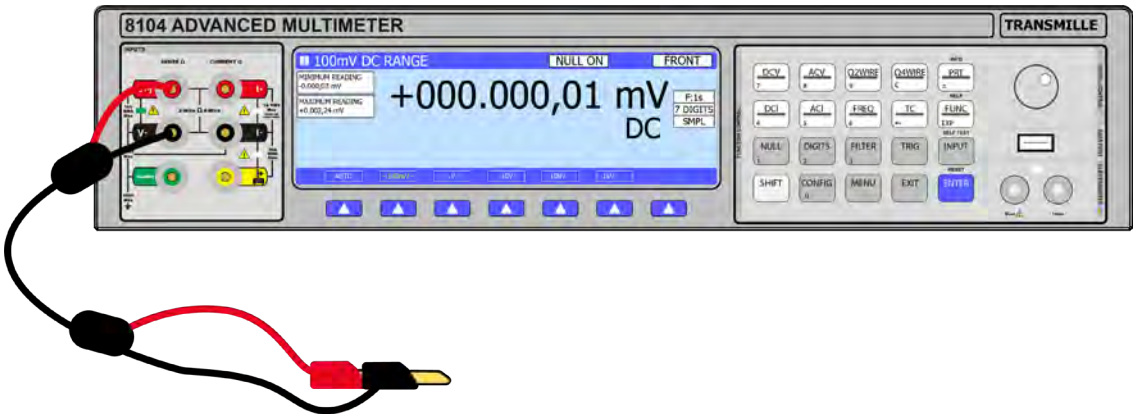
To perform a Null, it is standard practice to short out your interconnecting leads/wire at the point of connection with the source / device to be measured. The included leads feature stackable connections, and should be plugged into one another at the opposite end to the multimeter and allowed to stabilise after handling. It is important to note that if leads are taken from a warm area (for example resting on top of the instrument) they will require additional time to stabilise to the environment



After allowing the connections to stabilise, press the ‘NULL’ button on the front panel (or via remote command). A message will display on the multimeter indicating that a Null has been stored



After a Null has been performed the status bar at the top of the screen will display ‘NULL ON’ to indicate that a Null is presently active



When measuring devices that are specified as ‘relative to zero’, the zero should be performed with leads connected to the source and the multimeter nulled to the zero output of the source.

Example Connection

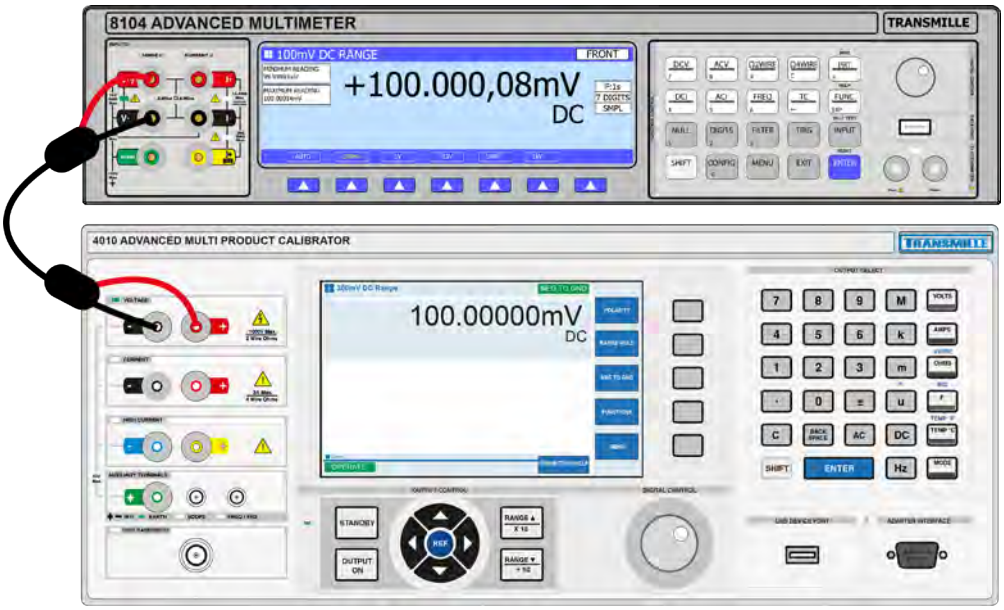
Connections via the front panel terminals should be made to the V+ (Red Insert) and V- (Black Insert) binding posts. Connection via the rear panel terminals should be made to the V+ (Red) and V- (Black) terminals.

Care should be taken to ensure that all connecting leads have are clean prior to inserting into the binding posts to avoid errors due to thermals in connections.

WARNING - Ensure that binding posts are fully tightened when performing measurements > 10V and that no contact is made to binding posts while voltage is present. Lethal voltages may be present at the input connectors

For the best measurement low thermal leads (such as those provided in the 8100LEAD kit) should be used while measuring DC Voltage. The leads feature low thermal gold plated copper 4mm banana jacks especially designed for precision DC Voltage, and the lead is of screened construction to

offer rejection of interference / noise

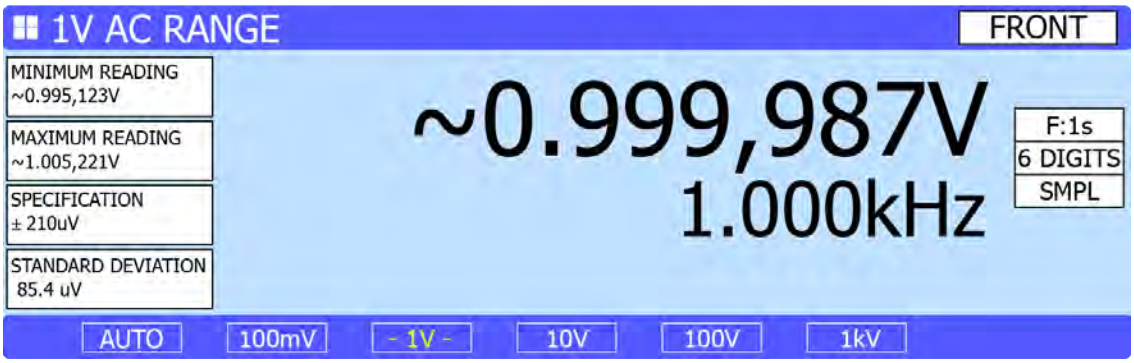


AC Voltage

The 8100 Series can be used to measure AC Voltage from 10 mV to 1000V at frequencies from 10Hz to 1MHz. Measurement capability is provided on Front and Rear (8104 only) terminals.

To enter AC Voltage mode, press the AC Voltage key from the function section of the Keyboard. The multimeter will change to the AC Voltage function (with an audible click), and the measurement screen will update to indicate available ranges. The multimeter will also change to auto range mode

After the multimeter has determined the frequency of the applied signal the frequency will be displayed under the main reading



The bottom menu indicates the current range by highlighting the text in YELLOW. The current range is also displayed in the top bar.

Selecting A Range

The Range menu is the default menu, and is accessed by pressing the ACV key or waiting for the sub menu to close automatically.

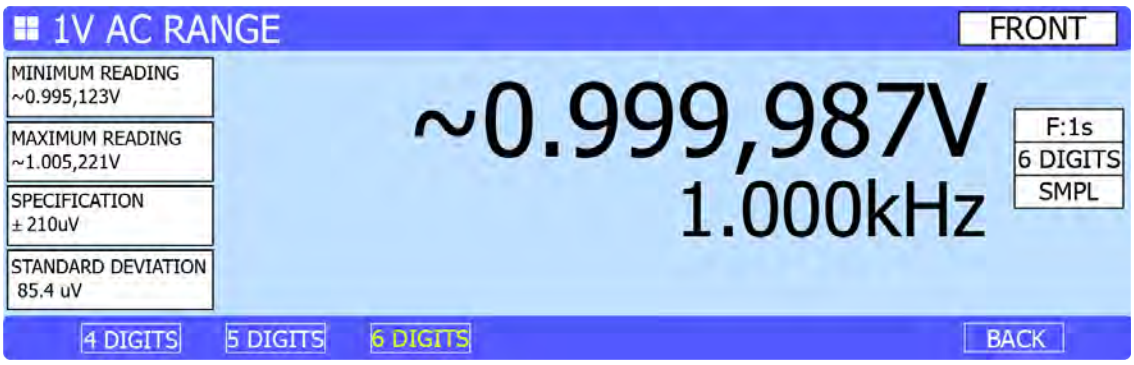
Selecting a range is performed by pressing the BLUE soft keys at the bottom of the screen. Pressing a the key directly under the text on the screen will set the range.

To configure the multimeter to auto range, press the AUTO soft key (left most key). The multimeter will automatically select the most appropriate range for the measurement, however it is best practice that when measuring voltages greater than 10V to manually select the range prior to applying any voltage.

Measurement Resolution

Pressing the DIGITS key will display the resolution menu. The resolution menu shows the available resolutions for the function, up to 6 Digits when in an AC Function (equating to 1ppm

resolution at full scale)



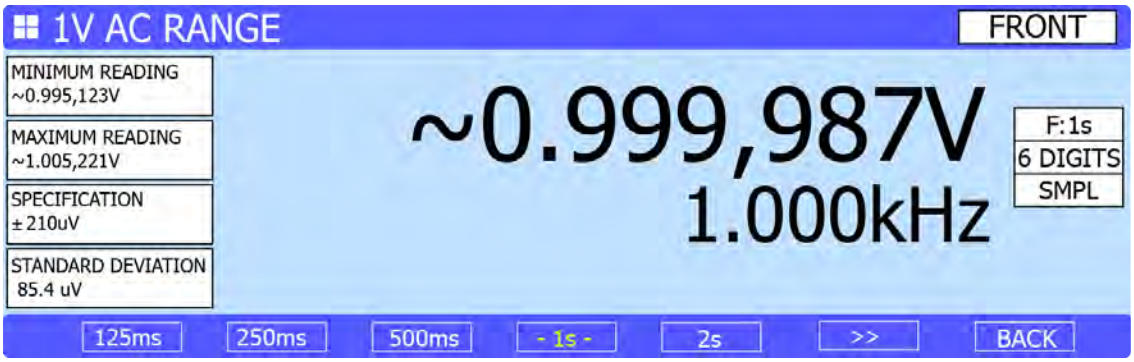
To select the desired resolution, press the BLUE soft key under the desired resolution.

Note - The measurement speed is limited by the resolution of the measurement. The higher the resolution of the measurement, the longer each measurement sample will take.

Configuring Sample Rate

Pressing the 'FILTER' key will display the filter speed menu. The filter menu shows the available measurement speeds for the configured measurement resolution and range

NOTE : Faster sample speeds will result in a higher standard deviation due to fewer samples making each individual measurement



To select the desired filter speed, press the BLUE soft key under the desired selection.

Note - The filter speeds available are dependant upon the current resolution. Refer to extended specifications for valid resolution and filter speed settings.

Selecting Frequency Gate

The 8100 series offers two frequency measurements modes. The default setting is a FAST frequency measurement circuit that reacts to changes in frequency rapidly and offers 0.1Hz resolution after 5 successive samples of the same input frequency. This is the default setting and allows fast

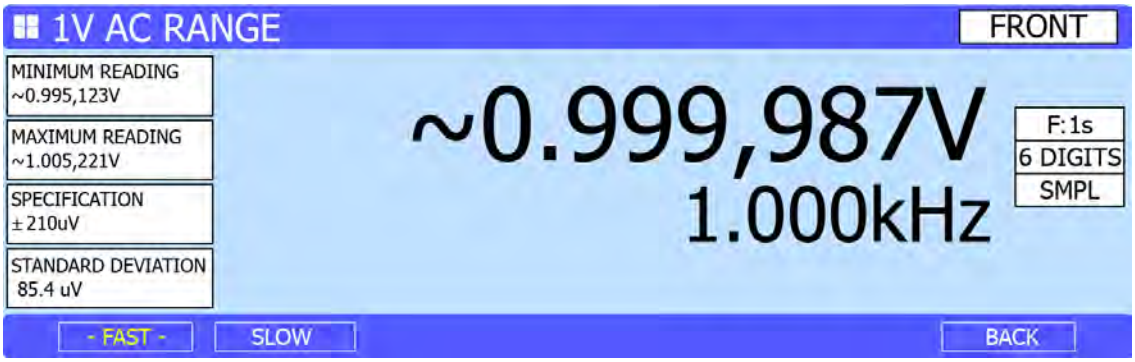
settling of readings.

To measure the input frequency with more resolution there is also a SLOW gate time which performs a reciprocal count of the input frequency compared to the internal frequency reference. This mode provides higher frequency resolution however is less reactive to changes in frequency.

To select the GATE speed, press the CONFIG button and select the GATE soft key.

Selecting the SLOW gate speed will highlight the SLOW menu item in Yellow and return to the main screen. After a few samples a high resolution frequency count will be displayed.

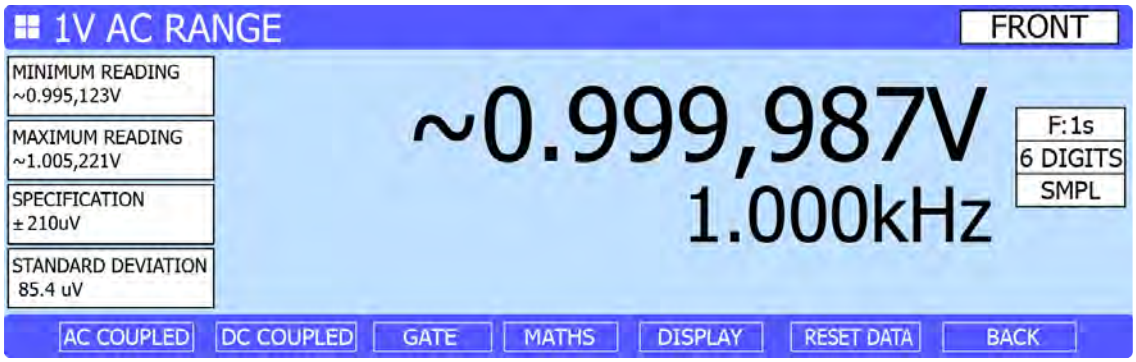
To return to the FAST gate mode, enter the CONFIG menu and select the GATE key again. Then press the FAST soft key. After a few samples the default frequency resolution will be displayed



Note - The SLOW gate is intended for measurement of frequencies below 10 kHz

Configuring AC / DC Coupling

Pressing the ‘CONFIG’ key will display the configuration menu. The configuration menu gives access to the coupling configuration of the AC Voltage function.

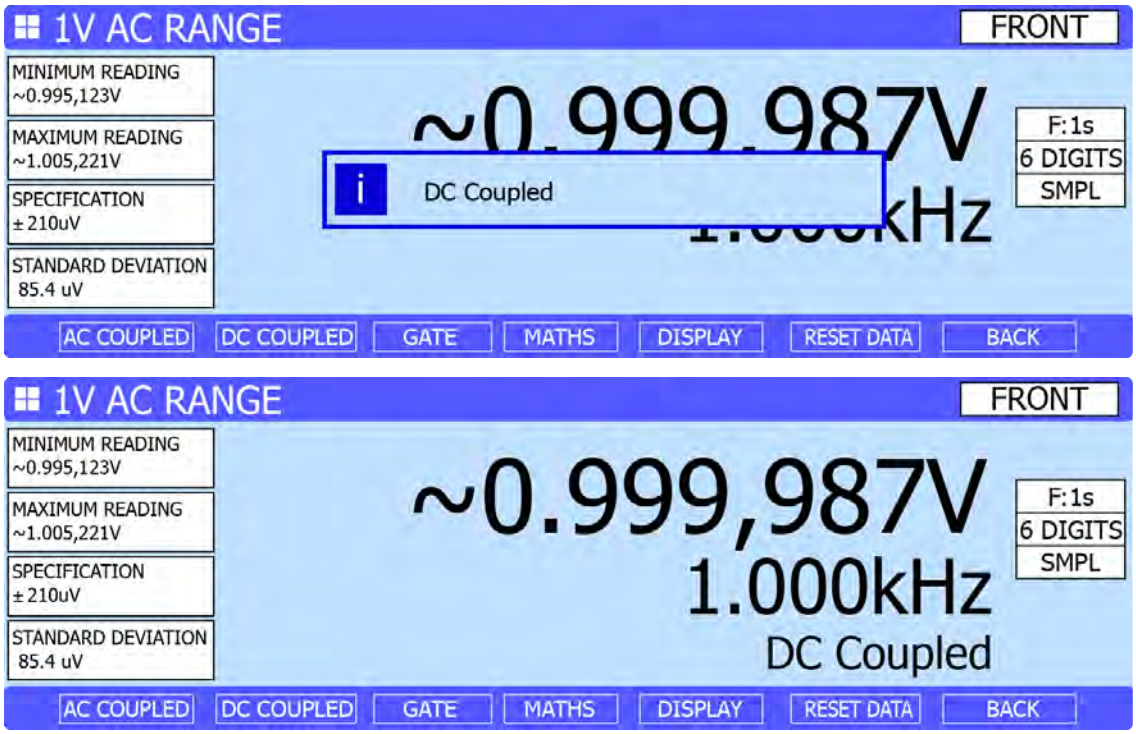


The default state for AC Voltage measurement is AC Coupled, so only AC components of the signal are measured, however in some cases it may be desirable to incorporate the DC offset into the measurement, especially when measuring signals below 10Hz.

Note : When measuring AC Voltage with the 8100 Series DC Coupling is not required to achieve the published specification.

To enable DC Coupling, press the soft key labelled ‘DC COUPLED’. A message will display for approximately 1 second to indicate that DC Coupling is active, and DC Coupled will appear below

the frequency on the measurement screen



Example Connection

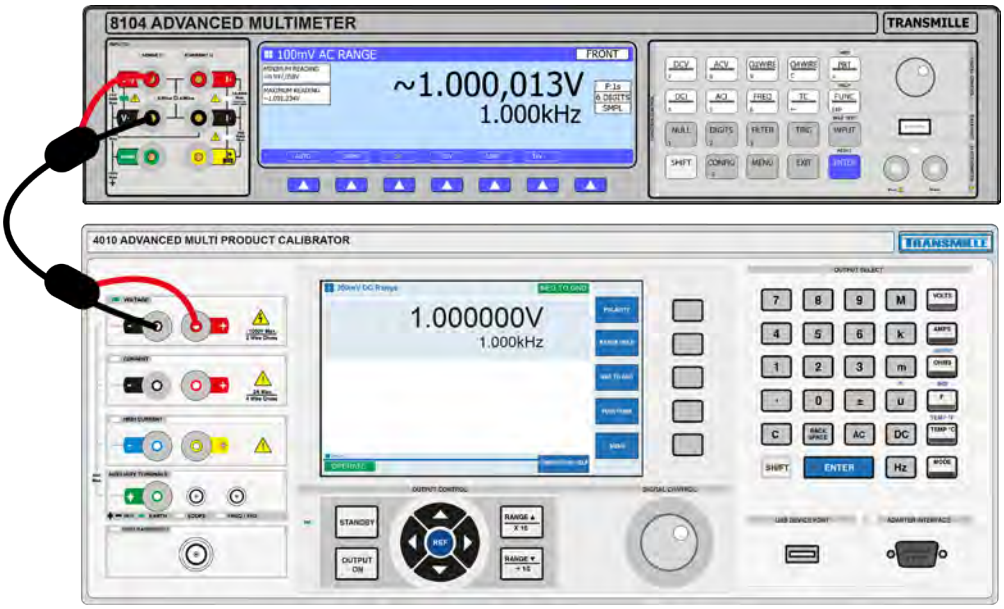
Connections via the front panel terminals should be made to the V+ (Red Insert) and V- (Black Insert) binding posts. Connection via the rear panel terminals should be made to the V+ (Red) and V- (Black) terminals.

Care should be taken to ensure that all connecting leads have are clean prior to inserting into the binding posts to avoid errors due to thermals in connections.

WARNING - Ensure that binding posts are fully tightened when performing measurements > 10V and that no contact is made to binding posts while voltage is present. Lethal voltages may be present at the input connectors

For the best measurement leads of the correct length (such as those provided in the 8100LEAD kit) should be used while measuring AC Voltage. The leads provided in the 8100LEAD kit are of coaxial construction and of 1m length that are designed to reduce the effects of leads on AC Voltage at

frequencies above 100kHz.



It should be noted that considerable errors can be caused by using leads with excessive capacitance

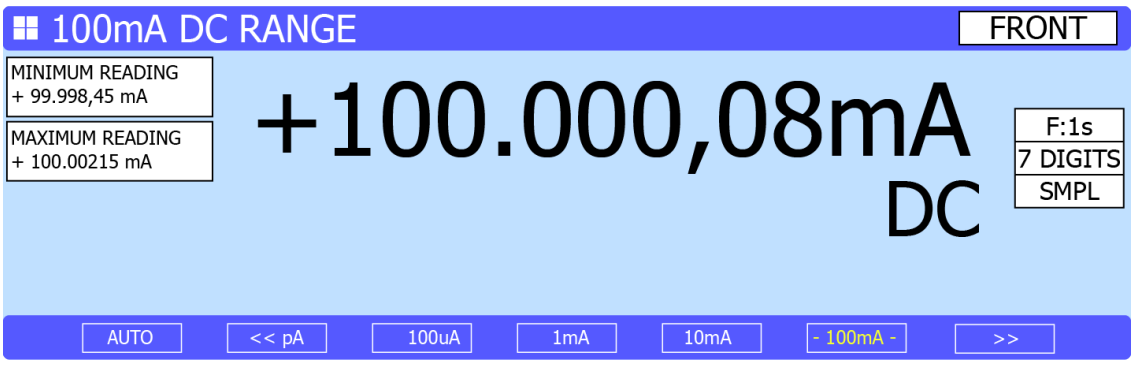
DC Current

The 8100 Series can be used to measure DC Current from 0uA to ± 30A. Measurement capability is provided on Front and Rear (8104 only) terminals.

Note - The Rear Terminals offer up to 1A Maximum current. The 10 and 30A ranges are available on the dedicated front panel terminals only

To enter DC Current mode, press the DCI key from the function section of the Keyboard. The multimeter will change to the DC Current function (with an audible click), and the measurement screen will update to indicate available ranges. The multimeter will enter Auto Range, starting with the 1A Range. The multimeter will make an audible click each time a new range is selected in DC Current

Note - The multimeter will not auto range up to the 10A and 30A Ranges as this requires a change in terminals



The bottom menu indicates the current range by highlighting the text in YELLOW. The current range is also displayed in the top bar.

Selecting A Range

The Range menu is the default menu, and is accessed by pressing the DCI key or waiting for the sub menu to close automatically.

Selecting a range is performed by pressing the BLUE soft keys at the bottom of the screen. Pressing a the key directly under the text on the screen will set the range.

The blue soft key marked with << or >> will update the range menu to show additional ranges if available. The button marked << will show ranges LOWER than currently displayed, the button marked >> will show ranges HIGHER than currently displayed

To configure the multimeter to auto range, press the AUTO soft key (left most key). The multimeter will automatically select the most appropriate range for the measurement, however it is

best practice that when measuring currents greater than 100mA to manually select the range prior to applying any input

Note - The auto range function takes approximately 0.3 seconds per range to select the most appropriate range. There is no risk to the multimeter during this auto range period however the source device may enter an overload / trip condition due to the compliance voltage across the terminals.

Measurement Resolution

Pressing the DIGITS key will display the resolution menu. The resolution menu shows the available resolutions for the function, up to 7 Digits.

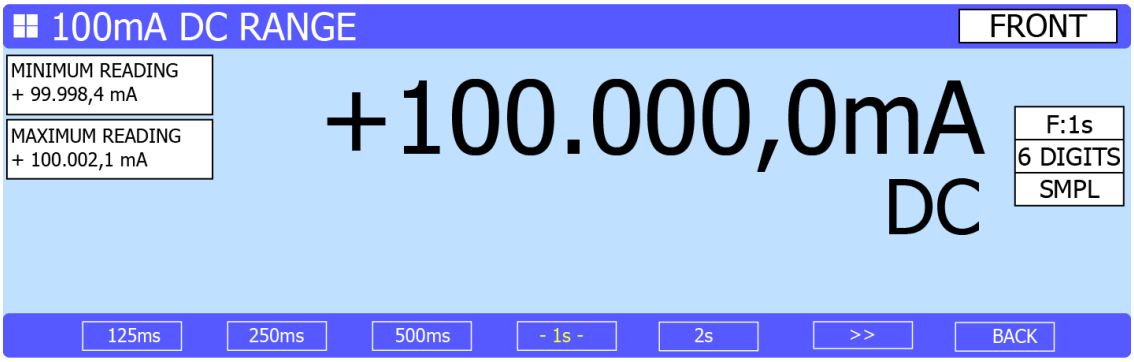
To select the desired resolution, press the BLUE soft key under the desired resolution.

Note - The measurement speed is limited by the resolution of the measurement. The higher the resolution of the measurement, the longer each measurement sample will take.

Configuring Sample Rate

Pressing the ‘FILTER’ key will display the filter speed menu. The filter menu shows the available measurement speeds for the configured measurement resolution and range

NOTE : Faster sample speeds will result in a higher standard deviation due to fewer samples making each individual measurement



To select the desired filter speed, press the BLUE soft key under the desired selection.

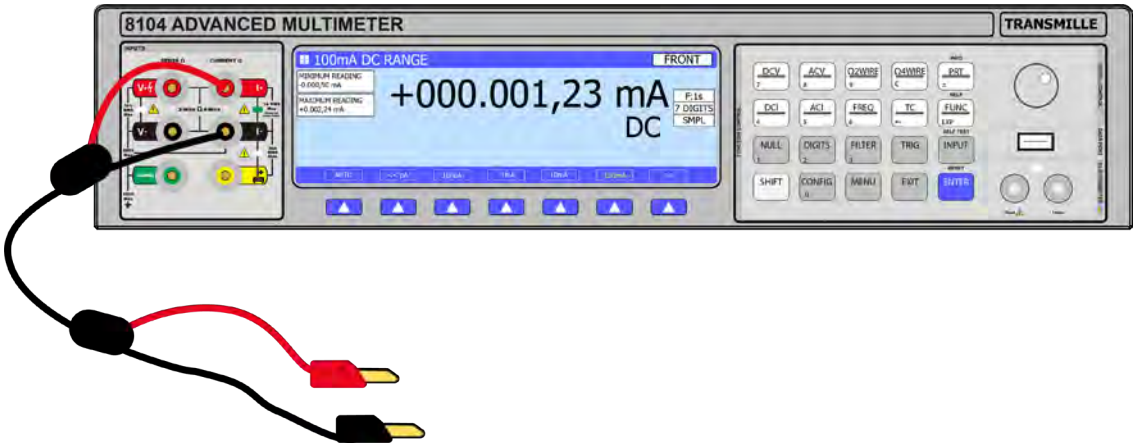
Note - The filter speeds available are dependant upon the current resolution. Refer to extended specifications for valid resolution and filter speed settings.

Performing A Null

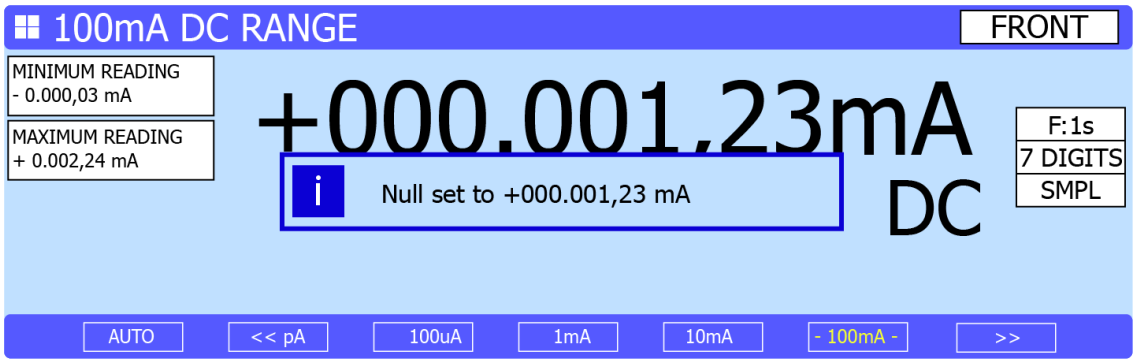
Performing a Null or Zero is an important part of preparing for a DC Current measurement. It is quite normal for a measurement system to display an offset if a zero has not been performed that will cause all measurements to be incorrect.

The process of performing a zero removes any pre existing current offsets from interconnections so that the multimeter indicates only the input signal rather than the input signal and current offsets.

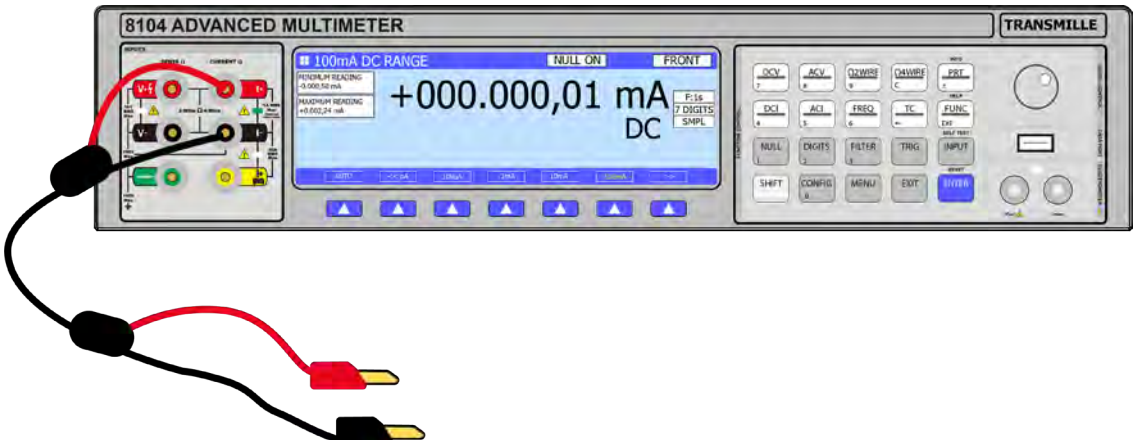
To perform a Null, it is standard practice to open circuit your interconnecting leads/wire at the point of connection with the source / device to be measured. It is important to note that some sources continue to source current even when in standby condition so it is recommended to have leads completely disconnected during the Null process.



After allowing the connections to stabilise, press the ‘NULL’ button on the front panel (or via remote command). A message will display on the multimeter indicating that a Null has been stored



After a Null has been performed the status bar at the top of the screen will display ‘NULL ON’ to indicate that a Null is presently active



When measuring devices that are specified as ‘relative to zero’, the zero should be performed with leads connected to the source and the multimeter nulled to the zero output of the source.

Example Connection

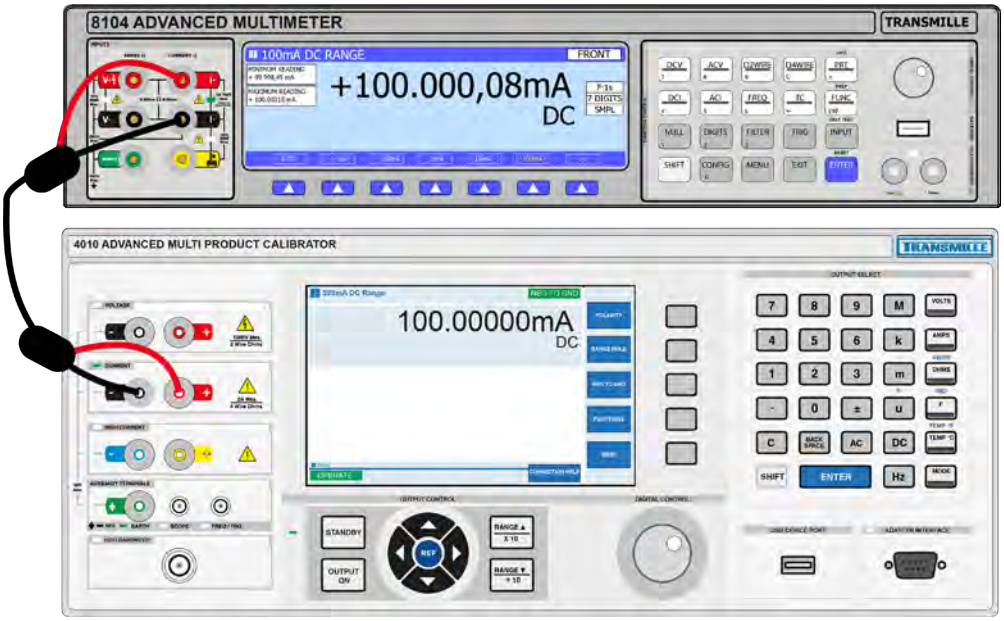
To measure current up to 1A the low current terminals should be used. Connect the source to the I+ (red insert) and I- (black insert) terminals on either the front panel or rear panel (8104 only) inputs.

For current above 1A the high current terminals should be used. Connect the source to the I+ (HI) (Yellow) and I- (black insert) terminals on the front panel.

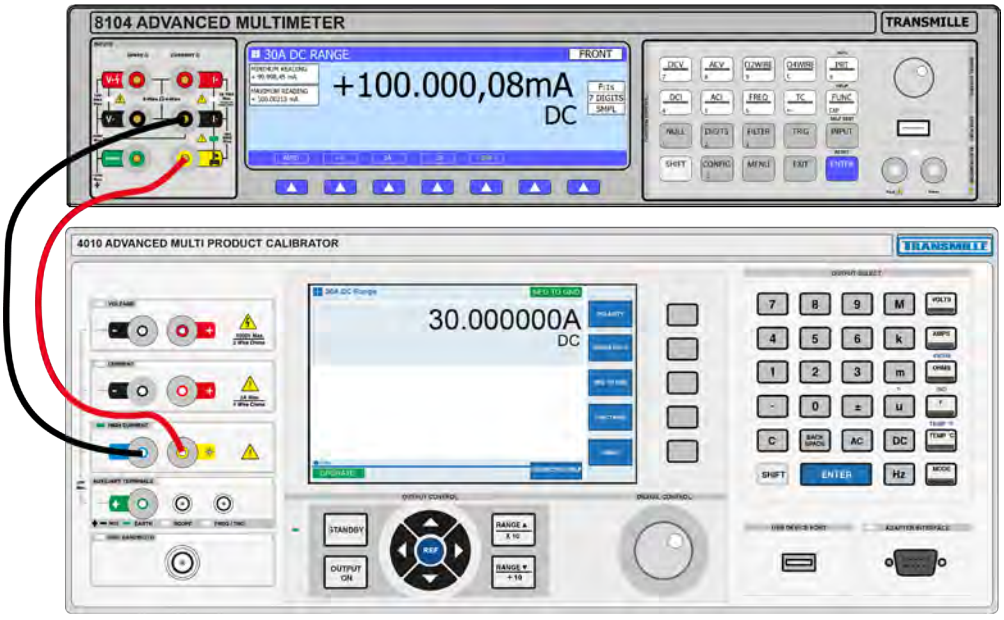
Note : When measuring High Currents make sure that suitable leads are used. Transmille supply suitable leads in the 8100LEAD set

Care should be taken to ensure that all connecting leads have are clean prior to inserting into the binding posts to avoid high contact resistance which can cause self heating increased input impedance causing some sources to reach compliance.

Connection diagram for Low Current (up to 1A)



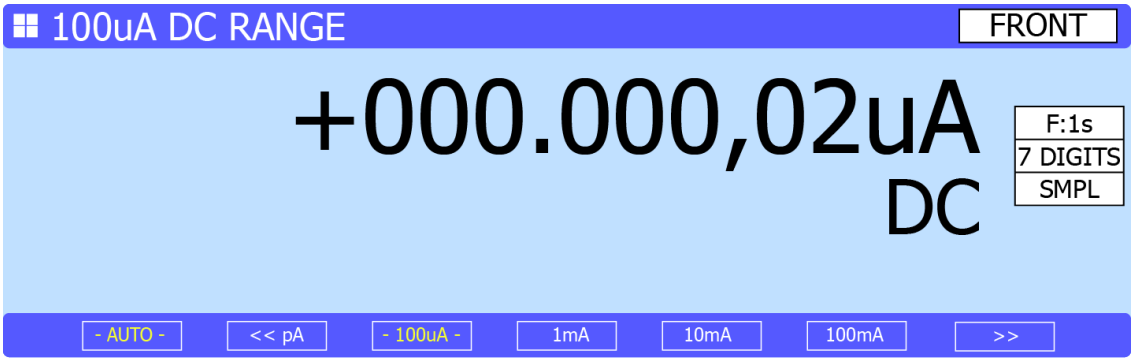
Connection diagram for High Current (above 1A)



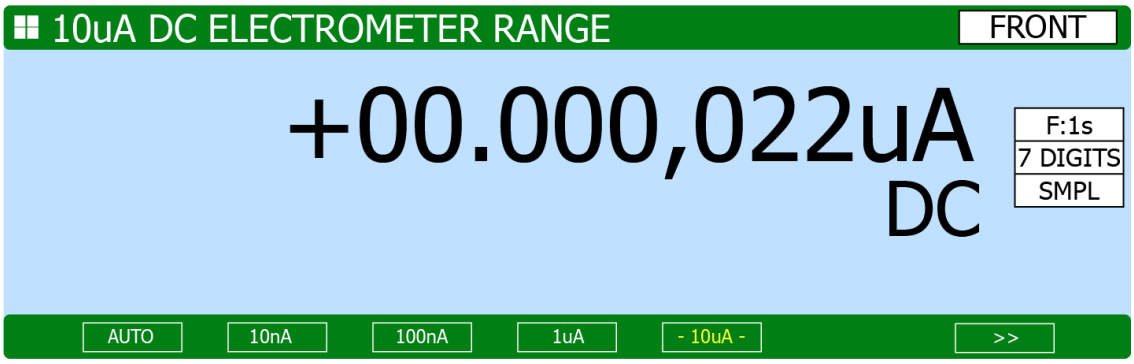
DC Current - Electrometer Input (8104 Only)

The 8104 offers low current ranges down to 10nA, offering femtoamp resolution, exceptional low noise performance low current measurement. Using the dedicated shielded BNC input the input signal is shielded from the source output through to the measurement input circuitry

To enter DC Current mode, press the DCI key from the function section of the Keyboard. The multimeter will change to the DC Current function (with an audible click), and the measurement screen will update to indicate available ranges. The multimeter will enter Auto Range, starting with the 1A Range. The multimeter will make an audible click each time a new range is selected in DC Current. To enter the Electrometer Current ranges allow the multimeter to auto range to the lowest range (100uA) and then press the << pA soft key.



The top and bottom measurement bars will change in colour to green to indicate that the electrometer input is now in use and the range selection menu will update.



The bottom menu indicates the current range by highlighting the text in YELLOW. The current range is also displayed in the top bar.

Selecting A Range

The Range menu is the default menu, and is accessed by pressing the DCI key or waiting for the sub menu to close automatically.

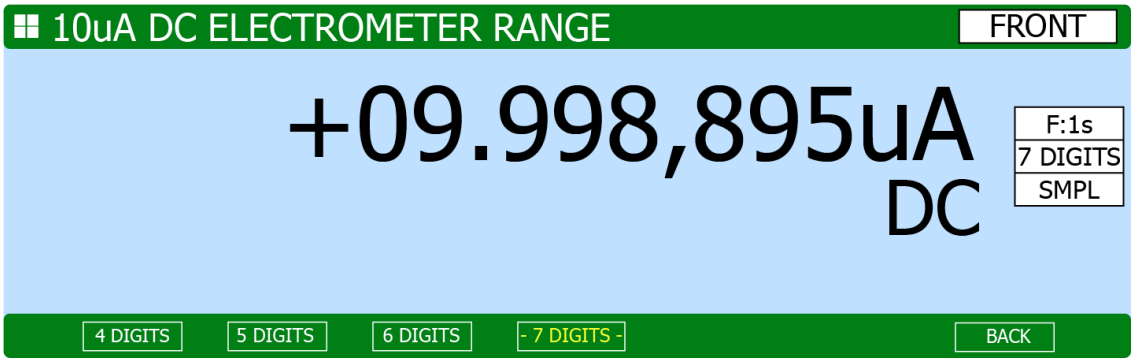
Selecting a range is performed by pressing the soft keys at the bottom of the screen. Pressing a the key directly under the text on the screen will set the range.

To configure the multimeter to auto range, press the AUTO soft key (left most key). The multimeter will automatically select the most appropriate range for the measurement.

Note - The multimeter will not auto range above the 10uA range when in Electrometer. A change of terminals is required to measure higher currents.

Measurement Resolution

Pressing the DIGITS key will display the resolution menu. The resolution menu shows the available resolutions for the function, up to 7 Digits.



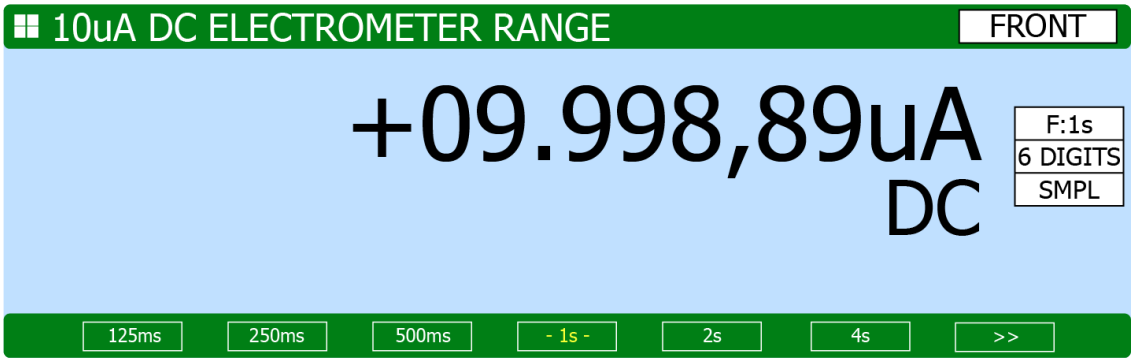
To select the desired resolution, press the BLUE soft key under the desired resolution.

Note - The measurement speed is limited by the resolution of the measurement. The higher the resolution of the measurement, the longer each measurement sample will take.

Configuring Sample Rate

Pressing the ‘FILTER’ key will display the filter speed menu. The filter menu shows the available measurement speeds for the configured measurement resolution and range

NOTE : Faster sample speeds will result in a higher standard deviation due to fewer samples making each individual measurement



To select the desired filter speed, press the soft key under the desired selection.

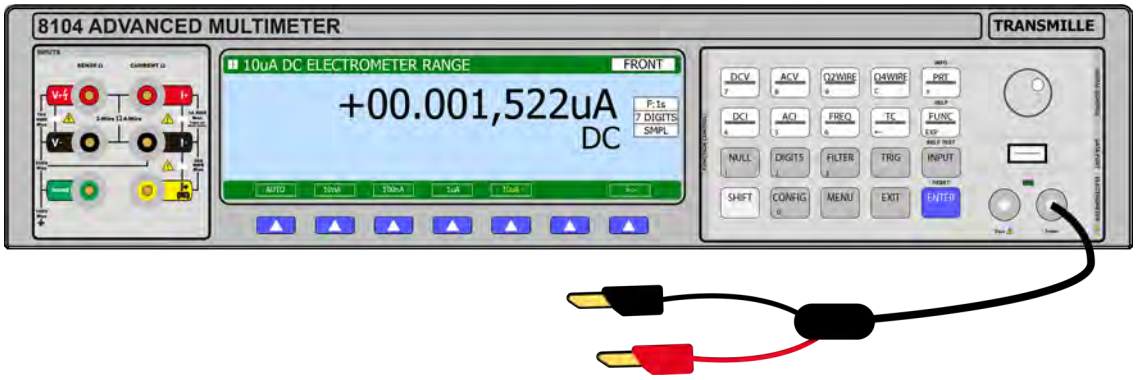
Note - The filter speeds available are dependant upon the current resolution. Refer to extended specifications for valid resolution and filter speed settings.

Performing A Null

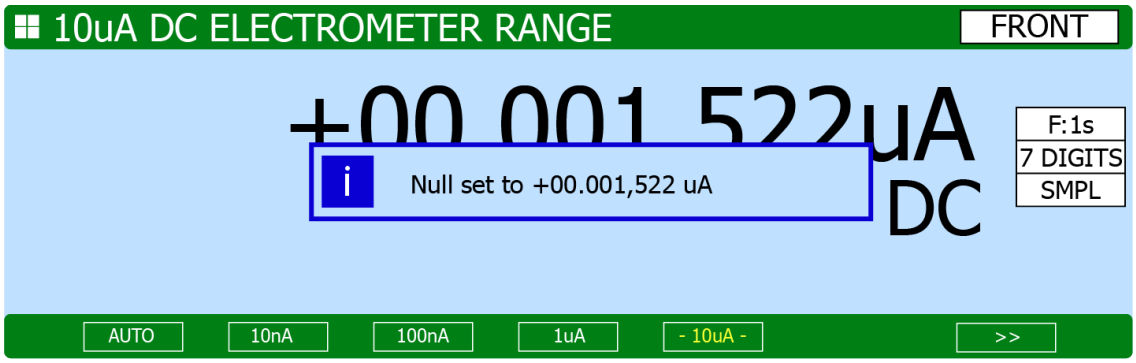
Performing a Null or Zero is an important part of preparing for a DC Current measurement. It is quite normal for a measurement system to display an offset if a zero has not been performed that will cause all measurements to be incorrect.

The process of performing a zero removes any pre existing current offsets from interconnections so that the multimeter indicates only the input signal rather than the input signal and current offsets.

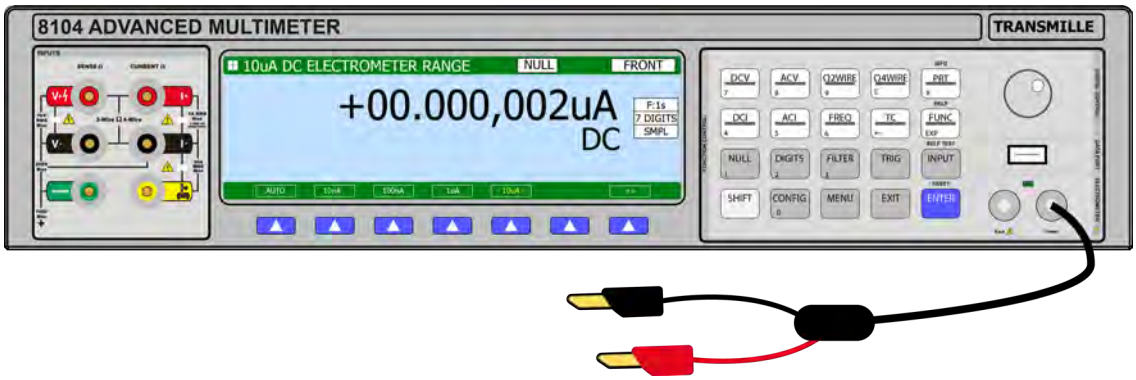
To perform a Null, it is standard practice to open circuit your interconnecting leads/wire at the point of connection with the source / device to be measured. It is important to note that some sources continue to source current even when in standby condition so it is recommended to have leads completely disconnected during the Null process.



After allowing the connections to stabilise, press the ‘NULL’ button on the front panel (or via remote command). A message will display on the multimeter indicating that a Null has been stored



After a Null has been performed the status bar at the top of the screen will display ‘NULL ON’ to indicate that a Null is presently active



When measuring devices that are specified as ‘relative to zero’, the zero should be performed with leads connected to the source and the multimeter nulled to the zero output of the source.

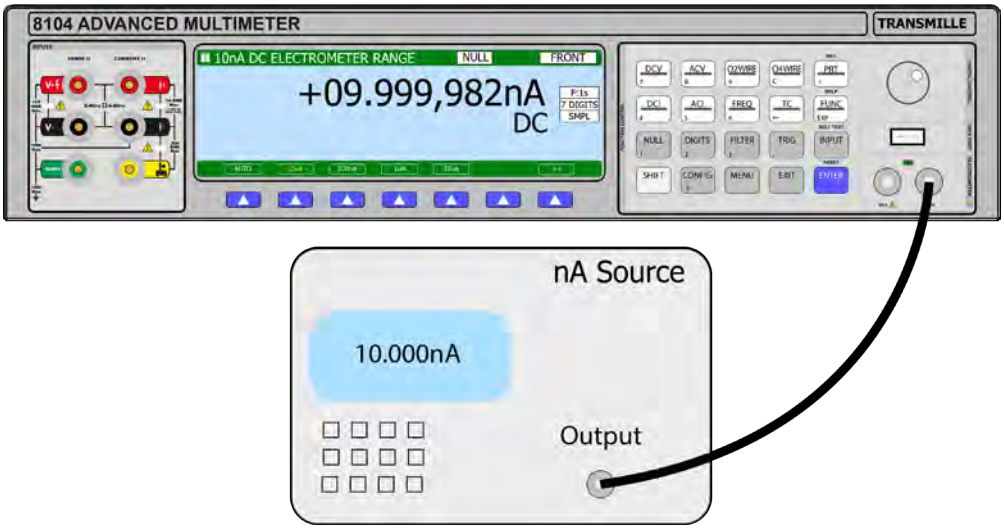
Note - When measuring nA level currents it is important to allow the measurement system to stabilise prior to performing nulls. This includes keeping leads and connections still to avoid Triboelectric effects that may cause low level offsets

Example Connection

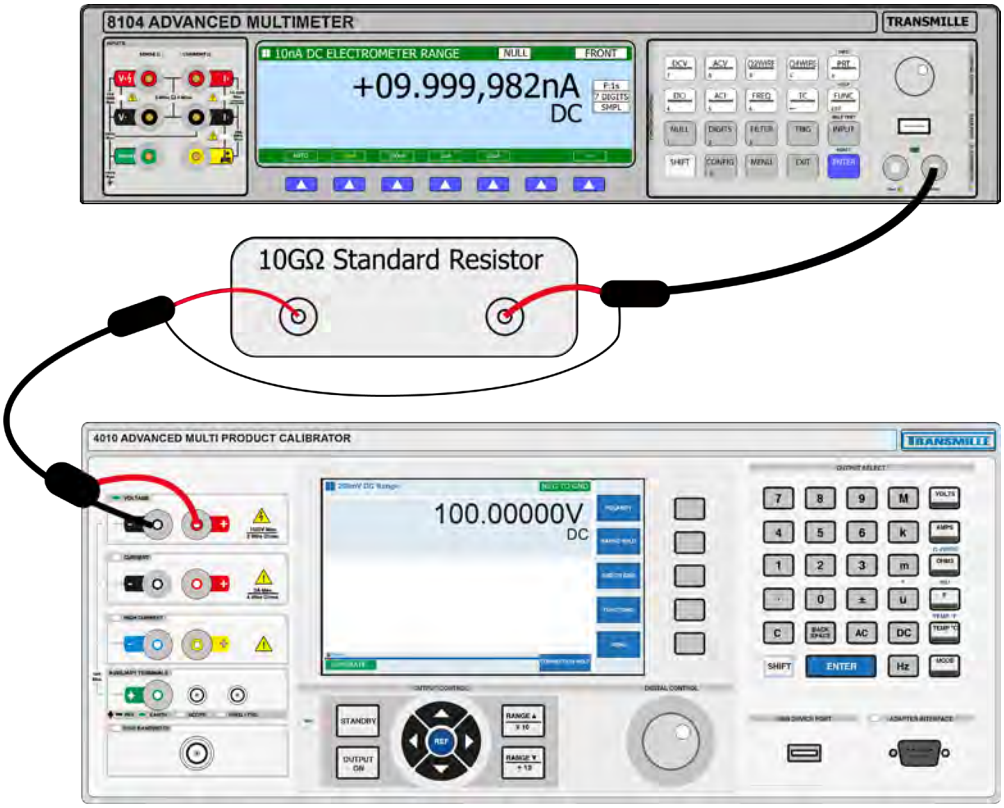
To measure current using the electrometer function a suitable lead must always be used. The BNC input is designed to have a screened lead of coaxial construction connected to ensure that both conductors are well insulated and isolated from noise.

If adapters must be used to connect to sources it is highly advised that this is performed as close to the point of connection to the UUT as possible as typically adapters (such as BNC to 4mm) are not shielded.

Note : The 8100LEAD kit provides leads and adapters that have been carefully selected to minimise errors



When using the 8104 as a low current measurement device in a circuit where high voltages are being sourced across a resistor (typically to measure High Value resistors or as part of a dual source bridge) the multimeter should be connected between the LOW of the voltage source and the LOW of the resistor.



AC Current

The 8100 Series can be used to measure AC Current from 10 uA to 30A at frequencies from 10Hz to 10kHz. Measurement capability is provided on Front and Rear (8104 only) terminals for currents up to 1A, with currents above 30A available on the front panel terminals only.

To enter AC Current mode, press the AC Current key from the function section of the Keyboard. The multimeter will change to the AC Current function (with an audible click), and the measurement screen will update to indicate available ranges. The multimeter will also change to auto range mode

After the multimeter has determined the frequency of the applied signal the frequency will be displayed under the main reading

The bottom menu indicates the current range by highlighting the text in YELLOW. The current range is also displayed in the top bar.

Selecting A Range

The Range menu is the default menu, and is accessed by pressing the ACI key or waiting for the sub menu to close automatically.

Selecting a range is performed by pressing the BLUE soft keys at the bottom of the screen. Pressing a the key directly under the text on the screen will set the range.

To configure the multimeter to auto range, press the AUTO soft key (left most key). The multimeter will automatically select the most appropriate range for the measurement, however it is best practice to manually configure ranges to avoid tripping out the current source.

Measurement Resolution

Pressing the DIGITS key will display the resolution menu. The resolution menu shows the available resolutions for the function, up to 6 Digits when in an AC Function (equating to 1ppm

resolution at full scale)

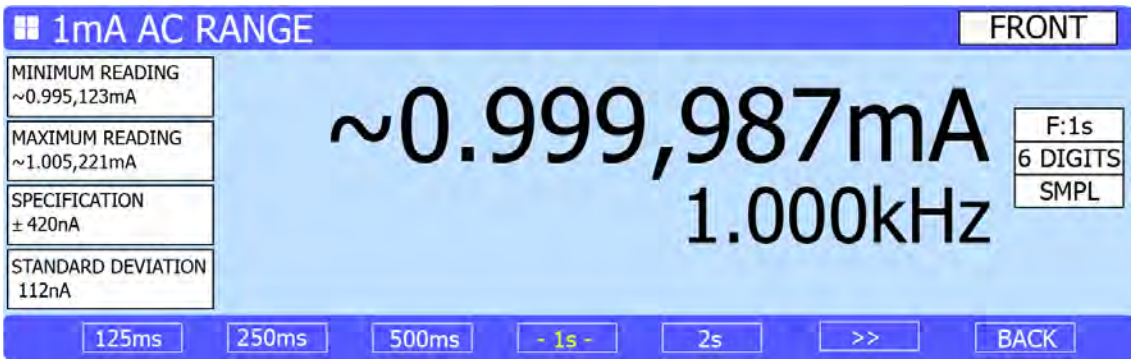
To select the desired resolution, press the BLUE soft key under the desired resolution.

Note - The measurement speed is limited by the resolution of the measurement. The higher the resolution of the measurement, the longer each measurement sample will take.

Configuring Sample Rate

Pressing the 'FILTER' key will display the filter speed menu. The filter menu shows the available measurement speeds for the configured measurement resolution and range

NOTE : Faster sample speeds will result in a higher standard deviation due to fewer samples making each individual measurement

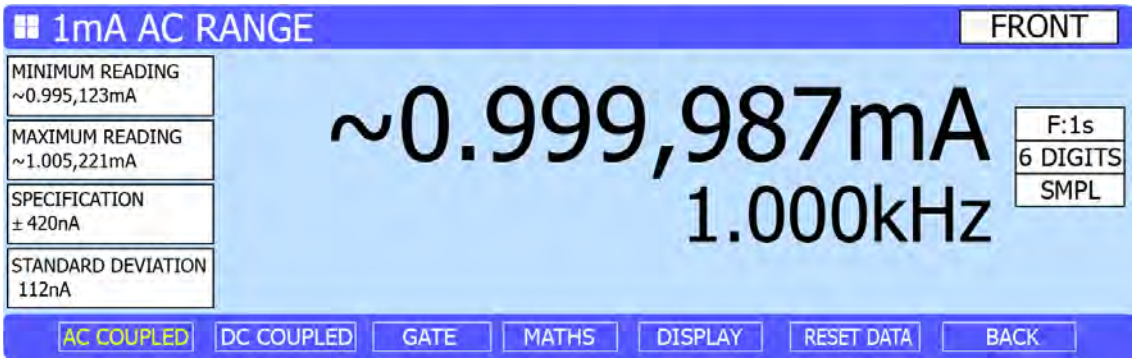


To select the desired filter speed, press the BLUE soft key under the desired selection.

Note - The filter speeds available are dependant upon the current resolution. Refer to extended specifications for valid resolution and filter speed settings.

Configuring AC / DC Coupling

Pressing the ‘CONFIG’ key will display the configuration menu. The configuration menu gives access to the coupling configuration of the AC Voltage function.

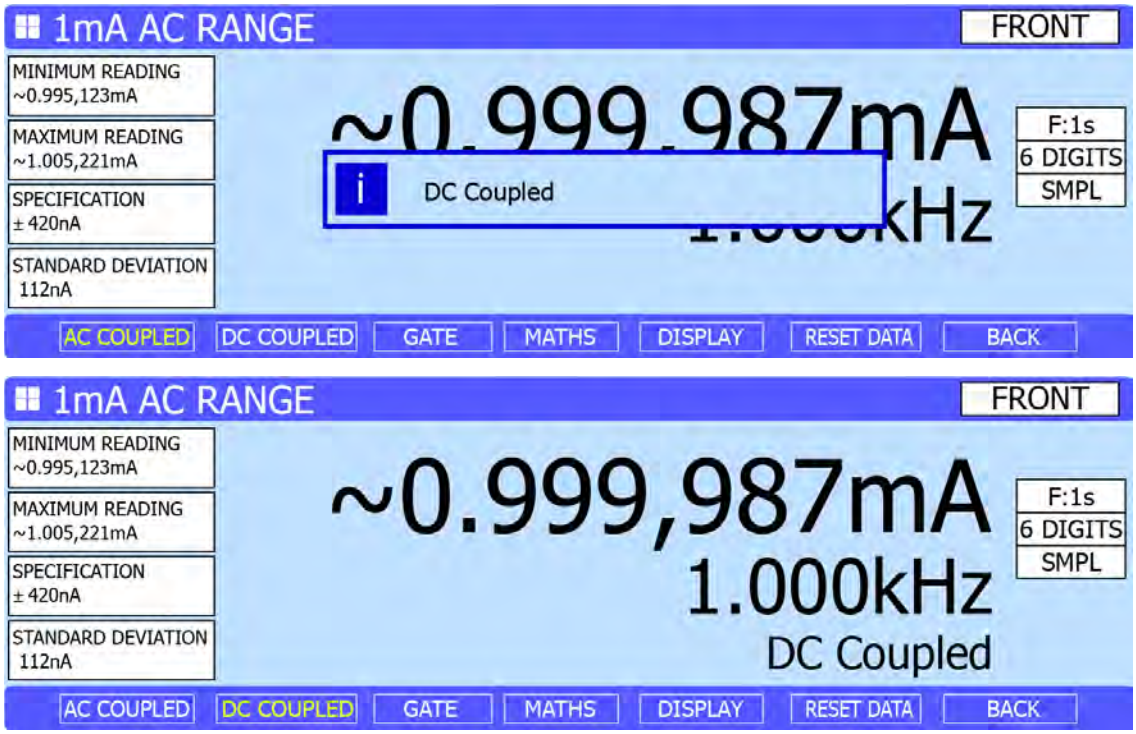


The default state for AC Voltage measurement is AC Coupled, so only AC components of the signal are measured, however in some cases it may be desirable to incorporate the DC offset into the measurement, especially when measuring signals below 10Hz.

Note : When measuring AC Voltage with the 8100 Series DC Coupling is not required to achieve the published specification.

To enable DC Coupling, press the soft key labelled ‘DC COUPLED’. A message will display for approximately 1 second to indicate that DC Coupling is active, and DC Coupled will appear below

the frequency on the measurement screen



Selecting Frequency Gate

The 8100 series offers two frequency measurements modes. The default setting is a FAST frequency measurement circuit that reacts to changes in frequency rapidly and offers 0.1Hz resolution after 5 successive samples of the same input frequency. This is the default setting and allows fast settling of readings.

To measure the input frequency with more resolution there is also a SLOW gate time which performs a reciprocal count of the input frequency compared to the internal frequency reference. This

mode provides higher frequency resolution however is less reactive to changes in frequency.

To select the GATE speed, press the CONFIG button and select the GATE soft key.

Selecting the SLOW gate speed will highlight the SLOW menu item in Yellow and return to the main screen. After a few samples a high resolution frequency count will be displayed.

To return to the FAST gate mode, enter the CONFIG menu and select the GATE key again. Then press the FAST soft key. After a few samples the default frequency resolution will be displayed

Note - The SLOW gate is intended for measurement of frequencies below 10 kHz

Example Connection

To measure current up to 1A the low current terminals should be used. Connect the source to the I+ (red insert) and I- (black insert) terminals on either the front panel or rear panel (8104 only) inputs.

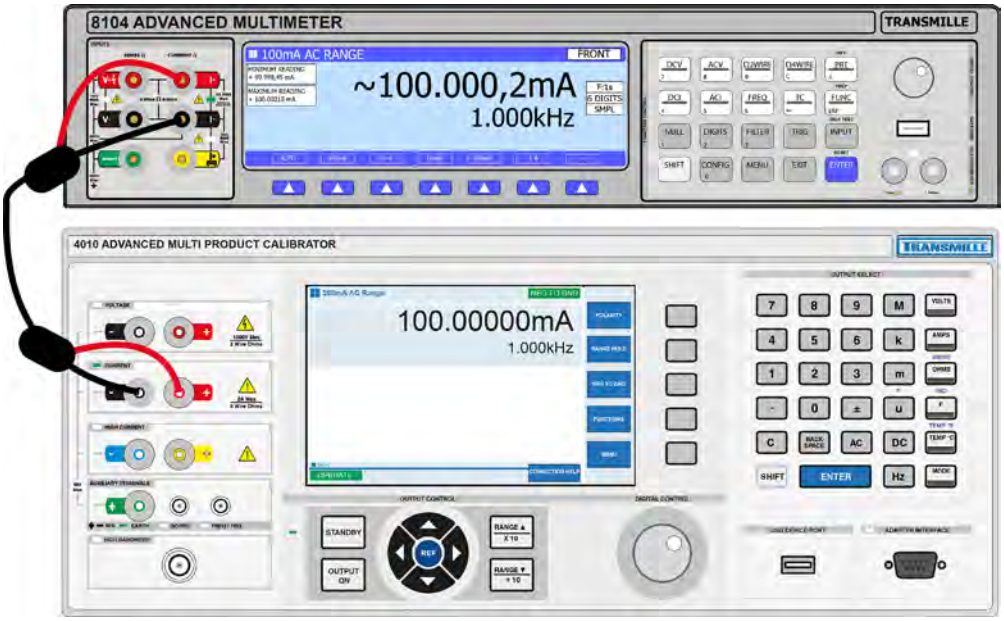
For current above 1A the high current terminals should be used. Connect the source to the I+ (HI) (Yellow) and I- (black insert) terminals on the front panel.

Note : When measuring High Currents make sure that suitable leads are used. Transmille supply suitable leads in the 8100LEAD set

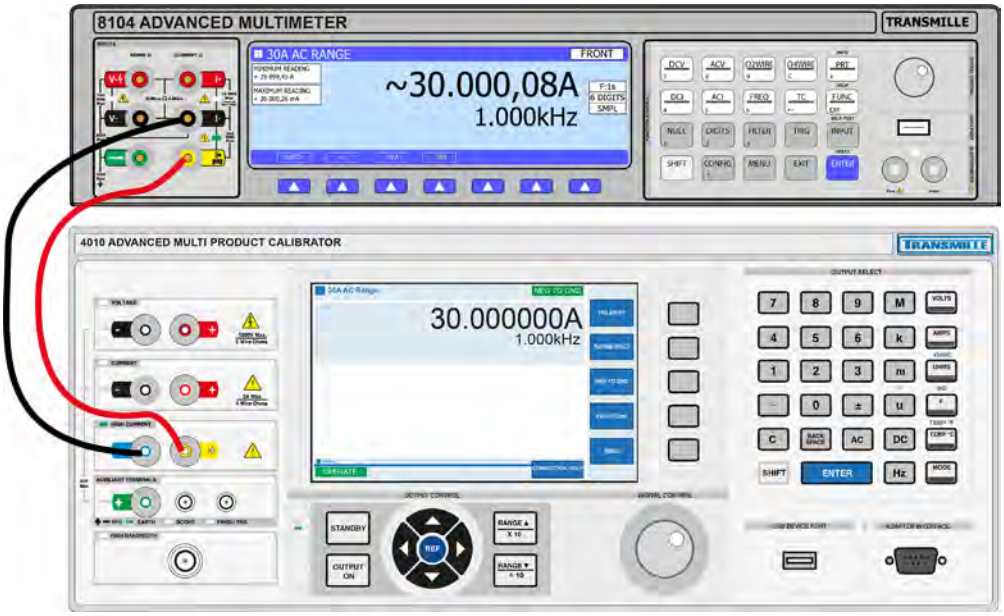
Care should be taken to ensure that all connecting leads have are clean prior to inserting into the binding posts to avoid high contact resistance which can cause self heating increased input

impedance causing some sources to reach compliance.

Connection diagram for Low Current (up to 1A)



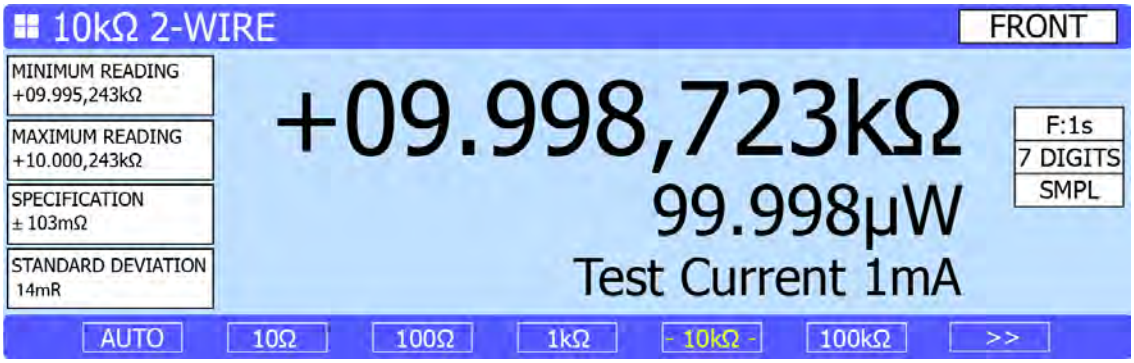
Connection diagram for High Current (above 1A)



Resistance - 2 Wire

The 8100 Series can be used to measure 2 Wire Resistance from 10 Ohms to 1 GOhms. Measurement capability is provided on Front and Rear (8104 only) terminals.

To enter 2 Wire Resistance mode, press the Ω2WIRE key from the function section of the Keyboard. The multimeter will change to the 2 Wire Resistance function (with an audible click), and the measurement screen will update to indicate available ranges.



The bottom menu indicates the current range by highlighting the text in YELLOW. The current range is also displayed in the top bar.

In resistance mode, a calculated power dissipation in the resistor is displayed along with the measurement current for easily calculating and avoiding self heating in the connected resistor in addition to the current reading.

Selecting A Range

The Range menu is the default menu, and is accessed by pressing the Ω2WIRE key or waiting for the sub menu to close automatically.

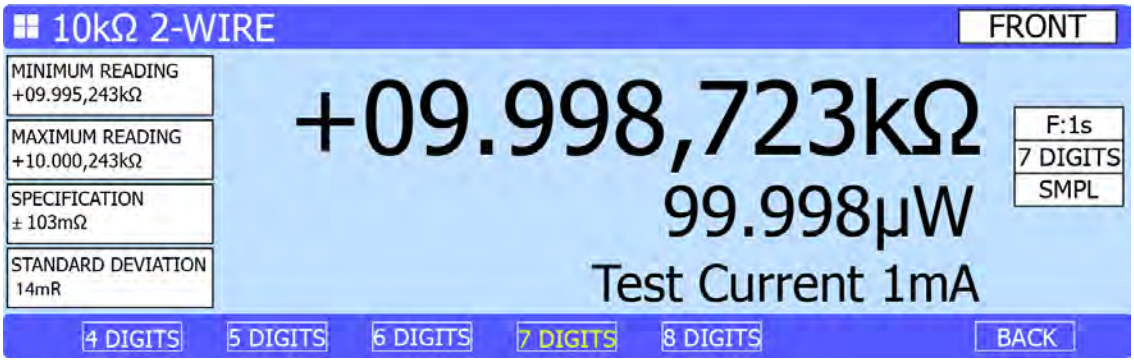
Selecting a range is performed by pressing the BLUE soft keys at the bottom of the screen. Pressing a the key directly under the text on the screen will set the range.

As there are more ranges than soft keys, the left most but one and right most keys will indicate either ‘<<’ or ‘>>’ to indicate that there are more ranges on a second screen. Pressing either of these buttons will update the range display to show additional ranges.

To configure the multimeter to auto range, press the AUTO soft key (left most key). The multimeter will automatically select the most appropriate range for the measurement

Measurement Resolution

Pressing the DIGITS key will display the resolution menu. The resolution menu shows the available resolutions for the function, up to 8 Digits (8104) / 7 Digits (8109).



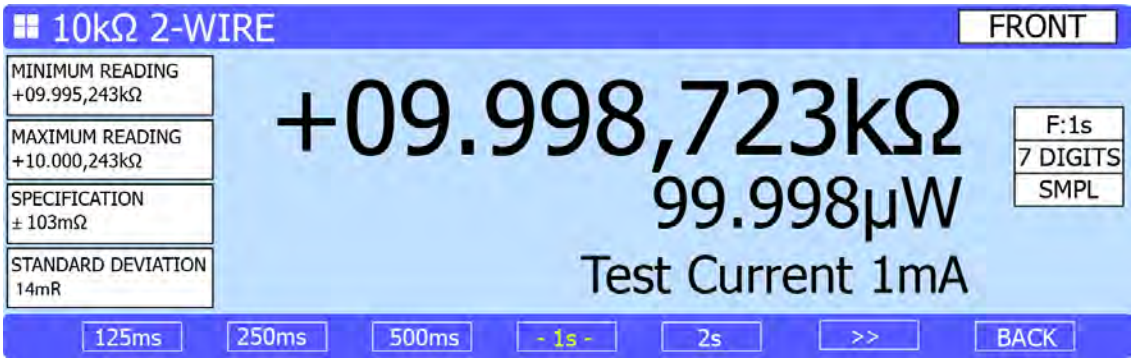
To select the desired resolution, press the BLUE soft key under the desired resolution.

Note - The measurement speed is limited by the resolution of the measurement. The higher the resolution of the measurement, the longer each measurement sample will take.

Configuring Sample Rate

Pressing the 'FILTER' key will display the filter speed menu. The filter menu shows the available measurement speeds for the configured measurement resolution and range

NOTE : Faster sample speeds will result in a higher standard deviation due to fewer samples making each individual measurement



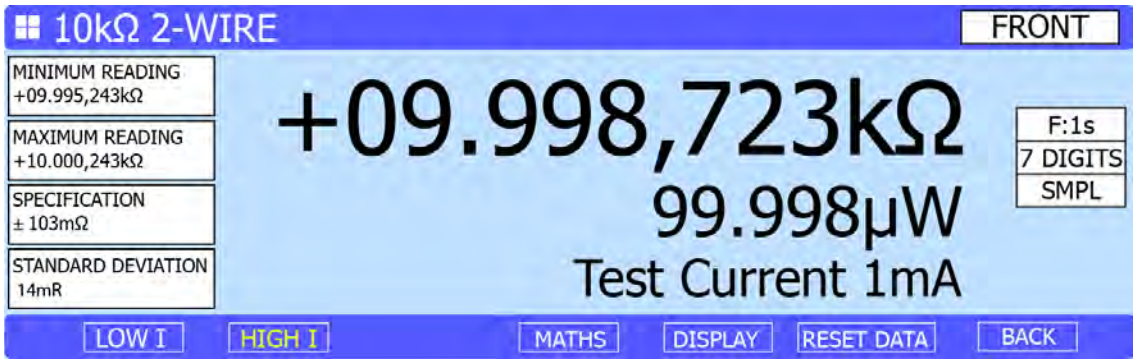
To select the desired filter speed, press the BLUE soft key under the desired selection.

Note - The filter speeds available are dependant upon the current resolution. Refer to extended specifications for valid resolution and filter speed settings.

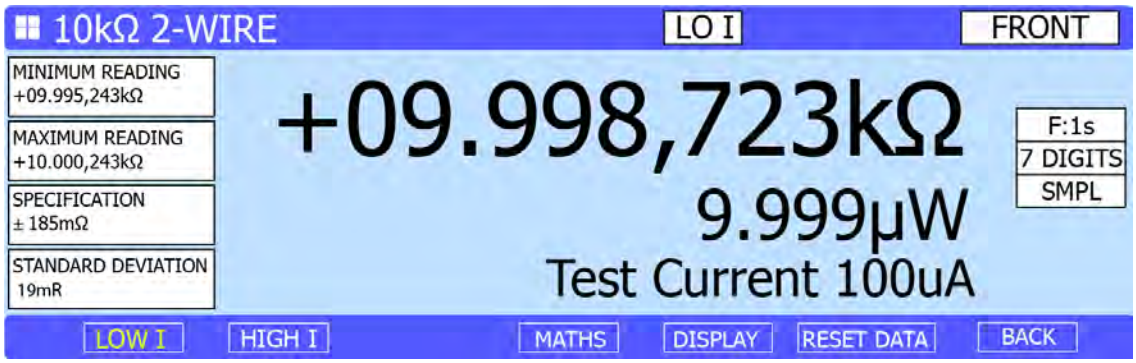
Configuring Measurement Current

To reduce self heating during resistance measurements (typically when measuring an RTD / PRT to determine temperature from resistance) as well as to reduce the current for simulated sources hat have limited current ranges the 8100 has a low current mode for 3 ranges (100 Ohm, 1 kOhm and 10 kOhm)

To set the measurement current, press the CONFIG key and then select the required current by pressing either HIGH I or LOW I



On pressing LOW I a indicator will appear at the top of the screen to indicate that the multimeter is measuring using the lower current.



Note - Measurements will have a slightly larger standard deviation when measuring using Low Current due to the lower voltage generated across the resistor, however self heating will be dramatically reduced in resistors with a poor temperature coefficient or RTD / PRT probes

Note - Some instruments that generate simulated resistance require the lower current mode to be set to operate correctly due to limitations in the simulation circuitry

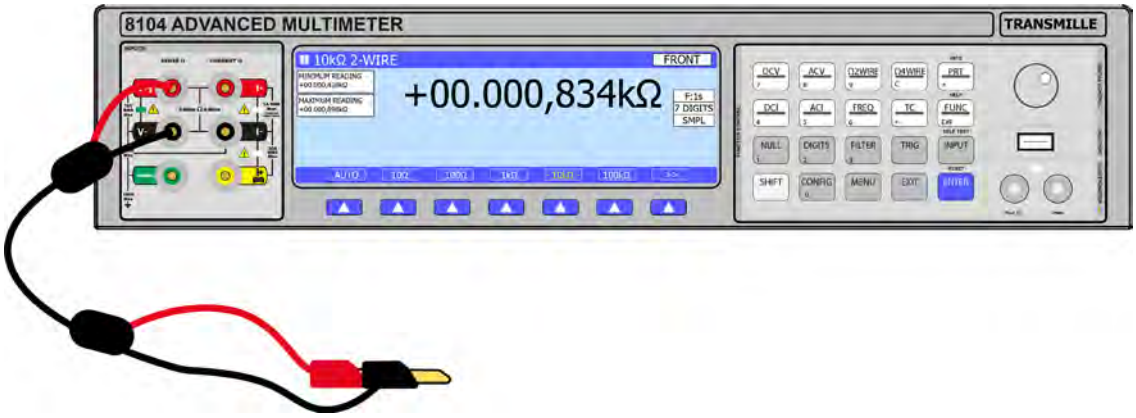
Performing A Null

Performing a Null or Zero is an important part of preparing for a Resistance measurement. It is quite normal for a measurement system to display an offset if a zero has not been performed that will cause all measurements to be incorrect. This offset is generated mainly by the resistance of

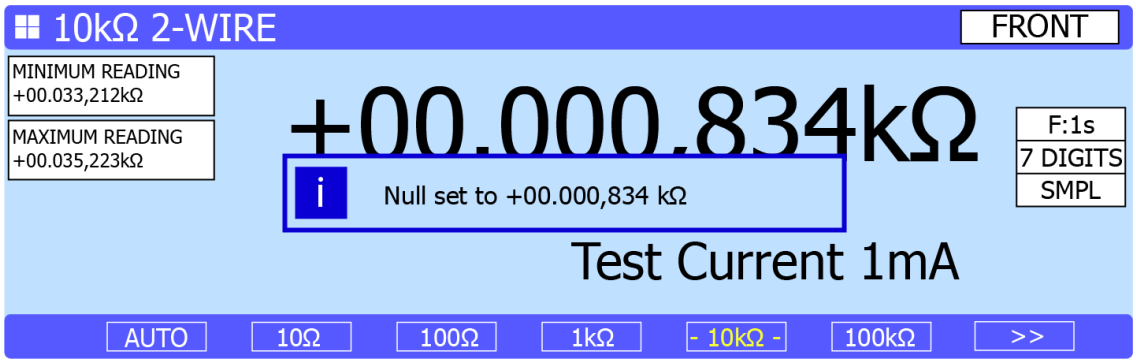
interconnecting leads in a 2 Wire Resistance measurement

The process of performing a zero removes any pre existing resistance offsets from interconnections so that the multimeter indicates only the input signal rather than the input signal and voltage offsets.

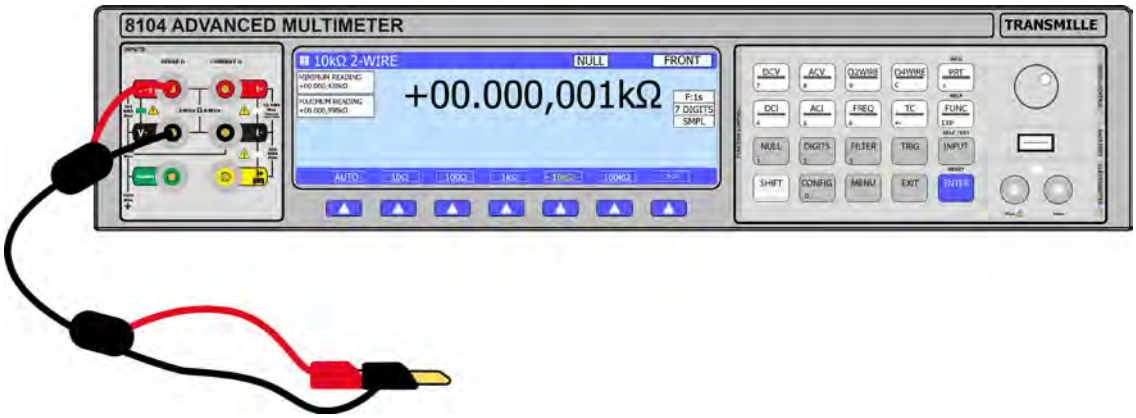
To perform a Null, it is standard practice to short out your interconnecting leads/wire at the point of connection with the source / device to be measured. The included leads feature stackable connections, and should be plugged into one another at the opposite end to the multimeter and allowed to stabilise after handling. It is important to note that if leads are taken from a warm area (for example resting on top of the instrument) they will require additional time to stabilise to the environment



After allowing the connections to stabilise, press the ‘NULL’ button on the front panel (or via remote command). A message will display on the multimeter indicating that a Null has been stored



After a Null has been performed the status bar at the top of the screen will display ‘NULL’ to indicate that a Null is presently active



When measuring devices that are specified as ‘relative to zero’, the zero should be performed with leads connected to the source and the multimeter nulled to the zero output of the source.

Example Connection

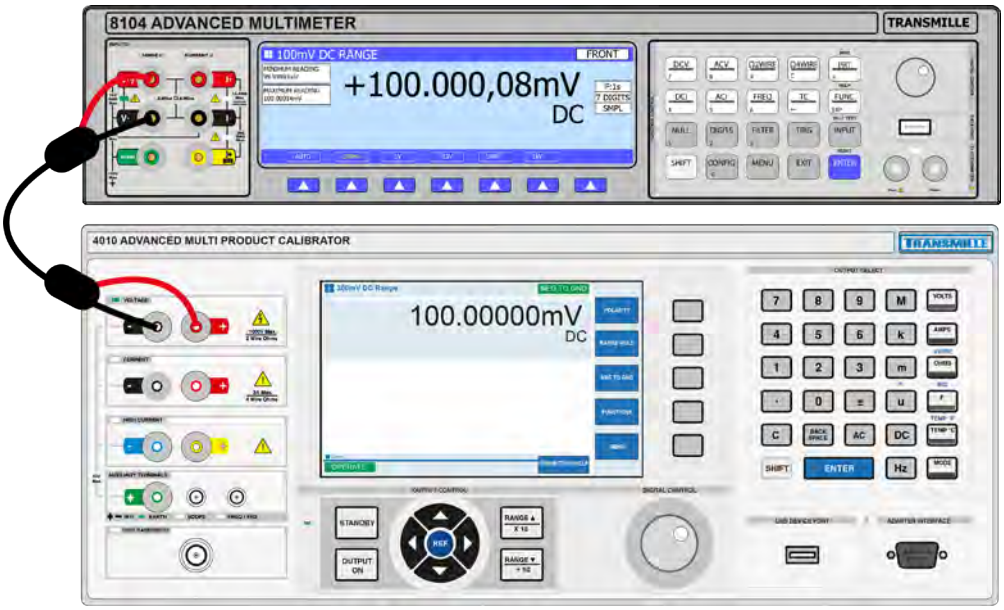
Connections via the front panel terminals should be made to the V+ (Red Insert) and V- (Black Insert) binding posts. Connection via the rear panel terminals should be made to the V+ (Red) and V- (Black) terminals.

Care should be taken to ensure that all connecting leads have are clean prior to inserting into the binding posts to avoid errors due to thermals in connections.

WARNING - Ensure that binding posts are fully tightened when performing measurements > 10V and that no contact is made to binding posts while voltage is present. Lethal voltages may be present at the input connectors

For the best measurement low thermal leads (such as those provided in the 8100LEAD kit) should be used while measuring DC Voltage. The leads feature low thermal gold plated copper 4mm banana jacks especially designed for precision DC Voltage, and the lead is of screened construction to

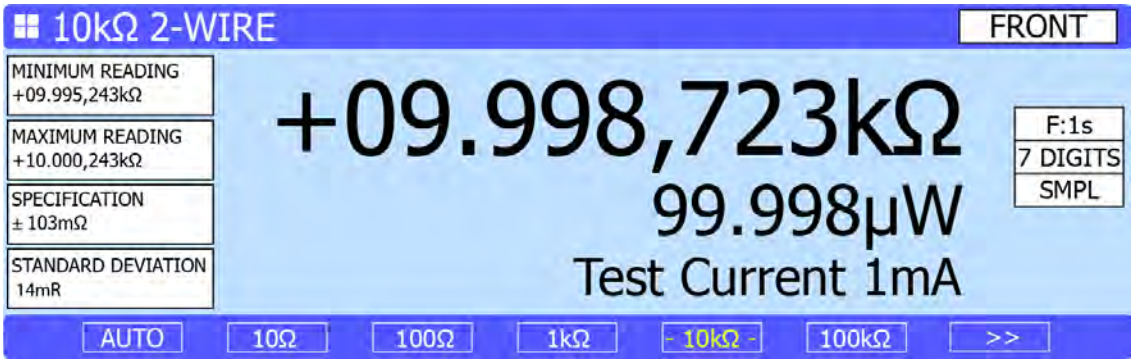
offer rejection of interference / noise



Resistance - 4 Wire

The 8100 Series can be used to measure 2 Wire Resistance from 1 Ohm (8109 10 Ohms) to 100 kOhms. Measurement capability is provided on Front and Rear (8104 only) terminals.

To enter 4 Wire Resistance mode, press the Ω4WIRE key from the function section of the Keyboard. The multimeter will change to the 4 Wire Resistance function (with an audible click), and the measurement screen will update to indicate available ranges.



The bottom menu indicates the current range by highlighting the text in YELLOW. The current range is also displayed in the top bar.

In resistance mode, a calculated power dissipation in the resistor is displayed along with the measurement current for easily calculating and avoiding self heating in the connected resistor in addition to the current reading.

Selecting A Range

The Range menu is the default menu, and is accessed by pressing the Ω4WIRE key or waiting for the sub menu to close automatically.

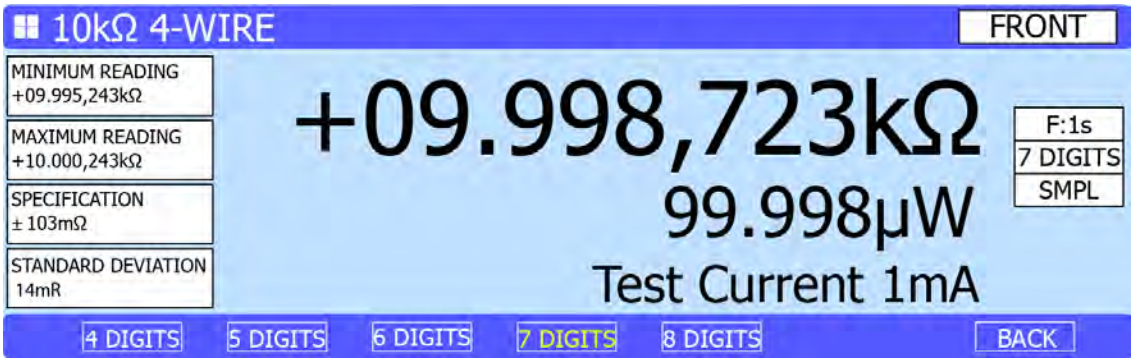
Selecting a range is performed by pressing the BLUE soft keys at the bottom of the screen. Pressing a the key directly under the text on the screen will set the range.

As there are more ranges than soft keys, the left most but one and right most keys will indicate either ‘<<’ or ‘>>’ to indicate that there are more ranges on a second screen. Pressing either of these buttons will update the range display to show additional ranges.

To configure the multimeter to auto range, press the AUTO soft key (left most key). The multimeter will automatically select the most appropriate range for the measurement

Measurement Resolution

Pressing the DIGITS key will display the resolution menu. The resolution menu shows the available resolutions for the function, up to 8 Digits (8104) / 7 Digits (8109).



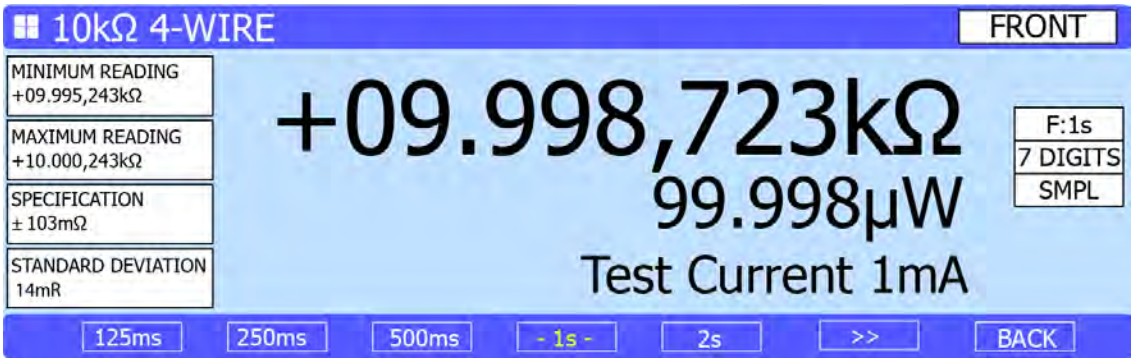
To select the desired resolution, press the BLUE soft key under the desired resolution.

Note - The measurement speed is limited by the resolution of the measurement. The higher the resolution of the measurement, the longer each measurement sample will take.

Configuring Sample Rate

Pressing the 'FILTER' key will display the filter speed menu. The filter menu shows the available measurement speeds for the configured measurement resolution and range

NOTE : Faster sample speeds will result in a higher standard deviation due to fewer samples making each individual measurement



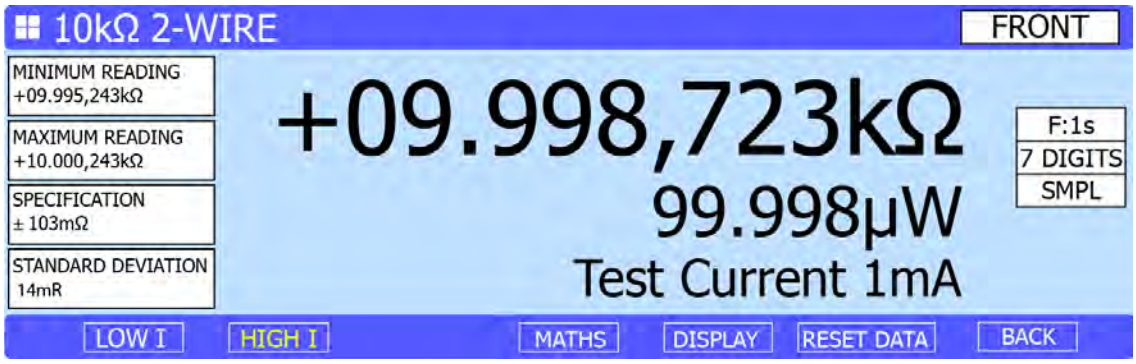
To select the desired filter speed, press the BLUE soft key under the desired selection.

Note - The filter speeds available are dependant upon the current resolution. Refer to extended specifications for valid resolution and filter speed settings.

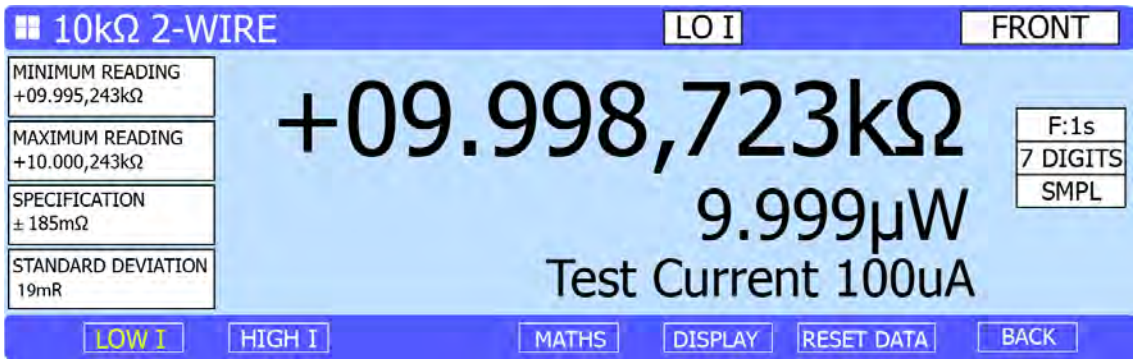
Configuring Measurement Current

To reduce self heating during resistance measurements (typically when measuring an RTD / PRT to determine temperature from resistance) as well as to reduce the current for simulated sources that have limited current ranges the 8100 has a low current mode for 3 ranges (100 Ohm, 1 kOhm and 10 kOhm)

To set the measurement current, press the CONFIG key and then select the required current by pressing either HIGH I or LOW I



On pressing LOW I a indicator will appear at the top of the screen to indicate that the multimeter is measuring using the lower current.



Note - Measurements will have a slightly larger standard deviation when measuring using Low Current due to the lower voltage generated across the resistor, however self heating will be dramatically reduced in resistors with a poor temperature coefficient or RTD / PRT probes

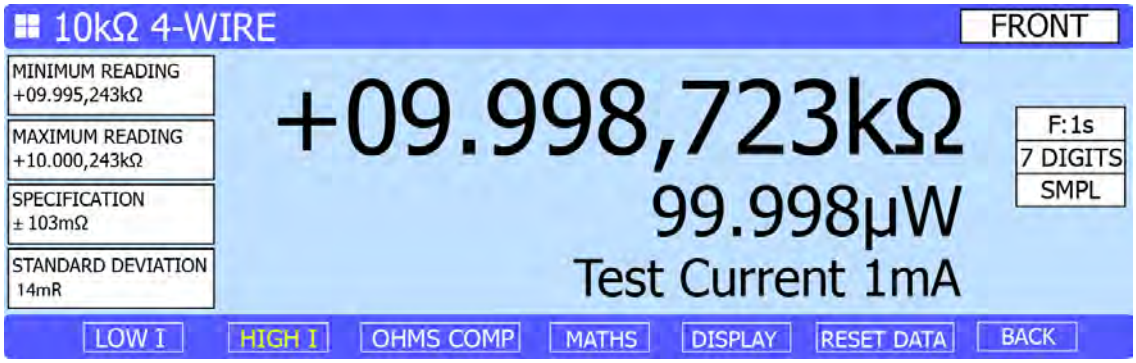
Note - Some instruments that generate simulated resistance require the lower current mode to be set to operate correctly due to limitations in the simulation circuitry

Configuring Ohms Compensation

The 8100 Multimeter offers ohms compensation in 4 Wire Resistance measurement. When this function is enabled the 8100 multimeter dynamically compensates for voltage offsets (thermals) in interconnecting leads by disabling the measurement current, measuring the offset in the potential measurement leads and then re-enabling the measurement current and then correcting the measurement dynamically for the voltage offset in the leads.

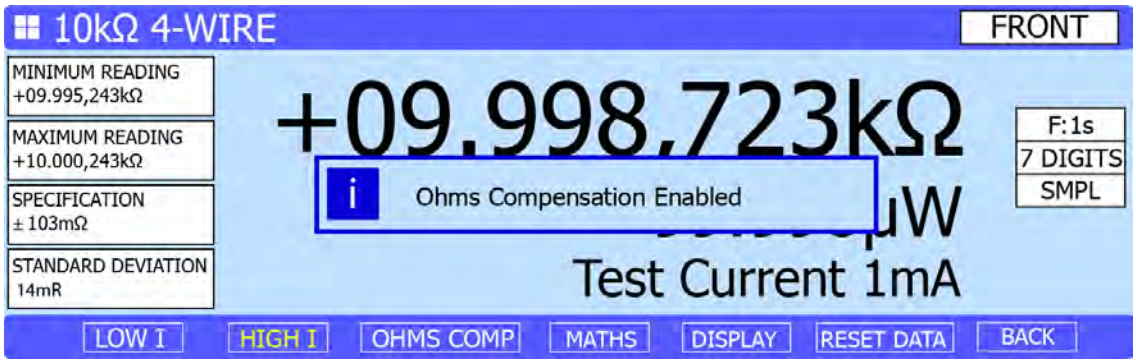
Note - When ohms compensation is enabled the effective sample rate will be lowered due to the automatic compensation cycle.

To enable Ohms Compensation, press the CONFIG button and then press the key labelled OHMS COMP.

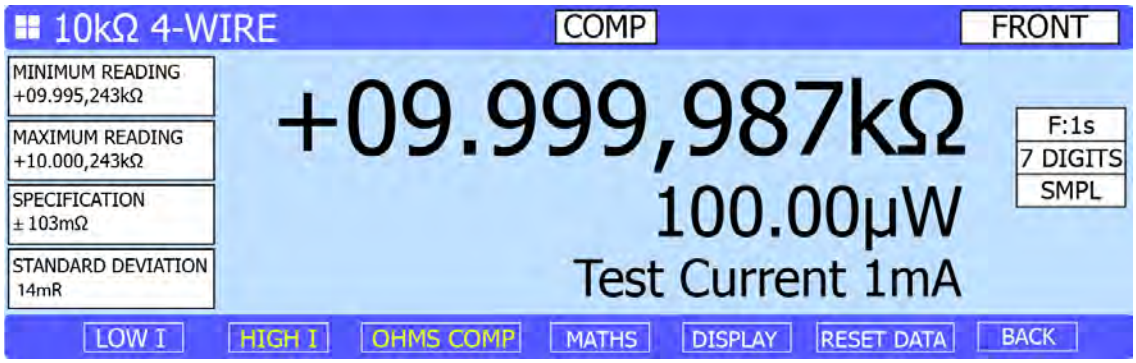


Depending upon the current state of Ohms Compensation this will either enable or disable the function. If OHMS COMP is highlighted in Yellow then Ohms Compensation is already enabled. Pressing the OHMS COMP button will display a message indicating that the function has been

enabled



When Ohms Compensation is enabled indicator at the top of the screen labelled ‘COMP’ will show providing indication that ohms compensation is presently active.



Note - It will be normal for the reading to change when Ohms Compensation is first enabled as any offset in the leads and connections will be compensated for

Note - While the multimeter is obtaining an offset measurement the measurement will not update during this cycle. This is normal behaviour

Performing A Null

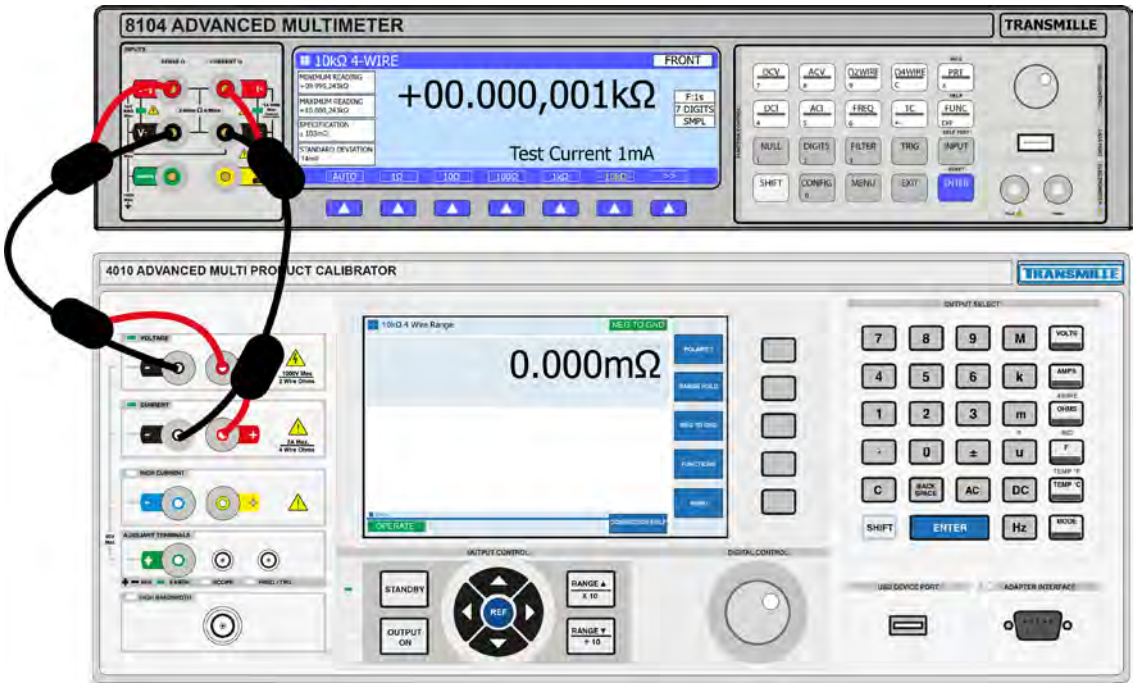
Performing a Null or Zero is an important part of preparing for a Resistance measurement. It is quite normal for a measurement system to display an offset if a zero has not been performed that will cause all measurements to be incorrect. This offset is generated mainly by the resistance of interconnecting leads in a 4 Wire Resistance measurement

The process of performing a zero removes any pre existing resistance offsets from interconnections so that the multimeter indicates only the input signal rather than the input signal and

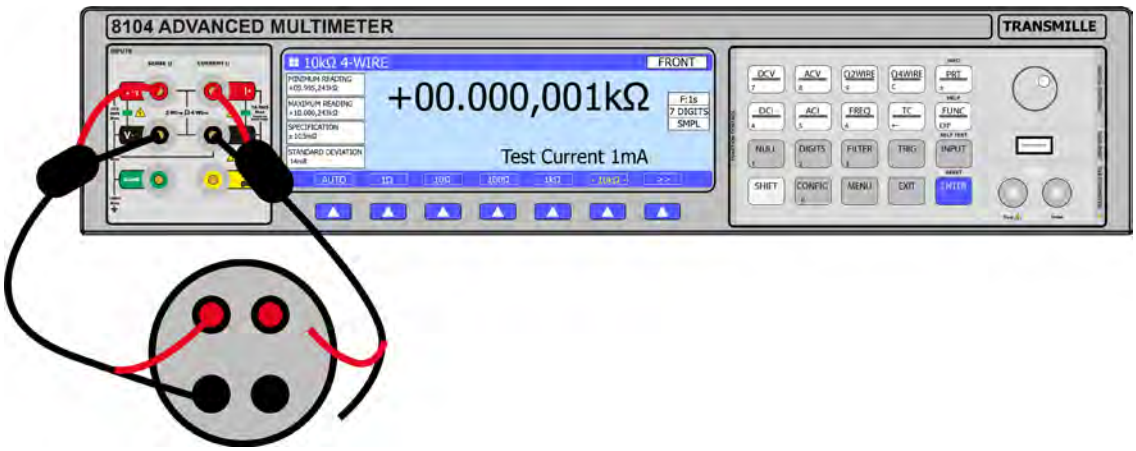
voltage offsets.

To perform a Null for 4 Wire Resistance ranges there are two different techniques depending upon the type of source/device you are trying to measure.

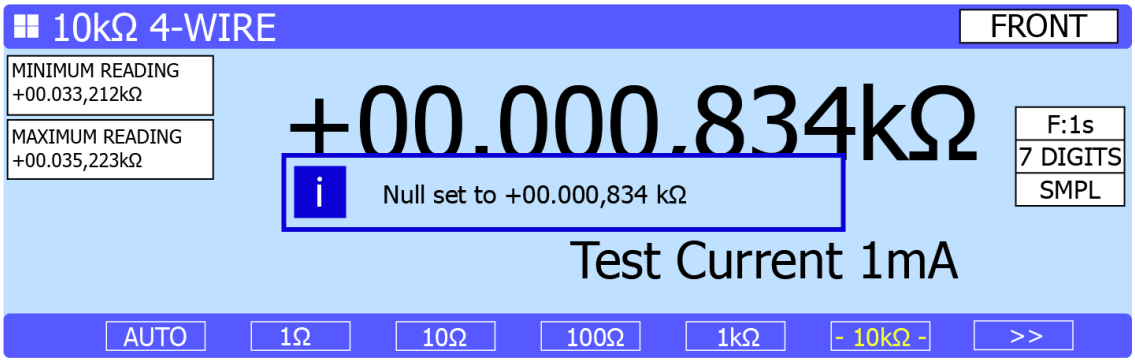
Devices that offer a Zero resistance output such as multi product calibrators (i.e. Transmille 3000A / 4000 Series) and decade boxes are designed to have the Zero output measured and the multimeter nulled to the zero output, in this case, connect the multimeter as for a normal 4 wire measurement and press the NULL key



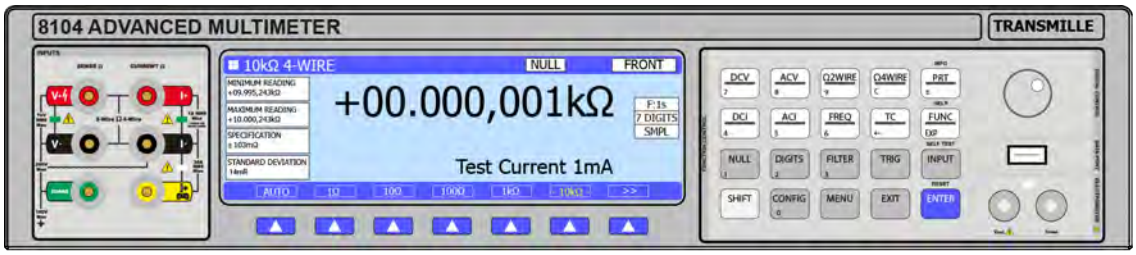
To null to a device such as a standard resistor, best practice is to open circuit the current source leads and perform a zero with the voltage measuring leads connected to the device. This removes all offsets in the leads as well as voltage offsets in the device itself (terminals, interconnects etc.)



After allowing the connections to stabilise, press the ‘NULL’ button on the front panel (or via remote command). A message will display on the multimeter indicating that a Null has been stored



After a Null has been performed the status bar at the top of the screen will display ‘NULL’ to indicate that a Null is presently active



Note - When the Ohms Compensation function is enabled, performing a manual Null is not required during normal use

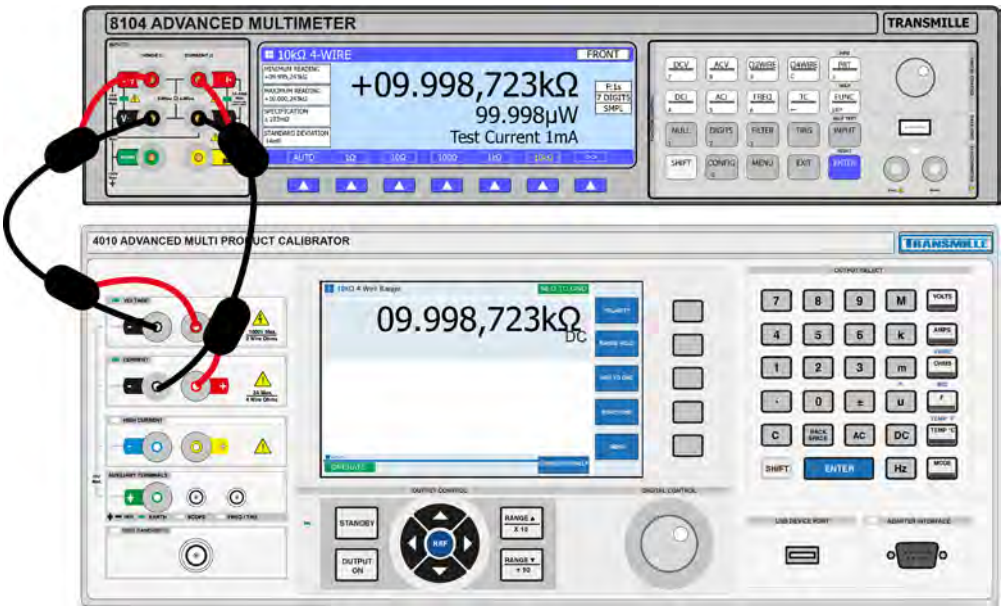
Example Connection

Connections via the front panel terminals should be made to the V+ (Red Insert), V- (Black Insert), I+ (Red Insert) and I- (Black Insert) binding posts. Connection via the rear panel terminals should be made to the V+ (Red), V- (Black), I+ (Red) and I- (Black) terminals.

Care should be taken to ensure that all connecting leads have are clean prior to inserting into the binding posts to avoid errors due to thermals in connections.

For the best measurement low thermal leads (such as those provided in the 8100LEAD kit) should be used while measuring 4 Wire Resistance. The leads feature low thermal gold plated copper 4mm banana jacks especially designed for minimising thermal effects, and the leads are of screened

construction to offer rejection of interference / noise

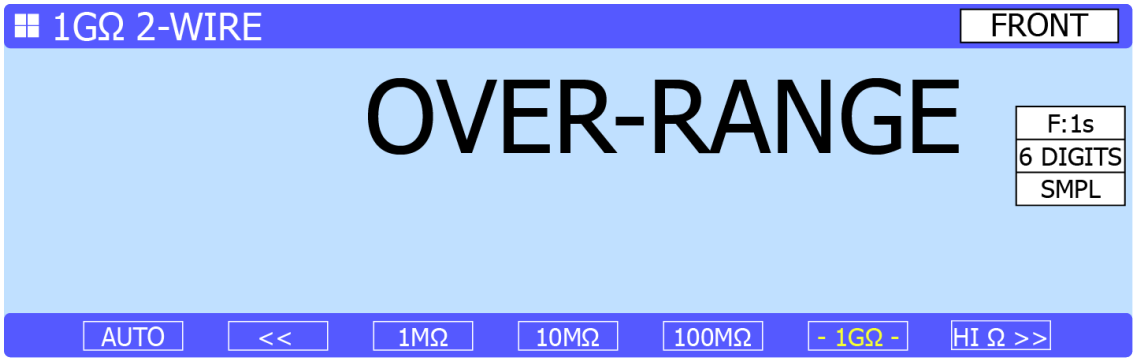


High Value Resistance (8104 Only)

The 8104 Multimeter comes fitted with a dedicated electrometer input designed for measurement of low currents (less than 10uA) and high resistance (greater than 10 MOhms). For resistance measurements above 10 MOhms the best performance can be achieved by selected the HI OHMS ranges from the front panel

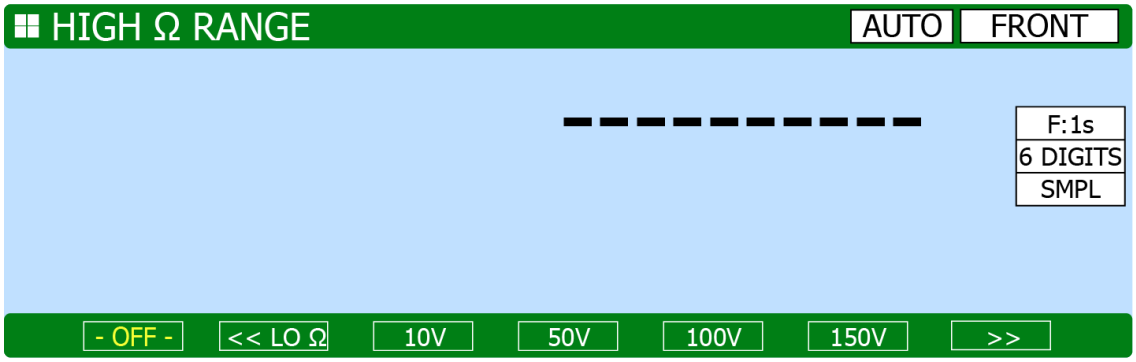
In High Value Resistance mode the multimeter sources DC Voltage in programmable steps up to 300V and measures the current flow through the resistor using screened BNC inputs for exceptional low noise performance and to minimise leakage effects caused by normal leads.

To enter High Value Resistance mode, press the Ω2WIRE function key, and then press the >> soft key until the HI Ω >> soft key is visible.



On pressing the HI Ω >> soft key the multimeter will enter High Value Resistance mode and the input terminals will change from the V+ and V- Terminals to the BNC inputs labelled Vout and Imeas. To indicate that the multimeter is now using the Electrometer terminals the Top and Bottom bars on the display will change to GREEN

WARNING - The Vout terminal is capable outputting High Voltage in excess of 300V depending upon the setting. Ensure that all leads are connected and hands free prior to configuring measurement voltage

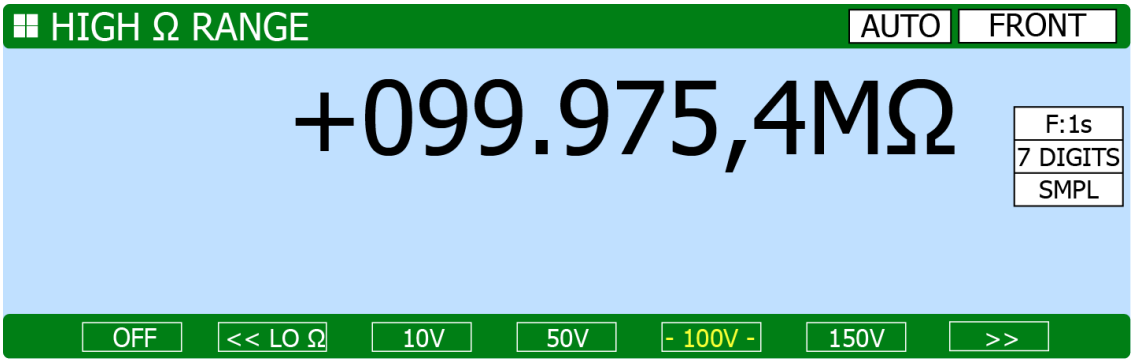


The default state is with the Voltage Output turned off for safety. In this mode the measurement screen will display --------- to reflect that no reading is being obtained.

Configuring Measurement Voltage

The High Value Resistance mode allows selection of 7 voltage levels : 10V, 50V, 100V, 150V, 200V, 250V and 300V. The voltage setting is the nominal voltage, so the absolute output of the multimeter will vary slightly.

To configure a new output voltage, press the appropriate soft key. If the required voltage is not presently displayed press the >> or << key as available to see additional voltage selections



Warning - Ensure that the resistor that is about to be measured is rated for the voltage output. Many resistors have maximum voltage ratings less than the maximum voltage that the 8104 is capable of outputting. Applying voltage in excess of ratings can cause permanent damage to the connected device.

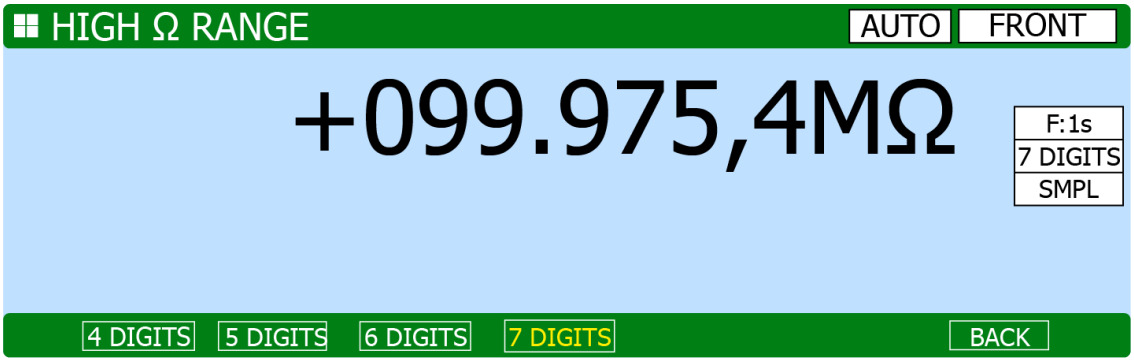
Note - It is normal for a quiet high pitched noise to heard when the output voltage is active

Selecting A Range

The High Value Resistance range does not offer direct range selection. The range is selected dynamically depending upon the Measurement Voltage and the measured current.

Measurement Resolution

Pressing the DIGITS key will display the resolution menu. The resolution menu shows the available resolutions for the function, up to 8 Digits (8104) / 7 Digits (8109).



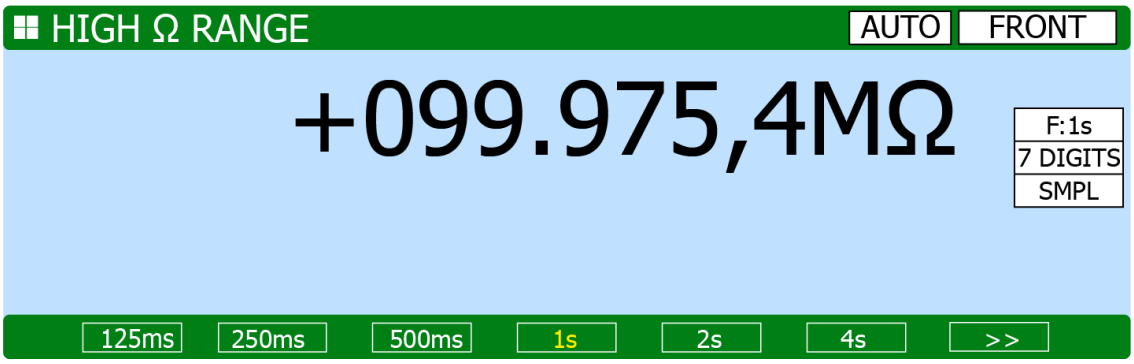
To select the desired resolution, press the BLUE soft key under the desired resolution.

Note - The measurement speed is limited by the resolution of the measurement. The higher the resolution of the measurement, the longer each measurement sample will take.

Configuring Sample Rate

Pressing the 'FILTER' key will display the filter speed menu. The filter menu shows the available measurement speeds for the configured measurement resolution and range

NOTE : Faster sample speeds will result in a higher standard deviation due to fewer samples making each individual measurement



To select the desired filter speed, press the BLUE soft key under the desired selection.

Note - The filter speeds available are dependant upon the current resolution. Refer to extended specifications for valid resolution and filter speed settings.

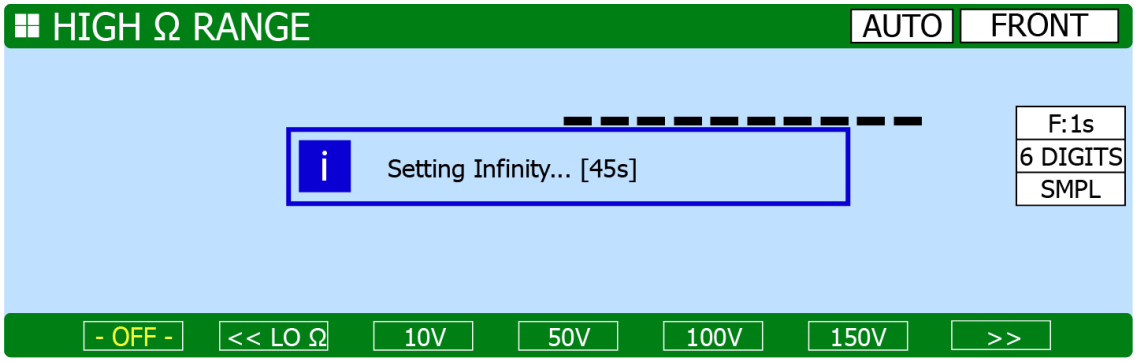
Performing A Null

Performing a Null or Zero is an important part of preparing for a High Resistance measurement. The High Resistance Measurement Null turns off the Voltage Source and removes current offsets from

the sensitive Imeas terminal.

The Null process takes approximately 1 Minute as the multimeter allows each sub range to settle prior to subtracting stray leakage currents.

To perform a Null, allow all connections to stabilise and press the NULL button. A message will appear on the screen saying ‘Set Infinity...’ along with the time remaining.



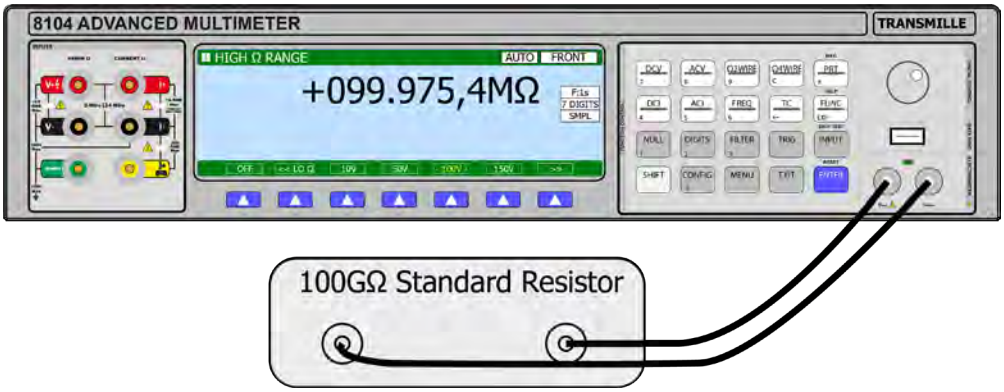
After completing the Null operating the multimeter will return to the main screen, and the NULL label will appear in the top bar to indicate that a Null has been set successfully

Example Connection

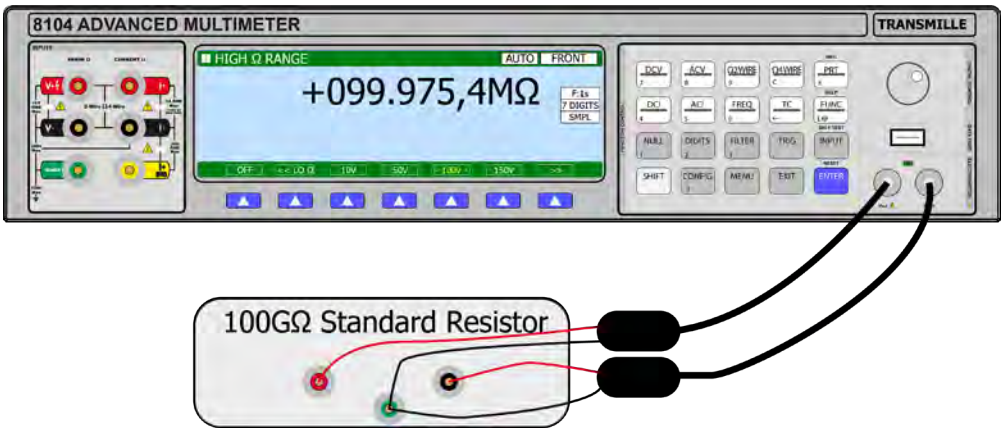
The 8104 High Resistance Function utilises BNC connections to ensure excellent low noise performance.

The centre pin of each connection (Vout and Imeas) is the positive connection, and the outer is the negative/low connection.

To connect to high resistance standards that offer BNC connections, follow the connection diagram below



To connect to high resistance standards or UUT's that offer 4mm terminals or other connections, follow the connection diagram below



Note - Using cables with insufficient insulation resistance will result in incorrect measurements. Ensure that cables with suitable insulation material are used. The leads supplied in the 8100LEADSET have been selected to ensure optimum performance and should be used if available.

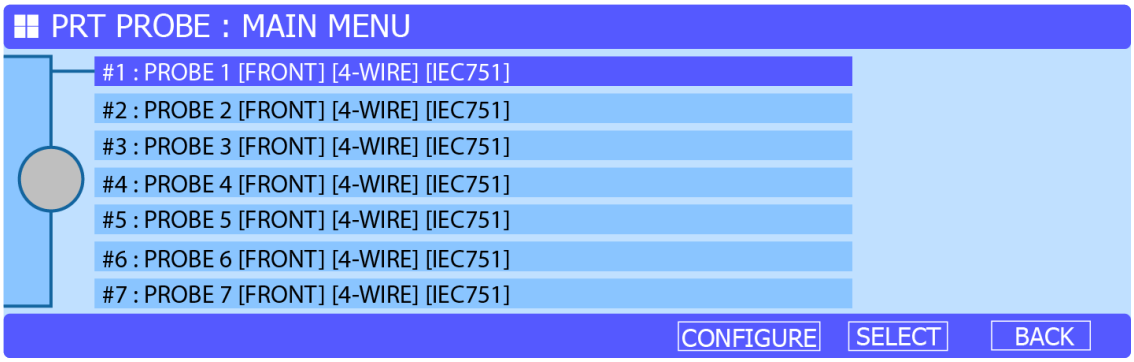
It is HIGHLY recommended that adapters are not used to connect to the terminals on the front panel, and that any adaptation happens at the point of connection to the UUT to minimise the length of cable that is not coaxial / shielded

Temperature Measurement - PRT / RTD (8104 Only)

The 8104 Multimeter can be used to measure a PRT / RTD probe and report the measurement in temperature units, using coefficients for a PRT or SPRT probe and the measured resistance of the probe.

Both the temperature (in units of °C, °F and K depending upon the users preference) and measured resistance are displayed on the screen simultaneously, as well as the calculated power dissipation in the PRT probe.

To enter PRT / RTD mode, press the PRT key from the function section of the Keyboard. The multimeter will display a menu indicating the probes available for the user to select.

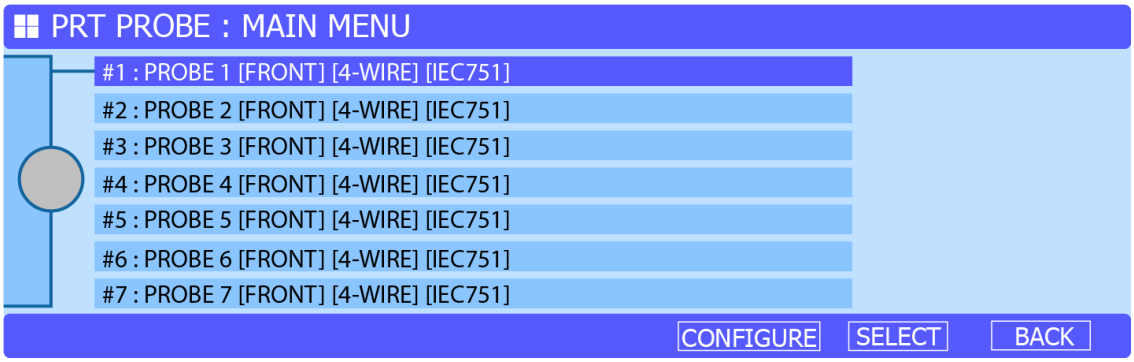


Configuring a Probe

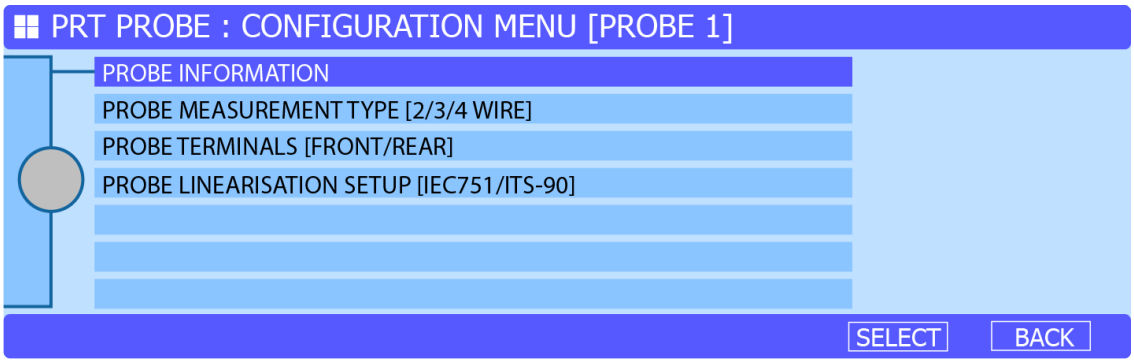
The 8104 converts the measured resistance of the PRT / SPRT probe to temperature units using coefficients from the calibration of the PRT probe.

The 8104 can perform conversions based on ITS90 calculations as well as IEC 60751 / Callendar-Van Dusen equations.

To configure or edit a probe, first enter PRT / RTD mode by pressing the PRT key from the function section of the keyboard. A menu will appear allowing you select or modify existing probes.



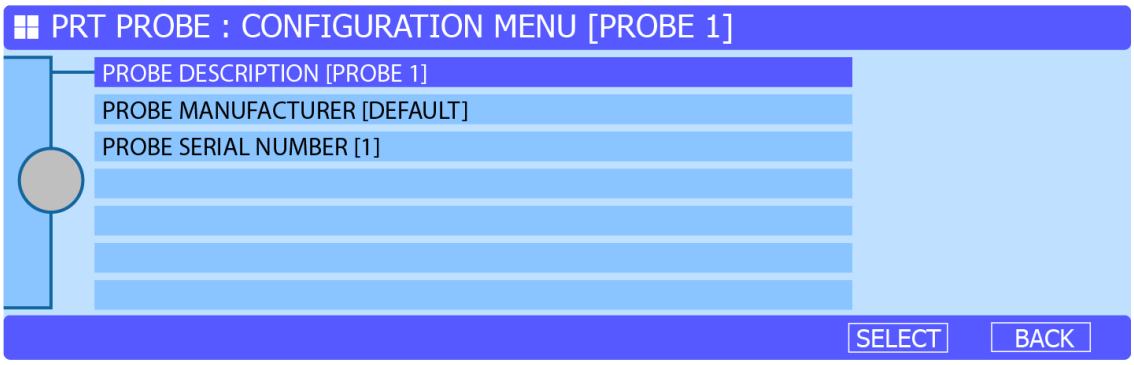
To configure the probe settings, press the CONFIGURE soft key. The screen will update to allow configuration of Probe Information (Description, Manufacturer and Serial Number), Measurement Configuration (2, 3 or 4 Wire), default input terminals (Front or Rear) and Probe Coefficients (IEC751 or ITS-90)



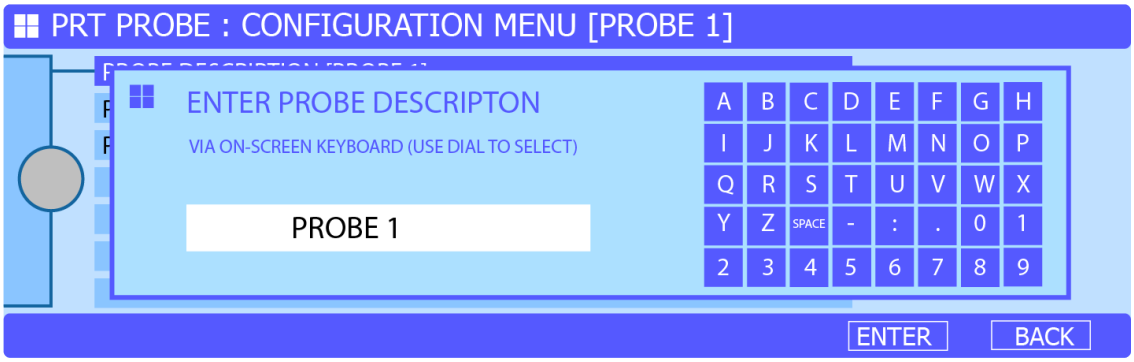
Configure Probe Information

To edit the Probe Information, highlight PROBE INFORMATION on the screen and press the ENTER key or the SELECT soft key. The screen will update to provide options to edit probe

information.



To update the Description, Manufacturer or Serial Number, highlighted the desired option using the digital control to navigate and press the ENTER key or the SELECT soft key. The on screen keyboard will appear allowing information for the probe to be edited.



Use the on screen keyboard to update information as required, then press the ENTER soft key to save the updated information

Note - Pressing the physical ENTER key will enter the currently highlighted letter from the on screen keyboard

Press the BACK soft key to return to the main configuration menu for the probe.

Configure Probe Wiring Scheme

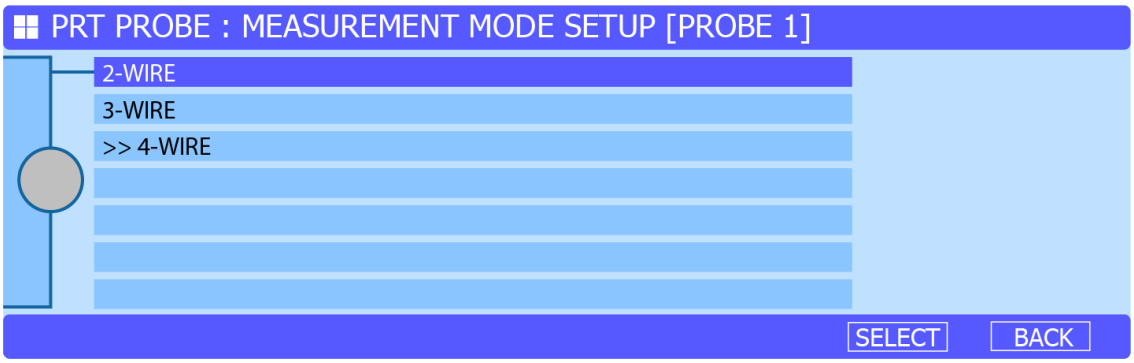
The 8104 can be configured to measure PRT probes with 2, 3 or 4 wire connection schemes.

Depending upon the connection scheme of the probe, the multimeter will use either 2 Wire measurement

Note : 2 Wire Probes cannot have Ohms Compensation to dynamically remove errors due to EMF

To modify the connection type, navigate to PROBE MEASUREMENT TYPE from the main Probe Configuration Menu and press the ENTER key or the SELECT soft key

Select the desired wiring configuration by highlighting the required option using the digital control and pressing the ENTER key or the SELECT soft key. The currently selected wiring scheme will be highlighted with '>>' in front of the menu item



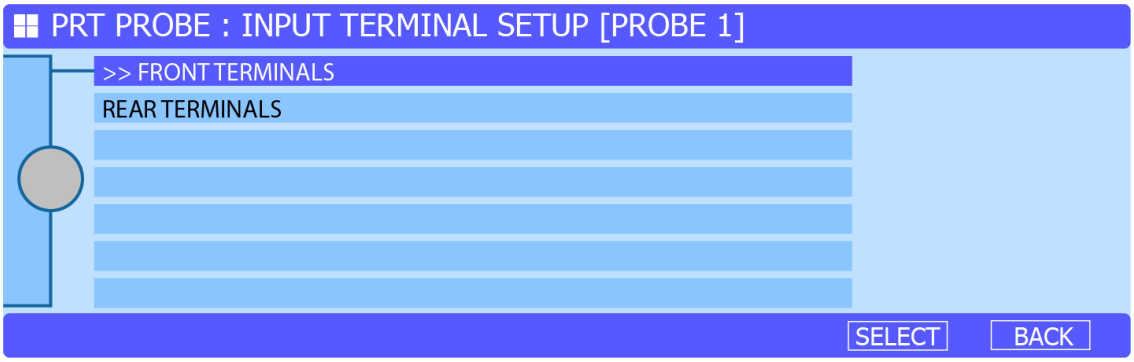
Press the BACK soft key to return to the main configuration menu for the probe

Configure Probe Terminals

Probes can be configured for use on either Front or Rear terminals to enable the use of both a reference probe and a UUT probe

To modify the terminals that will be used, navigate to PROBE TERMINALS from the main Probe Configuration Menu and press the ENTER key or the SELECT soft key

Select the desired terminals (FRONT or REAR) by highlighting the desired option using the digital control and pressing the ENTER key or the SELECT soft key. The currently selected terminals will be highlighted with '>>' in front of the menu item



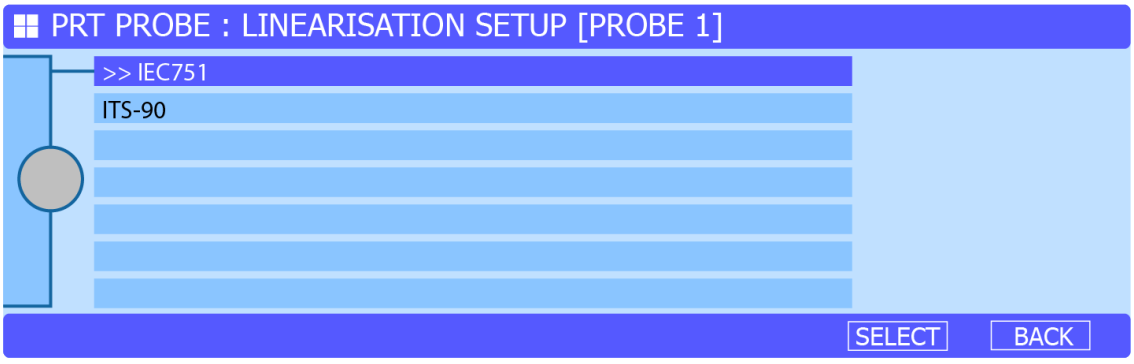
Press the BACK soft key to return to the main configuration menu for the probe

Configure Probe Linearisation

The 8104 can perform temperature conversion to both IEC751 (Callendar-Van Dusen) and ITS-90, with coefficients for multiple probes stored in memory.

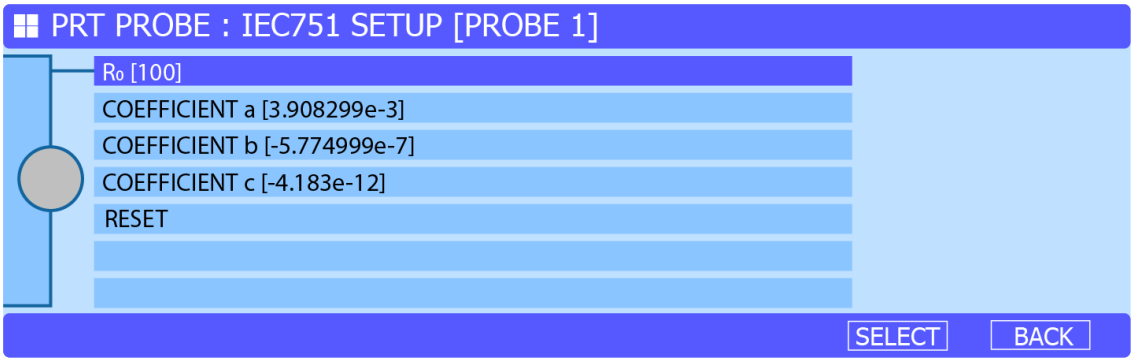
To modify the linearisation and conversion technique used, select PROBE LINEARISATION SETUP from the main Probe Configuration Menu and press the ENTER key or the SELECT soft key

Select the desired conversion algorithm from the subsequent menu and press the ENTER key or the SELECT soft key

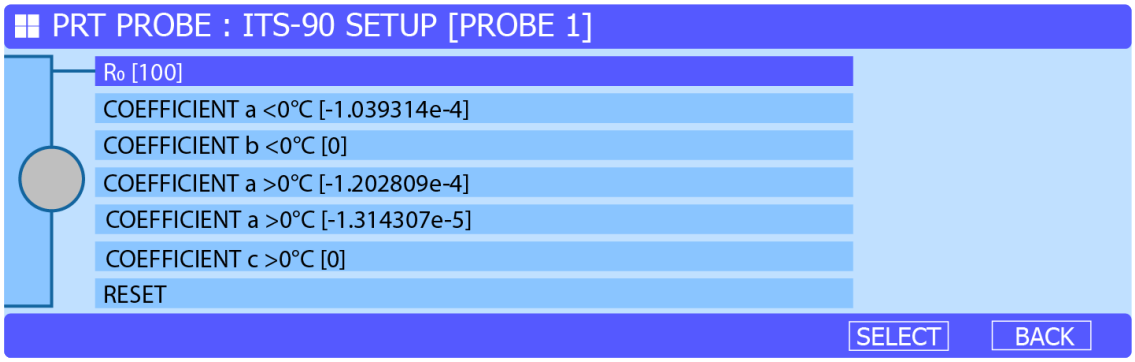


A menu allowing viewing and entry of the probe coefficients for the selected conversion method will appear.

IEC751 coefficients allow entry of R_0, A, B and C coefficients from a calibration certificate.



ITS-90 coefficients allow entry of Ro, a (<0°C), b (<0°C), a (>0°C), b (>0°C) and c (>0°C) coefficients



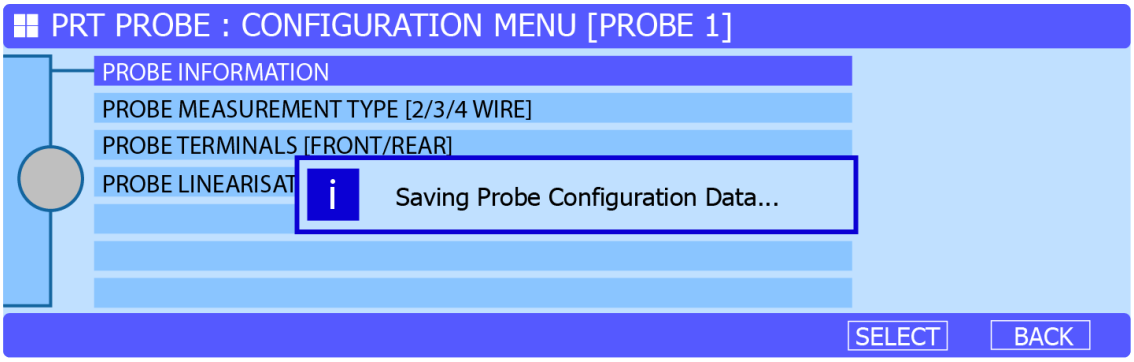
Highlighting the RESET menu option and pressing the ENTER key or the SELECT soft key will reset the probe coefficients to either the IEC751 or ITS-90 defaults.

Press the BACK soft key to return to the main configuration menu for the probe

Saving Probe Configuration

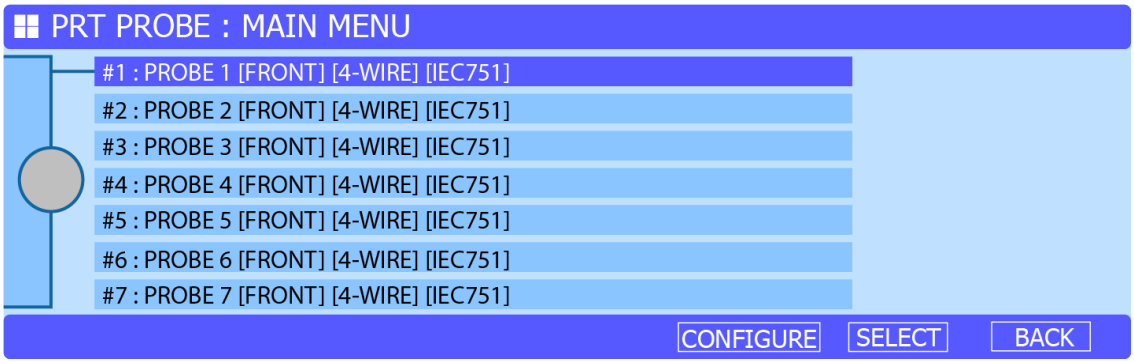
After making changes or modifications to the Probe Configuration, pressing the BACK key to return to the main PRT menu will save changes automatically.

A message will show to indicate that the Probe Configuration has been updated



Selecting a Probe

After configuring probes, from the main PRT / RTD menu, press the ENTER key or the SELECT soft key with the desired probe selected.

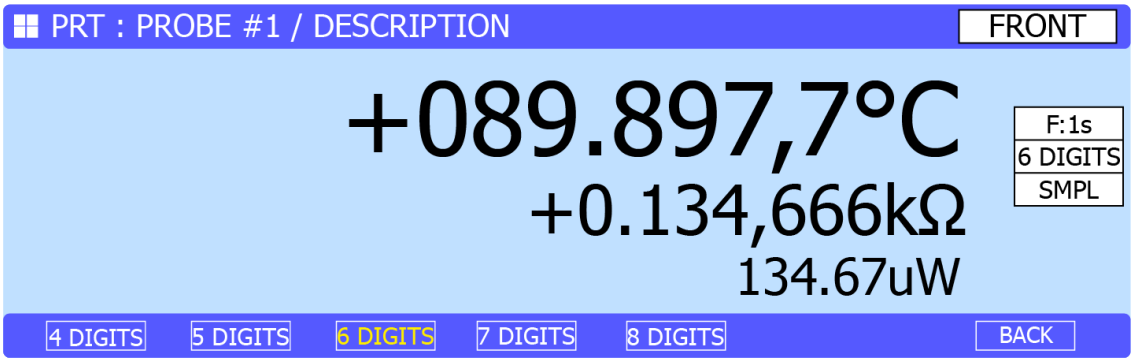


The probe selection can be modified using the digital control to select the desired probe.

On pressing the ENTER key or the SELECT soft key the multimeter will enter the PRT / RTD measurement mode and dynamically select the appropriate range for the measurement

Measurement Resolution

Pressing the DIGITS key will display the resolution menu. The resolution menu shows the available resolutions for the function



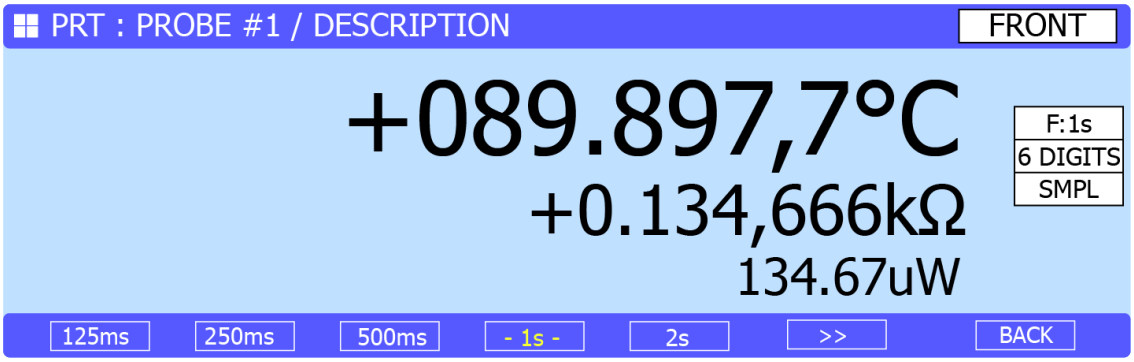
To select the desired resolution, press the BLUE soft key under the desired resolution.

Note - The measurement speed is limited by the resolution of the measurement. The higher the resolution of the measurement, the longer each measurement sample will take.

Configuring Sample Rate

Pressing the ‘FILTER’ key will display the filter speed menu. The filter menu shows the available measurement speeds for the configured measurement resolution and range

NOTE : Faster sample speeds will result in a higher standard deviation due to fewer samples making each individual measurement



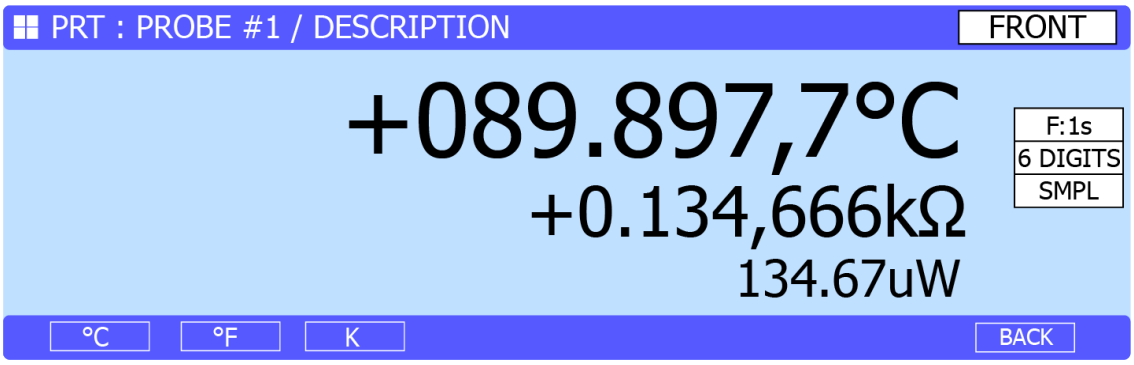
To select the desired filter speed, press the BLUE soft key under the desired selection.

Note - The filter speeds available are dependant upon the current resolution. Refer to extended specifications for valid resolution and filter speed settings.

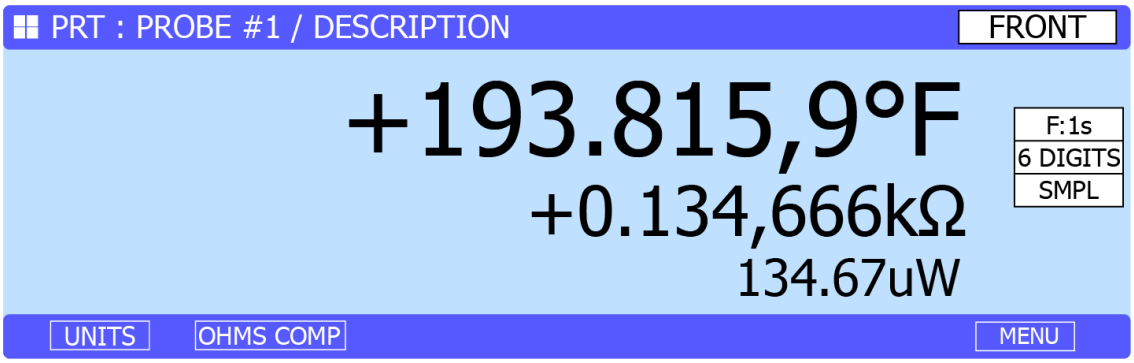
Configuring Temperature Units

The 8104 can perform PRT / RTD temperature conversion from Ohms to °C, °F and Kelvin.

To change temperature units while in PRT measurement mode, press the UNITS soft key. The quick menu will update providing the ability to change units



To change units, press the soft key under the desired unit. The measurement screen will update immediately with the new units



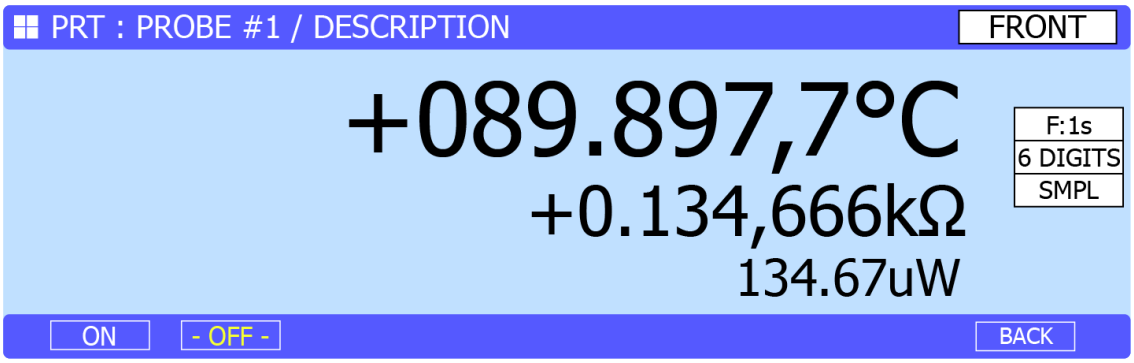
Note - Changing the temperature unit through the quick menu will not update the default units. To change default units refer to the Main Menu

Configuring Ohms Compensation

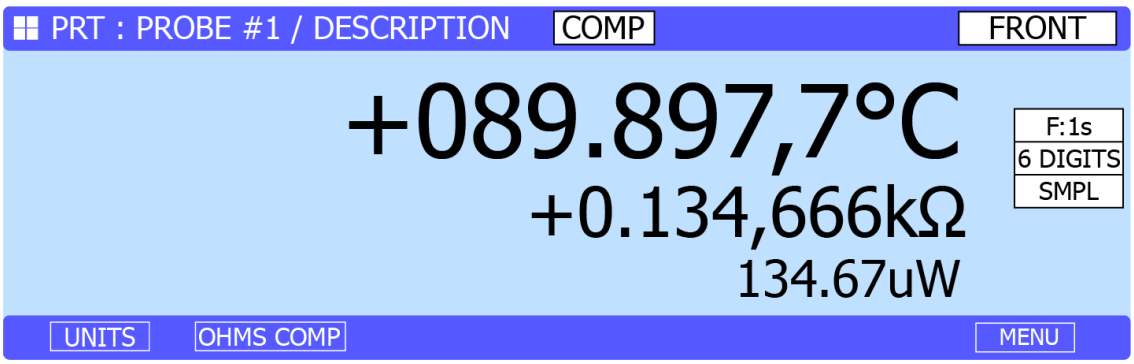
The 8100 Multimeter offers Ohms Compensation functionality for 3 and 4 Wire PRT to automatically compensate for EMF in the measurement leads.

Note - When ohms compensation is enabled the effective sample rate will be lowered due to the automatic compensation cycle.

To enable Ohms Compensation, press the OHMS COMP soft key. The quick menu will update providing the ability to turn the function on or off



When Ohms Compensation is enabled indicator at the top of the screen labelled ‘COMP’ will show providing indication that ohms compensation is presently active.



Note - It will be normal for the reading to change when Ohms Compensation is first enabled as any offset in the leads and connections will be compensated for

Note - While the multimeter is obtaining an offset measurement the measurement will not update during this cycle. This is normal behaviour

Performing A Null

Depending upon the Probe Wiring Scheme (2, 3 or 4 Wires) the Null process will be different.

When using a 2 Wire Connection the multimeter should have a null performed on the 2 Wire, 1 kOhm Low Current range prior to performing PRT Measurements. Refer to instructions on performing a 2 Wire Resistance Null in the 2 Wire Resistance section of this manual

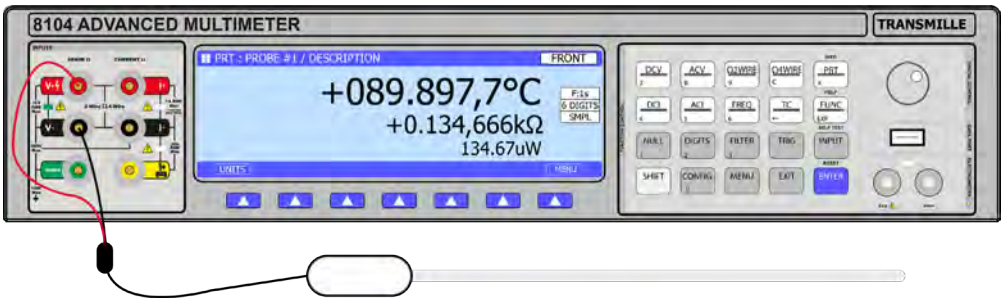
For 3 and 4 Wire measurements it is highly recommended that Ohms Compensation is used, however in instances that this is undesirable (for example maintaining a constant heating effect in the probe) refer to instructions on performing a 4 Wire Resistance Null in the 4 Wire Resistance section of this manual

Note - When the Ohms Compensation function is enabled, performing a manual Null is not required during normal use

Example Connection (2 Wire PRT / RTD)

Connections via the front panel terminals should be made to the V+ (Red Insert) and V- (Black Insert). Connection via the rear panel terminals should be made to the V+ (Red) and V- (Black) terminals.

Care should be taken to ensure that all connecting leads have are clean prior to inserting into the binding posts to avoid errors due to excessive lead resistance.

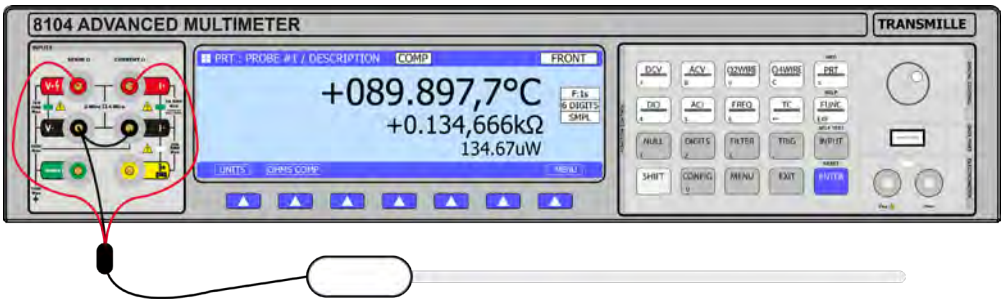


Example Connection (3 Wire PRT / RTD)

Connections via the front panel terminals should be made to the V+ (Red Insert, V- (Black Insert) and I+ (Red Insert). Connection via the rear panel terminals should be made to the V+ (Red), V- (Black) and I+ (Red) terminals. A link wire should be connected between V- and I- to complete the

current circuit.

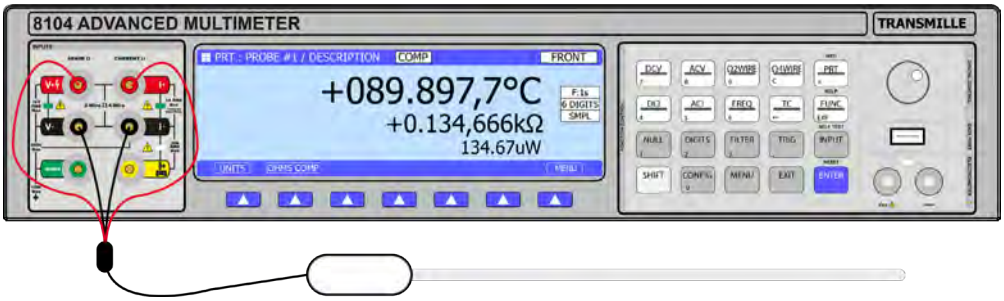
Care should be taken to ensure that all connecting leads are clean prior to inserting into the binding posts to avoid errors due to excessive lead resistance.



Example Connection (4 Wire PRT / RTD)

Connections via the front panel terminals should be made to the V+ (Red Insert, V- (Black Insert), I+ (Red Insert) and I- (Black insert). Connection via the rear panel terminals should be made to the V+ (Red), V- (Black), I+ (Red) and I- (Black) terminals.

Care should be taken to ensure that all connecting leads are clean prior to inserting into the binding posts to avoid errors due to excessive lead resistance and/or thermal EMF.



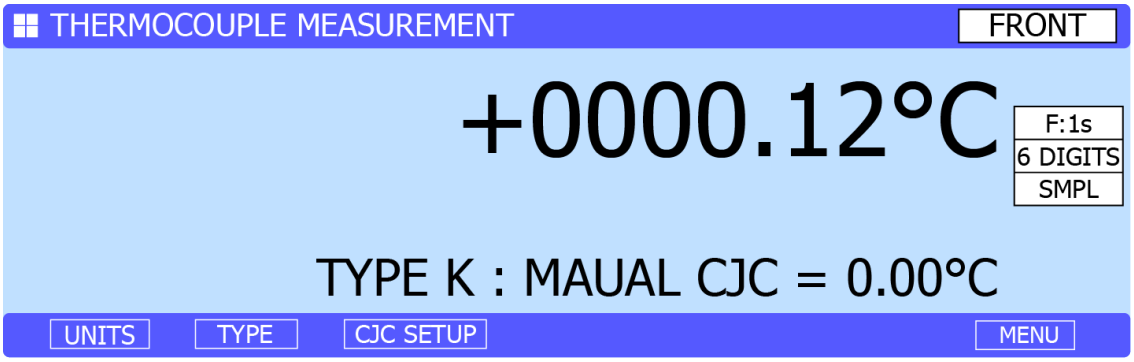
Temperature Measurement - Thermocouple (8104 Only)

The 8104 provides capability to measure thermocouples and report the measurement in absolute temperatures units as well as apply Cold Junction Compensation either automatically (via the TCLEAD accessory) or via direct entry (i.e. from a separate temperature measurement device)

Temperature can be reported as either °C, °F or °K

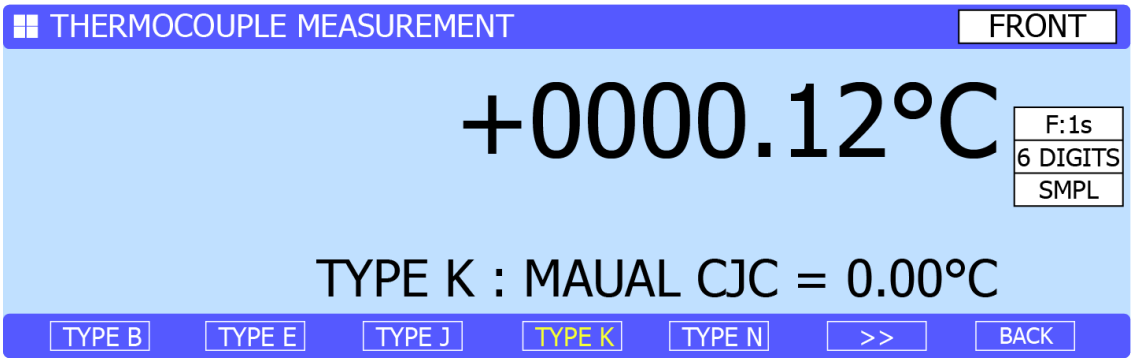
The 8104 supports the following Thermocouple Types : B, E, J, K, N, R, S and T as of UI Version 1.0.7

To enter Thermocouple Measurement mode, press the TC key from the FUNCTION section of the keyboard. Alternatively, press the FUNC key and select THERMOCOUPLE from the menu



Selecting Thermocouple Type

To change Thermocouple Type, press the TYPE soft key from the main measurement screen. The menu will update to display available Thermocouple Types.



To see additional Thermocouple Types, press either the >> or << depending on the current menu and the screen will update to display additional options

Configuring Cold Junction Compensation (CJC)

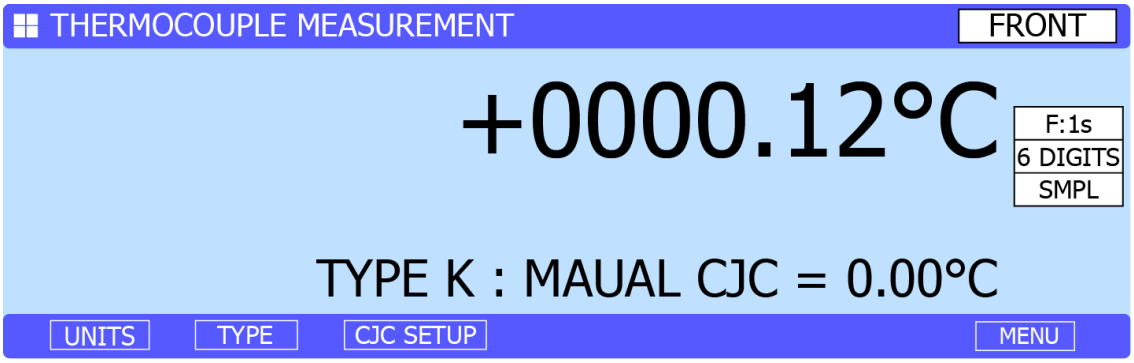
Thermocouples are a relative temperature device, unlike a PRT / RTD probe which is an absolute temperature device. A thermocouple generates a known amount of EMF based on the temperature difference between the end measuring the temperature (i.e. the end of a probe) and the measurement device (the Cold Junction).

When measuring thermocouples and converting to an absolute temperature (i.e. the temperature of a liquid) both the mV level generated by the thermocouple and the temperature at the Cold Junction must be known.

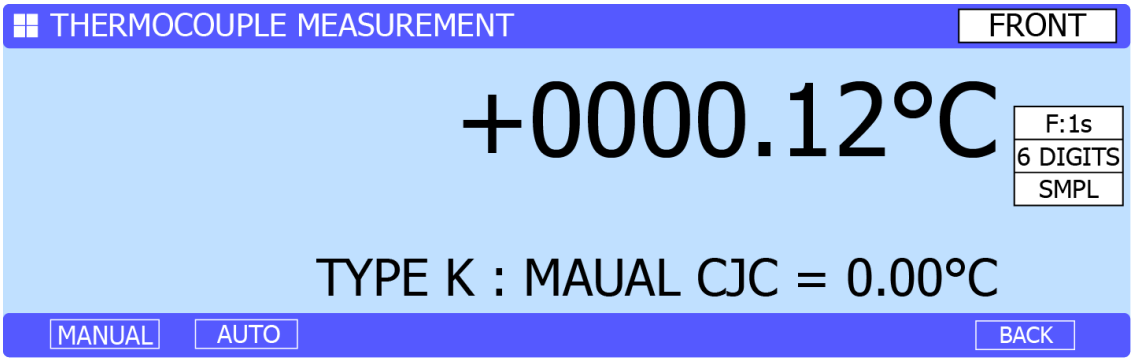
One method is to connect to take the thermocouple through an Ice Bath and connect using copper wires within the Ice Bath, knowing the Cold Junction to be at 0°C. This method requires a complicated set up and maintaining an ice bath.

The other method is to measure the temperature at the point of connection to the measuring device and compensate for the temperature of the Cold Junction.

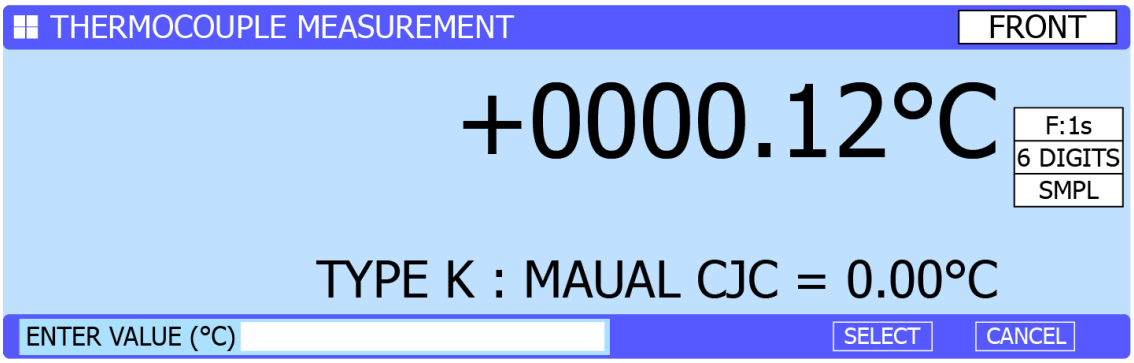
The current Cold Junction Method (MANUAL or AUTO) as well as the value is displayed on the lower portion of the main measurement screen.



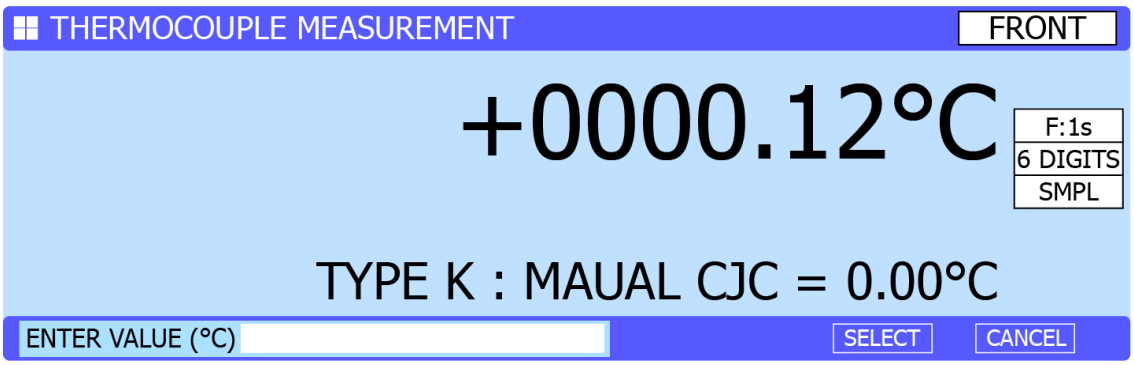
The COLD JUNCTION menu provides users with the ability to manually enter a cold junction value or to select AUTO (requires TCLEAD accessory). To enter the COLD JUNCTION menu, press the CJC SETUP soft key.



If MANUAL entry is selected an entry box will appear, allowing the cold junction value to be entered in the same units as the temperature measurement.

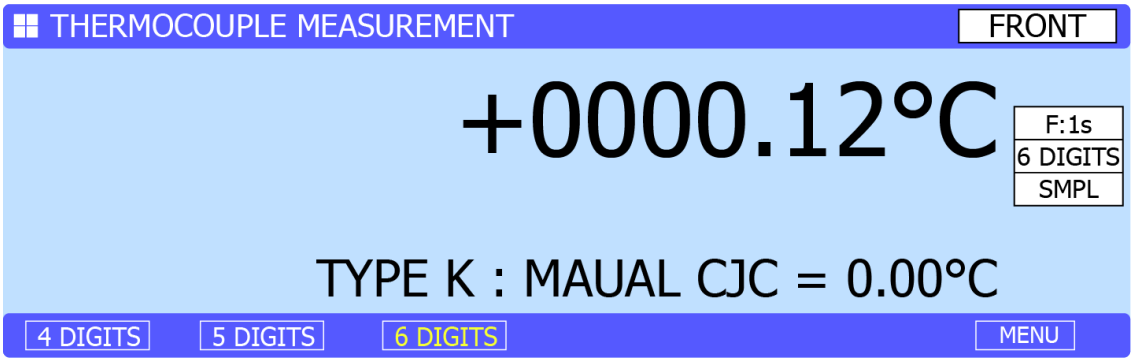


If AUTO is selected the unit will return to the main menu and periodically perform measurements of the Cold Junction automatically



Measurement Resolution

Pressing the DIGITS key will display the resolution menu. The resolution menu shows the available resolutions for the function, up to 8 Digits (8104) / 7 Digits (8109).



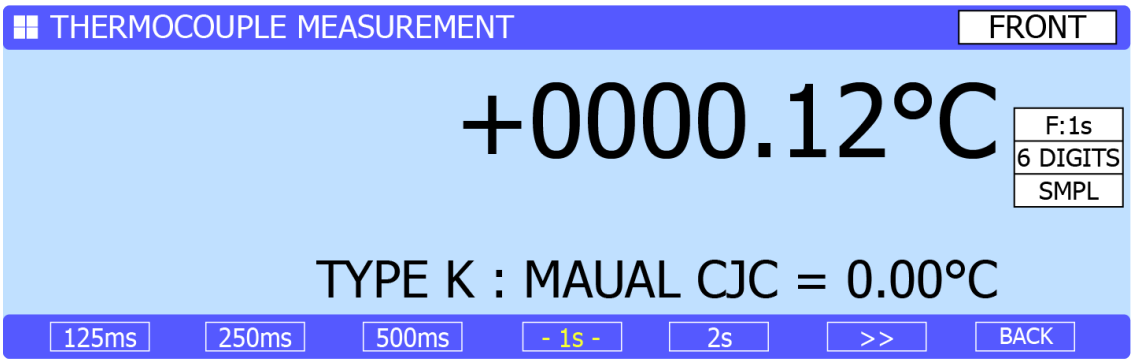
To select the desired resolution, press the BLUE soft key under the desired resolution.

Note - The measurement speed is limited by the resolution of the measurement. The higher the resolution of the measurement, the longer each measurement sample will take.

Configuring Sample Rate

Pressing the 'FILTER' key will display the filter speed menu. The filter menu shows the available measurement speeds for the configured measurement resolution and range

NOTE : Faster sample speeds will result in a higher standard deviation due to fewer samples making each individual measurement



To select the desired filter speed, press the BLUE soft key under the desired selection.

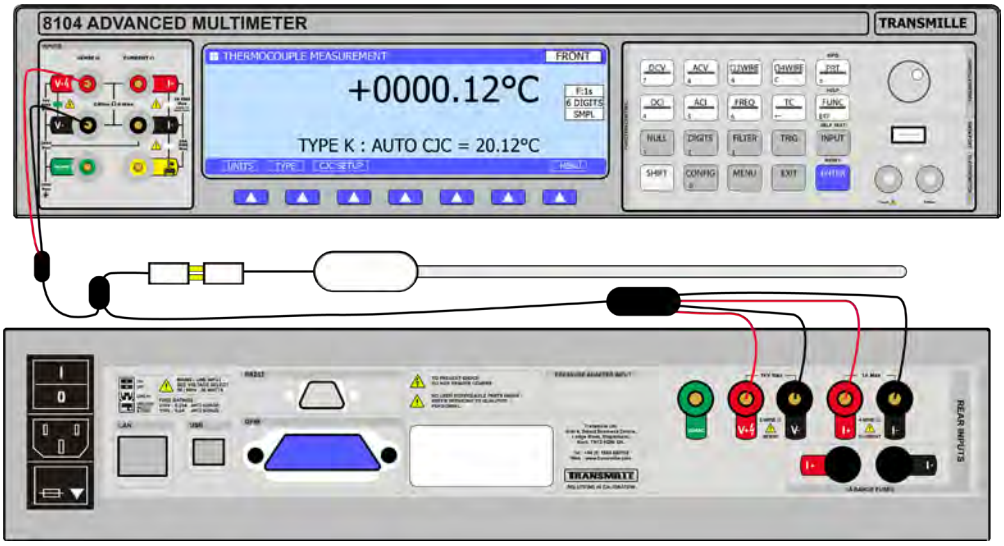
Note - The filter speeds available are dependant upon the current resolution. Refer to extended specifications for valid resolution and filter speed settings.

Example Connection (TCLEAD)

The optional TCLEAD accessory provides connections for both Voltage measurement as well as measurement of the Cold Junction at the point of connection with a thermocouple. The Connection provides a neutral Copper-Copper Mini TC Socket that thermocouples plug directly into and reduced

additional errors due to mismatch in wires.

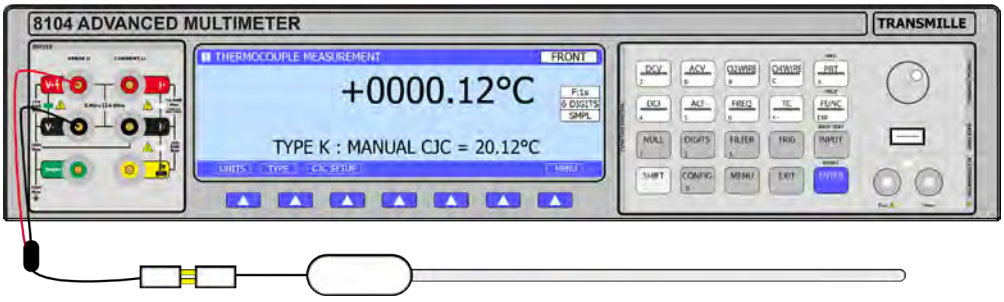
Embedded within the Mini TC Socket is a PRT sensor that is measured by the 8104 using the rear panel input terminals to obtain a highly accurate measurement of the Cold Junction as close as physically possible to the point of connection. This avoids the need for connecting through an ice bath or measuring the cold junction temperature with an additional sensor



Example Connection (Direct Connection)

When making a connection without the TCLEAD there are additional considerations that must be made to avoid large measurement errors

- Neutral connections and wires must be used to connect to the thermocouple output
- A highly accurate (< 0.1°C Error) measurement of the ambient temperature at the point of connection OR the use of an ice bath
- All connections must be low thermal (Gold plated copper or similar) - The use of nickel adapters will cause large errors.



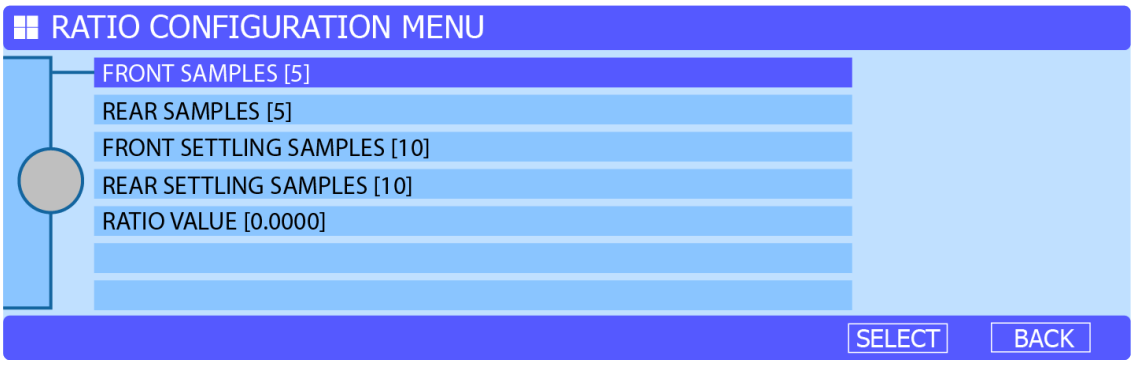
Ratio Measurements (8104 Only)

The 8104 provides powerful ratio measurement capability, with the ability to configure the number of samples to allow settling after changing inputs, the number of averages on a per input basis as well as the ability to 'Ratio To Value' in which the multimeter corrects for internal errors based on the value of an external standard.

Note - Ratio functionality is not available for DC or AC Current measurements or for resistance measurements that use the electrometer functionality.

Configuring Ratio Measurements

Ratio functionality is configured via the Ratio Configuration menu which is accessible via the Main Menu. Using the Main Menu, scroll to the RATIO CONFIGURATION option and press the ENTER key or the SELECT soft key



To select a menu item, use the digital control to scroll and then press the ENTER key or the SELECT soft key.

Menu Item	Description	Default Setting
FRONT SAMPLES	The number of samples that are taken on the FRONT input terminals on each cycle.	5
FRONT SETTLING SAMPLES	The number of samples that are taken on the FRONT terminals prior to taking an average. This allows the reading to stabilise after changing inputs / ranges without affecting the ratio measurement	10
REAR SAMPLES	The number of samples that are taken on the REAR input terminals on each cycle	5
REAR SETTLING SAMPLES	The number of samples that are taken on the REAR terminals prior to taking an average. This allows the reading to stabilise after changing inputs / ranges without affecting the ratio measurement	10

Menu Item	Description	Default Setting
RATIO VALUE	The value that is used in a Ratio To Value measurement, for example, 10.000108V from a Zener Reference connected to the rear terminals	0.0000

Note - Ratio settings will return to default when the multimeter is RESET.

Available Ratio Modes

The 8104 offers 6 different ratio modes, descriptions of which are below

Mode [Soft key Text]	Description
Front : Rear [F:R]	In this ratio mode the measurement from the FRONT terminals is divided by the measurement from the REAR terminals
Rear : Front [R:F]	In this ratio mode the measurement from the REAR terminals is divided by the measurement from the FRONT terminals
Value	In this ratio mode the measurement from the REAR terminals is used to correct for internal errors of the multimeter, the scaling factor of which is used to correct the measurement on the FRONT terminals
Front - Rear [F-R]	In this ratio mode the measurement from the REAR terminals is subtracted from the measurement on the FRONT terminals
Rear - Front [R-F]	In this ratio mode the measurement from the FRONT input is subtracted from the measurement on the REAR terminals

Performing a Ratio Measurement

To enter Ratio mode, select the function that the ratio is to be performed on (i.e. DC Voltage). Configure for either manual range (best performance) or auto range measurement

Press the INPUT key to display the input menu which will indicate the currently active input along with the RATIO soft key which allows access to the Ratio sub menu.

If the multimeter is already in a Ratio Mode the RATIO key will be highlighted in YELLOW text, if not already in a ratio mode the key will be WHITE

Pressing the RATIO soft key will display the ratio sub menu which provides access to all ratio modes

Ratio To Value

In the ‘Ratio To Value’ mode, the multimeter dynamically takes measurements from the REAR input terminals, determines a scaling factor for the error and then applies a correction to the measurement on the FRONT input terminals

For example, a Zener reference with a certified value of 10.000,000V is connected to the REAR input terminals. The RATIO VALUE setting would be set to the certified value and the ratio mode set to RATIO VALUE

The multimeter was calibrated 180 days ago and has drifted by 2ppm, so the measurement of the 10V on the rear panel is 9.999,980 V. To correct for this the scale factor would be 1.000002. The multimeter dynamically applies this scaling factor to the front panel terminals to correct for the drift of the multimeter as well as any temperature effects.

This mode is best used when performing a transfer between two standards or from a standard to a precision source such as a multi product calibrator as the multimeter is dynamically compensating for internal errors and the linearity performance of the multimeter can be used to perform an accurate transfer.

Shunt Current Measurement (8104 Only)

The 8104 features the capability to provide an absolute current measurement based upon the voltage developed across an external current shunt. This capability is offered for both DC and AC current.

For AC measurements the 8104 will perform both a calculation based upon the measured voltage across the shunt and the DC resistance, but also perform a linear correction for AC/DC error from the known AC/DC error from the calibration report based upon the measured frequency, reporting a corrected value of current for ease of use

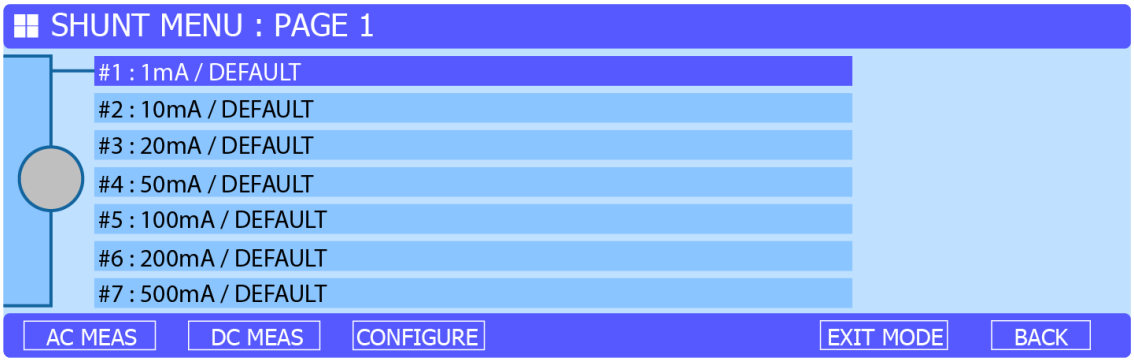
Shunt Configuration

The 8104 has been designed for use with the Transmille AC/DC Current Shunts which are available in 1,2 and 5 steps from 1mA to 100A. It is also possible to use current shunts from other

manufacturers

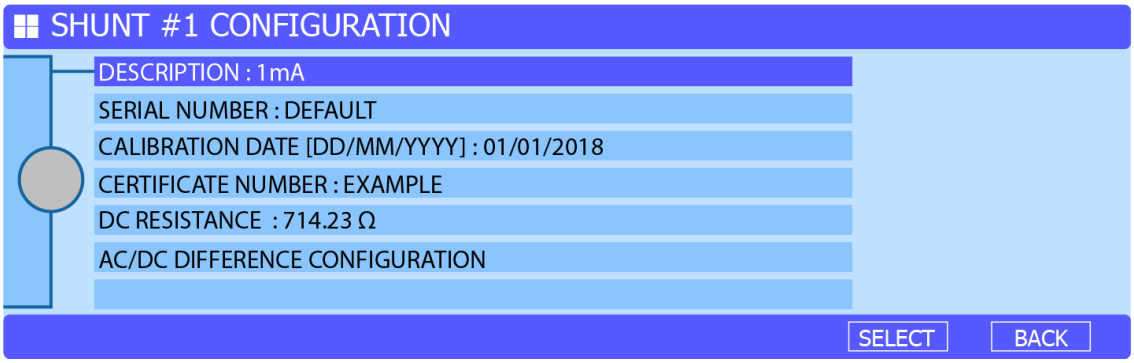
To enter correction factors for a new shunt, press the FUNCTION key and select the AC/DC SHUNT menu option

A scrollable list of 14 user configurable shunts will appear. This list is pre-loaded with default data for convenience based upon the range of AC/DC Shunts available from Transmille



To edit the configuration, highlight the desired Shunt from the menu and press the CONFIGURE soft key.

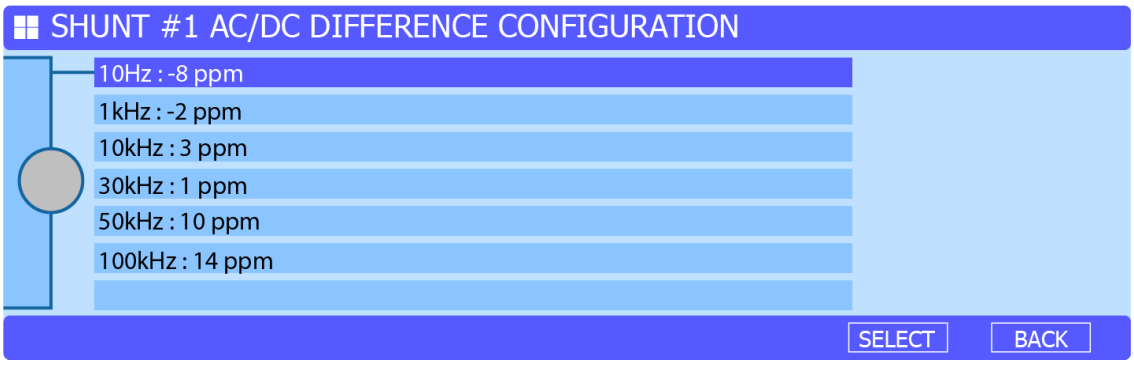
The SHUNT CONFIGURATION screen will appear, allowing the user to edit the Description, Serial Number, Calibration Date, Certificate Number, DC Resistance (in Ohms) as well as enter AC/DC Difference Characteristics



To edit any item, highlight using the DIGITAL CONTROL and then select the menu item. For text or date entry the On Screen Keyboard (described on Page 13) will appear. For numerical entry of the DC Resistance the numerical entry screen will appear.

To update or enter AC/DC correction factors, select the AC/DC DIFFERENCE CONFIGURATION menu item. A new menu will appear allowing entry of the AC/DC Difference

from the calibration certificate



The 8104 offers 6 fixed frequency correction points at 10Hz, 1kHz, 10kHz, 30kHz, 50kHz and 100kHz to match those offered with Transmille AC/DC Shunts. For other manufacturers a linear approximation can be made between points to match.

To edit a value, highlight and select an item using the digital control and press ENTER or SELECT. Enter the new correction factor in PPM and press the soft key labelled ENTER.

Press BACK to return to previous menus

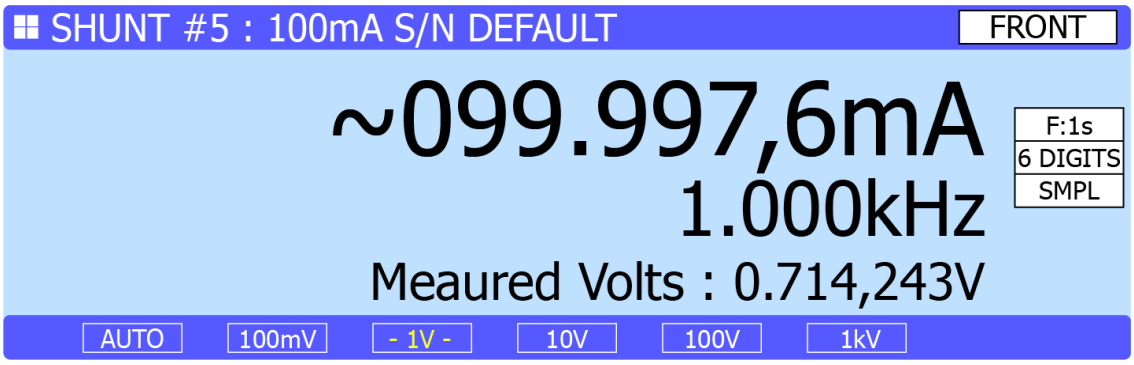
Selecting and using a Shunt

To select a Shunt for use, navigate to the SHUNT menu and highlight the desired shunt. Then select either AC MEAS or DC MEAS from the soft key menu at the bottom of the screen

Selecting AC MEAS will change the multimeter to the 1V AC Range (which offers high input impedance to minimise loading errors) in preparation for performing measurements.

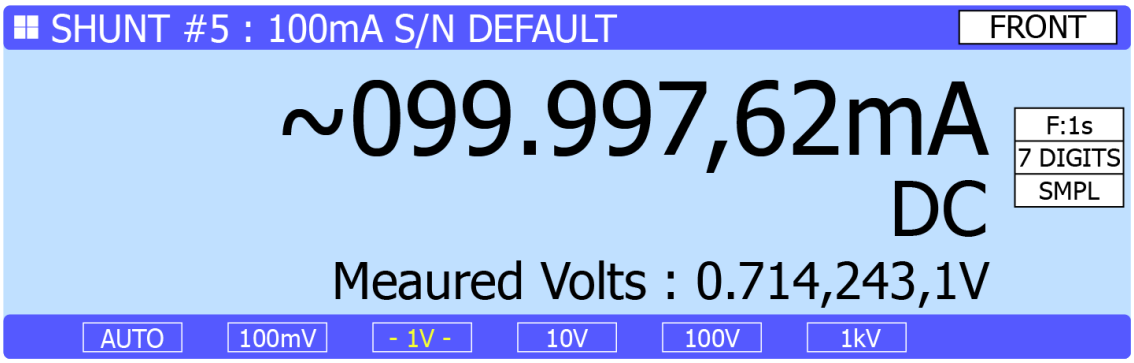
In AC MEAS mode the indicated reading is the result of the measured voltage (V) divided by the DC Resistance that has been configured for the shunt (R) and then an additional correction for the known AC/DC Difference at the measured frequency. The multimeter will perform a straight line

linearisation to determine the AC/DC Difference if the frequency is between the correction points.



The Calculated Reading, Frequency and the Voltage at the terminals are all displayed simultaneously as well as the Shunt Number, Description and Serial Number are shown in the top bar of the measurement screen.

Selecting DC Meas will change the multimeter to the 1V DC Range in preparation for performing measurements. The indicated reading is the result of the measured voltage (V) divided by the DC Resistance that has been configured for the shunt (R).



As in AC Measurement the Calculated Reading and Voltage at the terminals is displayed, with the Shunt Number, Description and Serial number shown in the top bar of the measurement screen.

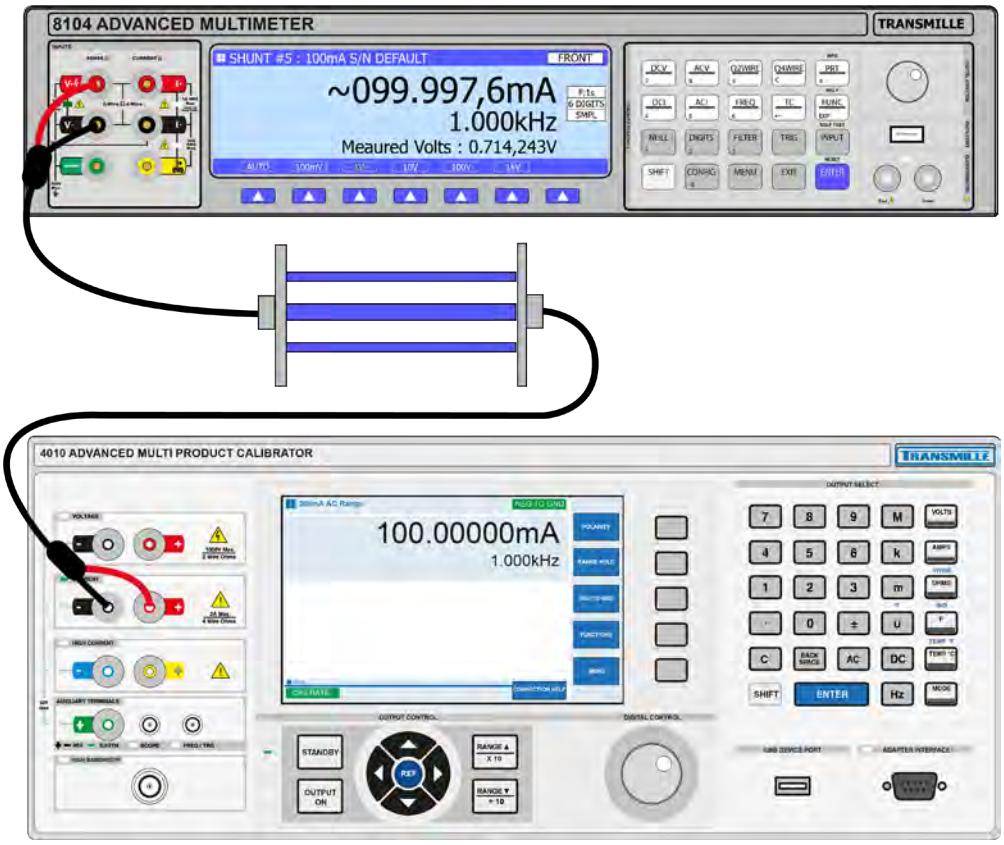
Example Connection

Connections to the multimeter are made from the Voltage OUTPUT of the current shunt connected to the Voltage INPUT of the multimeter, front or rear terminals

It is important to ensure that the use of adapters (i.e. Type N to 4mm) is minimised to reduce the effects of thermals in DC Measurements (typically low cost adapters are constructed from nickel

rather than materials with low EMF) and to reduce AC measurement errors with higher frequencies.

Transmille provide lead sets that are suitable for making interconnections between Transmille AC/DC shunts and the 8104 as well as current sources.



Ensure that excessive force is not applied when making connections to shunts and that all leads are kept as short as possible.

Maths Operations

The 8100 Series features a configurable MATHS function enabling maths functions such as multiplication to be applied to the incoming reading, and the result displayed as the current reading.

Maths functions are enabled and disabled through the Maths menu which is available either through the Main Menu (Read Page 23 for information) or via the CONFIG key and selecting MATHS from the soft key menu

The 8100 Series offers Multiplication, Division and Subtraction as arithmetic functions, and provides both Rolling and Block average functions.

Arithmetic Functions

Multiply by m

When this Maths mode is activated the input is multiplied by the number m

Divide by d

When this Maths mode is activated the input is divided by the number d

Subtract n

When this Maths mode is activate the input has the number n subtracted.

Sequential Arithmetic

Each Maths function is performed in turn, and when multiple Maths functions are enabled it is possible to perform more advanced calculations, for example :

10V Input with parameters m = 4, d = 2 and n = 1.2
= ((Input x m) / d) - n
= ((10V x 4) / 2) - 1.2
= 18.8V

Note - It is not possible to change the order of this calculation

Averaging Functions

The 8100 series has configurable averaging modes that are configurable by the end user. The result of the configured average is displayed in place of the main measurement. The averaging functions can be used simultaneously with the arithmetic functions

Rolling Average

The Rolling Average mode provides a ‘smoothed’ display of the last x readings, where x is the number of readings in the average.

In Rolling Average mode once x readings have been stored in memory, on the next sample the oldest measurement is removed from the average and the newest sample added. This is desirable for long term measurements of a single source such as a Zener Reference or Standard Resistor where the effects of occasional noise wish to be filtered out.

Block Average

The Block Average mode provides the average of the present x readings, where x is the number of readings in the average.

In Block Average mode once x readings have been stored in memory, the average is reset and the average starts again. This is desirable for readings that may be changing periodically and an

average that is faster to respond is desirable.

Remote Operation

The 8100 series has been designed to be easy to program and use in a fully automated system. All functions of the multimeter are available over the remote interface.

Native Commands

Native commands are directly compatible with Transmille 8000 Series command structures. This means that any application/procedure that was written for the 8000 Series will operate with the 8100 Series without modification.

Command Structure

Native commands sent to the 8100 Series can be joined using the / (forward slash) character. This allows for compound commands to be sent to set Range and measurement parameters as a single command.

The command structure is as follows :

<Command 1>{</Command 2}><CR>

Where Command 2 is encompassed in { } and is optional and <CR> represents Carriage Return or Line Feed

All commands must be terminated with either Carriage Return (ASCII Character 13) or Line Feed (ASCII Character 10)

Command Response Codes

The 8100 Series responds to commands with the following strucutre

Response	Meaning
*0<cr><lf>	Successful Command
*2<cr><lf>	Command correct with an incorrect input signal
*3<cr><lf>	Command correct with incorrect or missing parameters
*6<cr><lf>	Unauthorised command
*7<cr><lf>	Command sent with incorrect range
*9<cr><lf>	Unrecognised Command

Setting Ranges/Functions

AC Voltage

Command	Parameters
RANGE:AC:VOLTAGE<space><value>	Value = 0.1 to 1,000
RANGE:AC:VOLT<space><value>	

DC Voltage

Command	Parameters
RANGE:DC:VOLTAGE<space><value>	Value = 0.1 to 1,000
RANGE:DC:VOLT<space><value>	

AC Current

Command	Parameters
RANGE:AC:CURRENT<space><value>	Value = 0.000,1 to 30
RANGE:AC:CURR<space><value>	

DC Current

Command	Parameters
RANGE:DC:CURRENT<space><value>	Value = 0.000,000,01 to 30
RANGE:DC:CURR<space><value>	

4 Wire Resistance - Low Current

Command	Parameters
RANGE:FRES:LOWI<space><value>	Value = 100 to 10,000
RANGE:FRESISTANCE:LOWI<space><value>	

4 Wire Resistance

Command	Parameters
RANGE:FRES<space><value>	Value = 1 to 100,000
RANGE:FRESISTANCE<space><value>	

2 Wire Resistance - Low Current

Command	Parameters
RANGE:RES:LOWI<space><value>	Value = 100 to 10,000
RANGE:RESISTANCE:LOWI<space><value>	

2 Wire Resistance

Command	Parameters
RANGE:RES:LOWI<space><value>	Value = 10 to 1,000,000,000
RANGE:RESISTANCE:LOWI<space><value>	

Thermocouple (8104 Only)

Command	Parameters
RANGE:THERMOCOUPLE:<TC_ TYPE><space><Cold_Junction>	TC_TYPE = B,E,J,K,N,R,S,T Cold_Junction = -273 to 1800'C OR 'AUTO'

PRT (ITS-90 Linearisation) (8104 Only)

Command	Parameters
RANGE:PRT:ITS<space><probe_number>	Probe_Number = 1 to 10

PRT (IEC751 Linearisation) (8104 Only)

Command	Parameters
RANGE:PRT:IEC<space><probe_number>	Probe_Number = 1 to 10
RANGE:PRT<space><probe_number>	

Electrometer Output Voltage (8104 Only)

Command	Parameters
ELECTROMETER:VOLTAGE<space><voltage>	Voltage = 10, 50, 100, 150, 200, 250, 300

Measurement Parameters

Obtaining Readings

Command	Response
READ?	Returns the next reading obtained by the Instrument

Setting Resolution

Command	Response
D<Digits>	Digits = 4 to 8

Setting Filter

Command	Response
F<Filter_Range>	Filter_Range = 0 to 9 where : 0 = 125ms 1 = 250ms 2 = 500ms 3 = 1s 4 = 2s 5 = 4s 6 = 8s 7 = 16s 8 = 32s 9 = 64s

System Functions

Enable / Disable Backlight

Command	Response
DISPLAY:BACKLIGHT<parameter>	Parameter = ON or 1 for Backlight ON, OFF or 0 for Backlight OFF

Reset to Startup Parameters

Command	Response
*RST	Multimeter resets to start up conditions as described on “Power On Defaults” on Page 20

Query Instrument ID

Command	Response
*IDN?	The Instrument will respond with the following <manufacturer>,<model number>,<serial number>,<version number> as per IEEE 488 Guidelines

Query Instrument Internal Temperature

Command	Response
*TEMP?	The Instrument will respond with the internal temperature in °C

Perform backup of Calibration Factors

Command	Response
SYSTEM:CALIBRATION:BACKUP	The Instrument will indicate on the front panel that an Internal backup of calibration factors is being performed

Calibration & Verification

Introduction

The 8100 Series has been designed to be easy to calibrate by tehnicians and laboratories with suitable equipment. No special software is required and all adjustments are available via the front panel or over the remote interface.

It is highly advised to automate this process to ensure repeatable results as well as minimise time requirements. Automated procedures are available for use with Transmille ProCal software which perform full verification and adjustment to manufacturers specification.

Calibration Instructions

Instructions for verifiying and adjusting the 8100 Series multimeters can be found on the online support portal at http://support.transmille.com/solution/folders/9000184288. These pages include automated spreadsheets for determining pass/fail limits based upon the reccomended test points and the applied value

Important Notes

The 8100 Series are highly accurate instruments and great care should be taken when performing verification and adjustments. Suitable equipment should be used and care should be taken to ensure that the accuracies of the source equipment (i.e. multiproduct calibrator, standard resistor) are suitable for performing verification and adjustments to the 8100 Series.

Transmille provide free advise and suggestions on how to avoid issues during verification and adjustment. We can be contacted via email at support@transmille.com where we can advise on how best to perform verifications based upon the available equipment.

ABOUT US

We truly believe in offering Solutions in Calibration, offering bespoke solutions for calibration laboratories and manufacturers across the globe. Our mission statement is not just a phrase, it is our design and support philosophy, offering support and advice that cannot be found elsewhere with a friendly atmosphere.

Transmille was founded in 1997 as a commercial calibration service, and soon after began to develop and manufacture a range of electrical calibration products and software to answer a growing requirement for solutions to common problems. Following this small beginning, Transmille has worked year on year to provide unique equipment and software to benefit calibration laboratories and manufacturers across the globe.

Ever since releasing the very first products Transmille have continued to innovate and develop new products for the metrology community, from world first products such as the 2100 Electrical Test Equipment calibrator, through to the worlds lowest cost multi product calibrator the 1000 series.

Transmille now produce over 600+ calibration instruments per year, shipping instruments to customers ranging from National Standards Laboratories and manufacturers through to small calibration test houses around the world.

An unrivalled commitment to quality and innovation drives Transmille forwards, with a dedicated design and support team in house with a combined experience of over 60 years in manufacture and design of electrical calibration products and software.

With local distributors across the globe, we can offer one to one personalised support, no matter how large or small the customer.

TRANSMILLE
SOLUTIONS IN CALIBRATION

Unit 4, Select Business Centre,
Lodge Road,
Staplehurst,
Kent
TN12 0QW.
United Kingdom

Main Office : +44 (0) 1580 890700
sales@transmille.com
www. transmille.com

Distributor Details :

YouTube
www.youtube.com/Transmille