



Time Electronics
Calibration, Test and Measurement

User Manual

5018 Programmable Voltage and Current Calibrator

Revision 2206-1

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Nothing from this manual may be multiplied, or made public in any form or manner, either electronically or hard copy, without prior written consent from Time Electronics Ltd.

This also applies to any schematics, drawings and diagrams contained herein.

This manual provides operating and safety instructions for the Time Electronics product.

To ensure correct operation and safety, please follow the instructions in this manual.

Time Electronics reserves the right to change the contents, specifications and other information contained in this manual without notice.

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1 Introduction

1.1 Overview

The 5018 is a versatile programmable calibrator capable of covering a wide range of testing applications. It can be configured as a single function DC voltage source or advanced AC/DC voltage and current calibrator controlled via PC or laptop, performing any number of tasks as part of a complex ATE test rig.

It is suitable for automated signal injection in R&D and manufacturing applications where a stable and accurate source is required. The compact form factor means it takes up minimal bench space in the lab, or an optional 19" rack mount kit is available for integration into a modular test equipment setup.

GPIB, RS-232 and USB interfaces allow the 5018 to be connected to a PC and controlled by an external program such as EasyCal calibration software. The 5018 uses a SCPI command structure for programming. This makes writing control programs in Visual Basic, C and Labview a simple task.

Features

- 0 to 22 V DC
- 220 V and 1 kV DC options
- 0 to 220 mA AC/DC options
- 0 to 22 V AC option
- Ramping feature
- GPIB / RS-232 / USB interfaces
- EasyCal Software compatible

Internal Factory Fitted Options

- 9718: Current option (220 mA max)
- 9719: AC option (22 V max)
- 9721: 200 V DC option
- 9720: 1 kV DC option (includes 200 V DC option 9721)

External Options

- 19" Rack Mount Kit
- Test Lead Sets
- Soft Carry Case
- Low noise attenuators (low level AC/DC signals with low noise)
- EasyCal calibration software and peripherals

1.2 Important Information



Warning: The 5018 is a heavy instrument and care should be taken when lifting to prevent injury. Use both handles to carry.

Warning: If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. This instrument must be connected to a grounded outlet.



High Voltage

The 5018 is capable of producing **1000 V** and users should be aware of the dangers involving serious electrical shock.



Warning: If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired. This instrument must be connected to a grounded outlet.



This instrument is to be serviced by trained personnel only.

Disconnect mains supply before removing cover or replacing fuses.

For operations involving removal of the 5018's cover, users should be aware that certain sections of the circuitry carry high voltages, which are hazardous. Very high currents causing burns can also be generated if certain terminals are inadvertently shorted.

1.3 Specifications

1.3.1 Technical Specifications

Accuracy specifications are shown as ppm (or %) of output + floor and apply for settings between 10 % and 100 % of range. Specifications apply at an ambient temperature of 23 °C ± 5 °C after the calibrator has warmed up for at least 1 hour.

DC Voltage

Range	Accuracy 1 year	Output resistance	Max output Current	Resolution
22 mV	30 ppm + 4 μ V	10 Ω	-	100 nV
220 mV	15 ppm + 6 μ V	10 Ω	-	1 μ V
2.2 V	15 ppm + 20 μ V	< 0.15 Ω	20 mA	1 μ V
22 V	15 ppm + 150 μ V	< 0.15 Ω	20 mA	10 μ V

DC High Voltage options (9721: 220 V range only / 9720: Both ranges)

Range	Accuracy 1 year	Output resistance	Max output current	Resolution
220 V *	15 ppm + 1 mV	< 0.25 Ω	10 mA	100 μ V
1 kV *	25 ppm + 3 mV	< 1 Ω	1 mA	1 mV

* Minimum Load 20 k Ω

DC Current option 9718

Range	Accuracy 1 year	Compliance voltage	Resolution
220 μ A	150 ppm + 15 nA	11 V	1 nA
2.2 mA	100 ppm + 40 nA	11 V	10 nA
22 mA	80 ppm + 200 nA	11 V	10 nA
220 mA	80 ppm + 3 μ A	11 V	100 nA

AC Voltage option 9719: 10 Hz to 20 kHz (sine 0.01 % crystal controlled)

Range RMS	Accuracy % 1yr 10 Hz - 1 kHz	Accuracy % 1 yr 1 kHz - 10 kHz	Accuracy % 1 yr 10 kHz - 20 kHz	Output resistance	Max output current	Resolution
22 mV	0.05 % + 100 μ V	0.05 % + 150 μ V	0.05 % + 250 μ V	10 Ω	-	1 μ V
220 mV	0.04 % + 100 μ V	0.04 % + 150 μ V	0.04 % + 250 μ V	10 Ω	-	1 μ V
2.2 V	0.03 % + 170 μ V	0.03 % + 250 μ V	0.03 % + 300 μ V	< 0.15 Ω	20 mA	10 μ V
22 V	0.03 % + 2.0 mV	0.03 % + 3.0 mV	0.03 % + 4.0 mV	< 0.15 Ω	20 mA	100 μ V

AC Current option: 20 Hz to 1 kHz (Sine) - available if current and AC options are fitted

Range RMS	Accuracy 1 year	Compliance voltage RMS	Resolution
220 μ A	0.07 % + 300 nA	5 V	10 nA
2.2 mA	0.05 % + 300 nA	5 V	10 nA
22 mA	0.05 % + 3 μ A	5 V	100 nA
220 mA	0.05 % + 30 μ A	5 V	1 μ A

1.3.2 General Specifications

Warm up: 1 hour to full accuracy.

Settling time: Less than 5 seconds.

Standard interfaces: GPIB (IEEE-488), RS-232, USB.

Temperature performance: Operating: 10 to 40 °C, Full Spec: 23 °C ± 5 °C, Storage: -10 to 50 °C.

Operating humidity / Altitude: < 80 % non-condensing. Altitude: 0 to 3 km. Non-operating 3 to 12 km.

Line power: 100 to 230 V AC 50/60 Hz. Power consumption 60 W typical, 100 W maximum.

Max Voltage between terminals: Between V+ and V- terminals: < 1500V peak
Between V- and Earth: < 75V peak

Dimensions / Weight: W 450 x D 272 x H 152 mm (18 x 11 x 7 ") / 8.2 kg (18 lbs).

Supplied with: User manual, RS-232 cable, USB adaptor/cable.

1.3.3 Ordering Information

5018	Programmable DC/AC V/I Calibrator
9718.....	Internal Current option (220 mA max)
9719.....	Internal AC option (22 V max)
9721.....	Internal 200 V DC option
9720.....	Internal 1 kV DC option (includes 200 V DC option 9721)
9728.....	19 " universal rack mount kit
9541.....	Basic test lead set
9796.....	Premium test lead set
C142.....	Traceable calibration certificate (Factory)
C104.....	Accredited calibration certificate (ISO 17025)
9766.....	External low noise attenuator 1000:1
9767.....	External low noise attenuator 100:1
9795.....	Printer and connectivity kit
ECFLA	EasyCal Software (see separate datasheet for options)

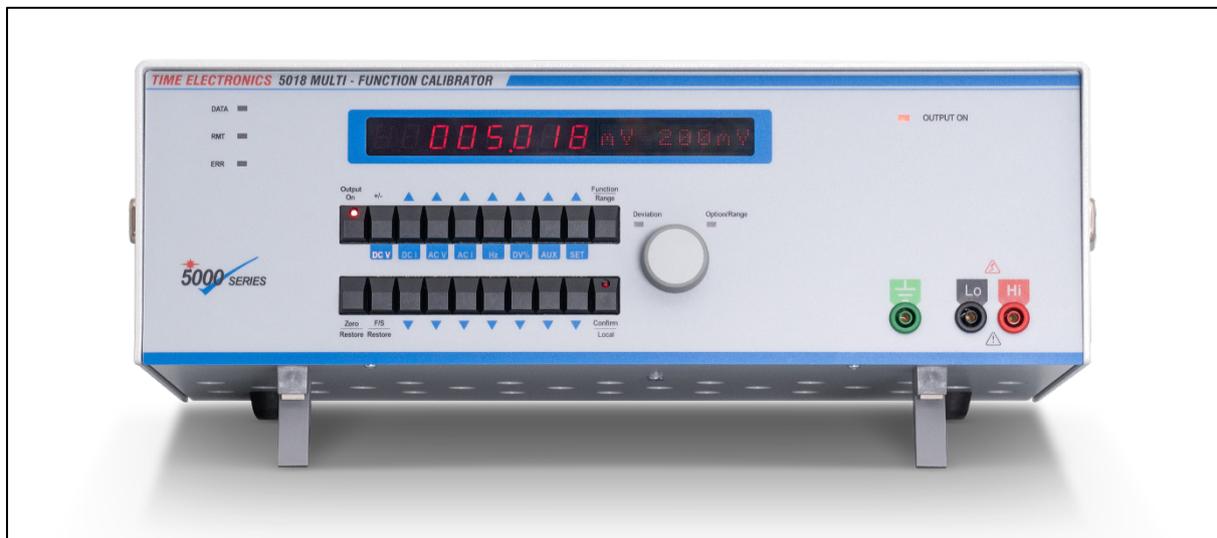
1.4 Installation

1.4.1 Positioning the Instrument

Benchtop Use

The 5018 should always be positioned on a flat, firm surface. The instrument base is fitted with four feet. The front feet have tilt legs to angle the instrument upwards for ergonomic front panel operation.

- A 10 cm area of free space is recommended at the rear of the instrument.
- Do not obstruct the fan inlet on the rear of the instrument.
- Do not obstruct any exhaust outlets on the bottom of the instrument.
- Do not place objects or materials under the instrument.



Rack Mounting

A 19" rack mount option is also available. In this configuration mounting brackets replace the carry handles.

Cleaning

When cleaning the 5018 use an alcohol-free wipe such as a 'durable screenclean 50'.

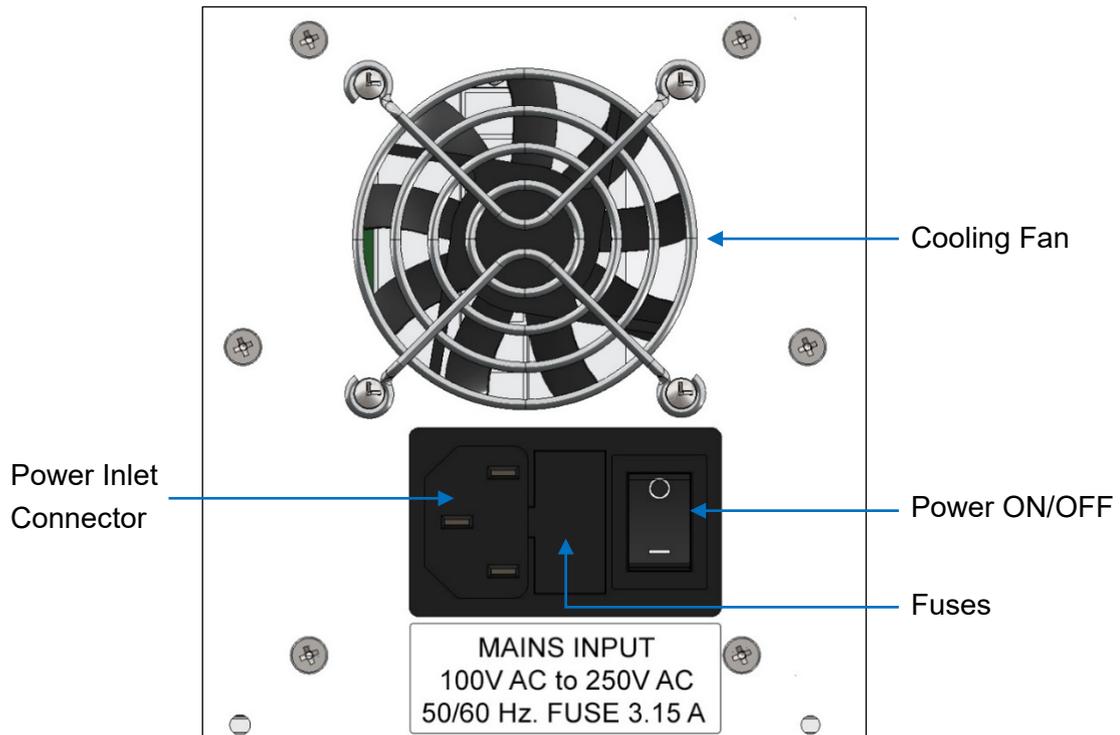
Packaging

The 5018 is supplied in a carton with protective inserts. Retain the shipping box and internal packaging for future use. If the unit is returned to Time Electronics for calibration, please use this original packaging to avoid possible damage in transit.

1.4.2 Mains (Line) Power Supply

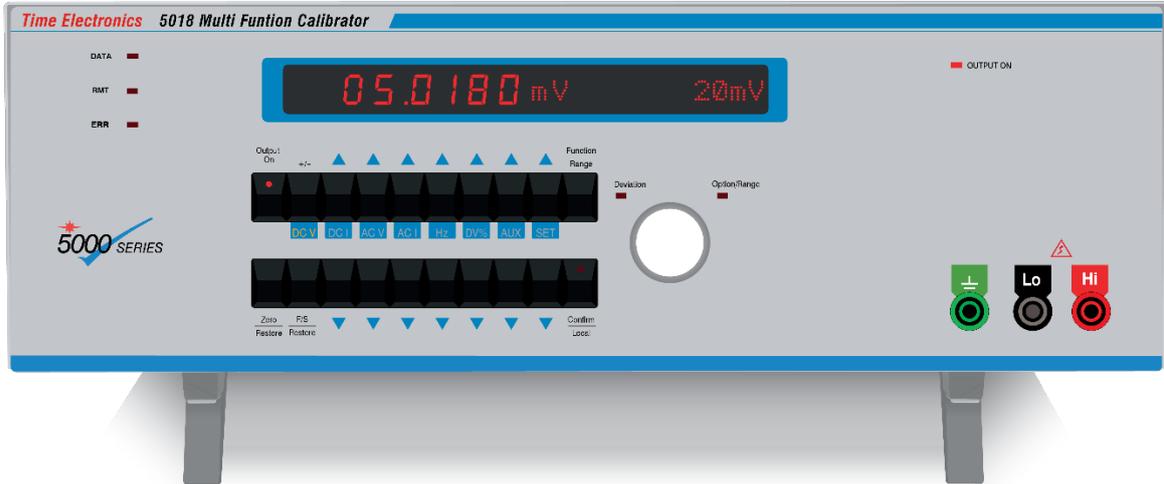
The supply power is connected via a standard IEC Euro connector on the rear panel. The standard voltage supply is 220/230 V 50 Hz. There are two protection fuses mounted on the rear panel next to the IEC connector, both are 3.15 A slow blow.

Mains Power Unit - Rear Panel

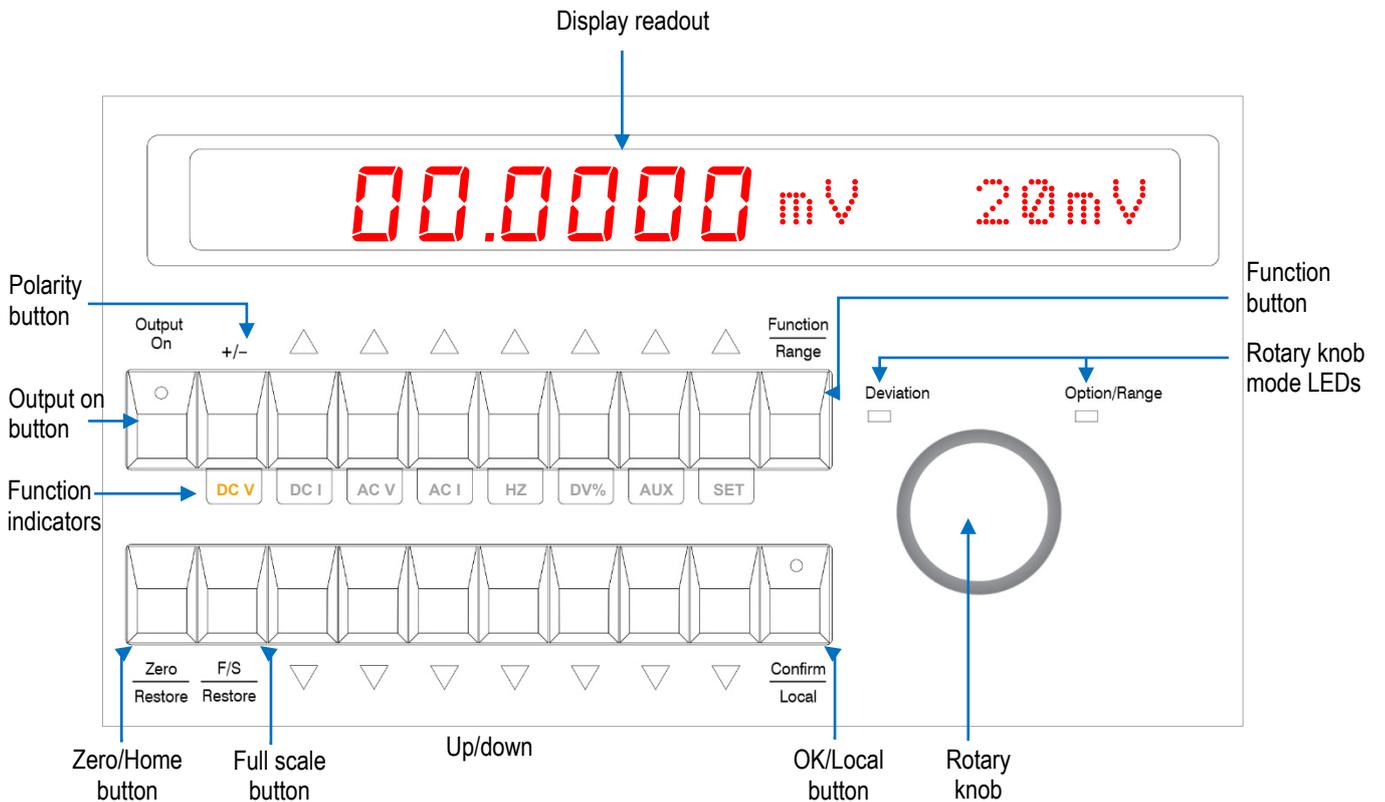


For information on PC communication and settings see the Remote Operation Section.

2 Front Panel Controls



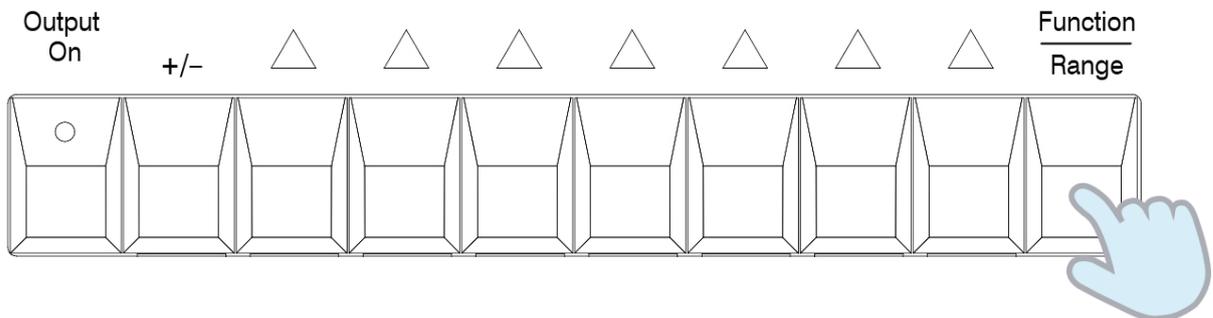
2.1 Keypad and Display



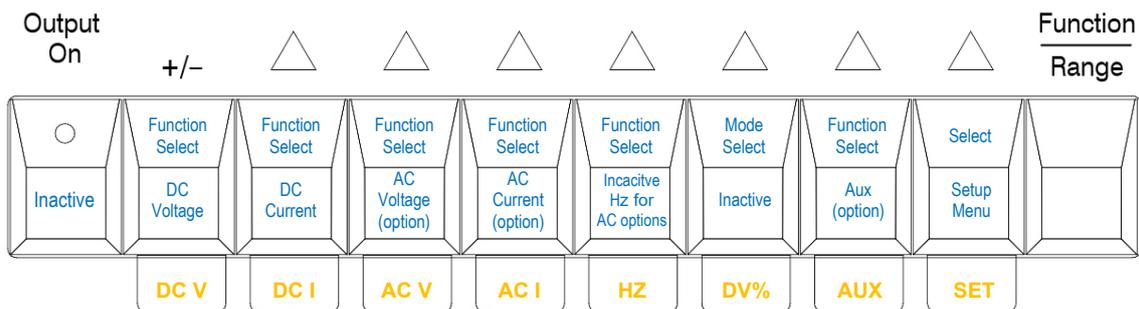
2.2 Keypad Buttons

2.2.1 Function Selection Buttons

Function selection is initiated by pressing the “**Function/Range**” button.



The function indicators flash to prompt a selection. This informs the user that the buttons adjoining the indicators are now function selectors:



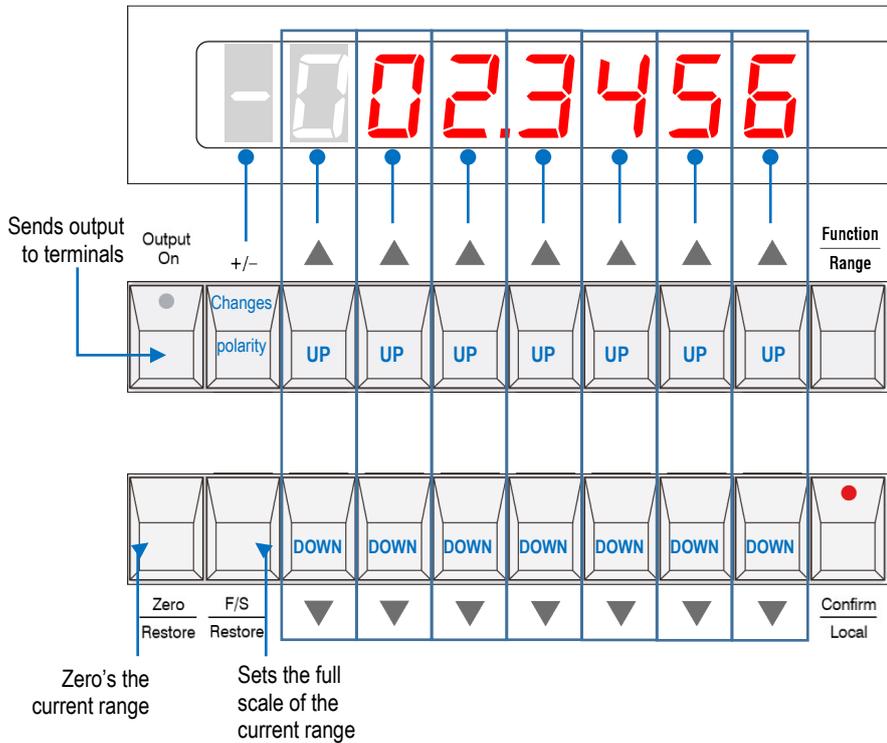
The **Function/Range** button can also be pressed after a function has been selected and is in use. The function indicators will flash show they are selectable. Any modes or setting buttons available for use will also flash. The user can choose to:

- Select a new function.
- Select a new range or setting for the present function, by pressing the same function.
- DV%: Deviation mode if available on the present function.
- SET: Settings menu.

2.2.2 Output Value Setting Buttons

Setting an output value is performed by using the up/down buttons for the following functions: DC Voltage, DC Current, AC Voltage (option), AC Current (option).

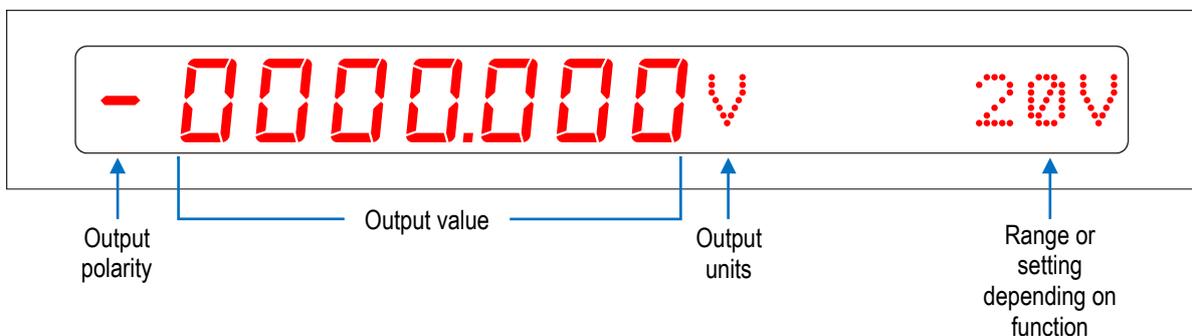
The buttons are in-line with the numerical readout to the as shown below:



2.3 Display Readout

An alphanumeric display. During calibrator output operation shows the following:

- Output value.
- Output unit of measure (mV, V, mA, A, Hz etc).
- Function range or setting depending on the function.



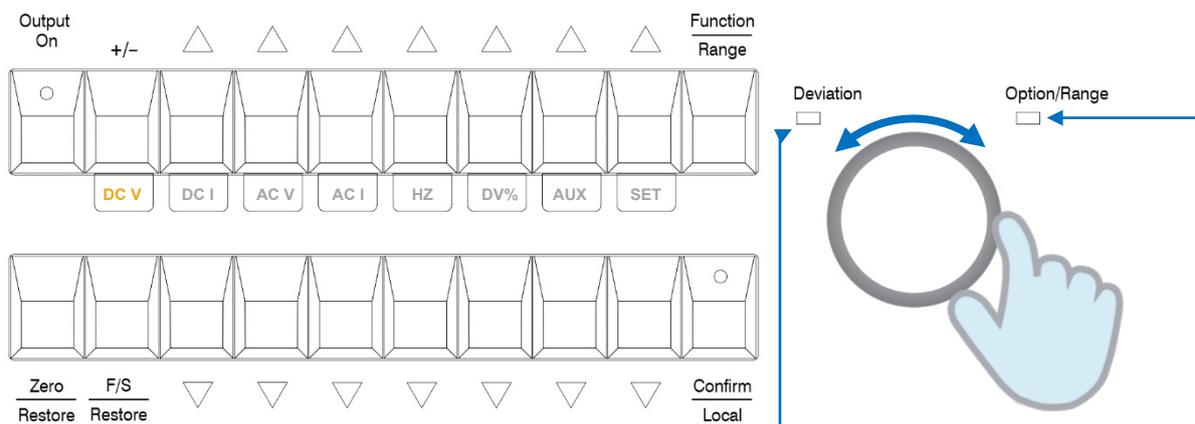
Note: Display resolution depends on the function and operating range.

2.4 Rotary Knob

The rotary knob is used to select ranges, settings and options. It is adjusted clockwise or anti-clockwise to the required selection. The “**Deviation**” or “**Option/Range**” LEDs illuminate to prompt usage of the rotary knob for the required operation. Ranges, options and settings are activated by pressing the “**OK**” button after selection. Deviation is a mode that provides percentage increase/decrease of an output and is active in real time.

The rotary knob is used for the following:

- Range selection (DC V, DC I, AC V, AC I).
- Deviation mode.
- Settings options.

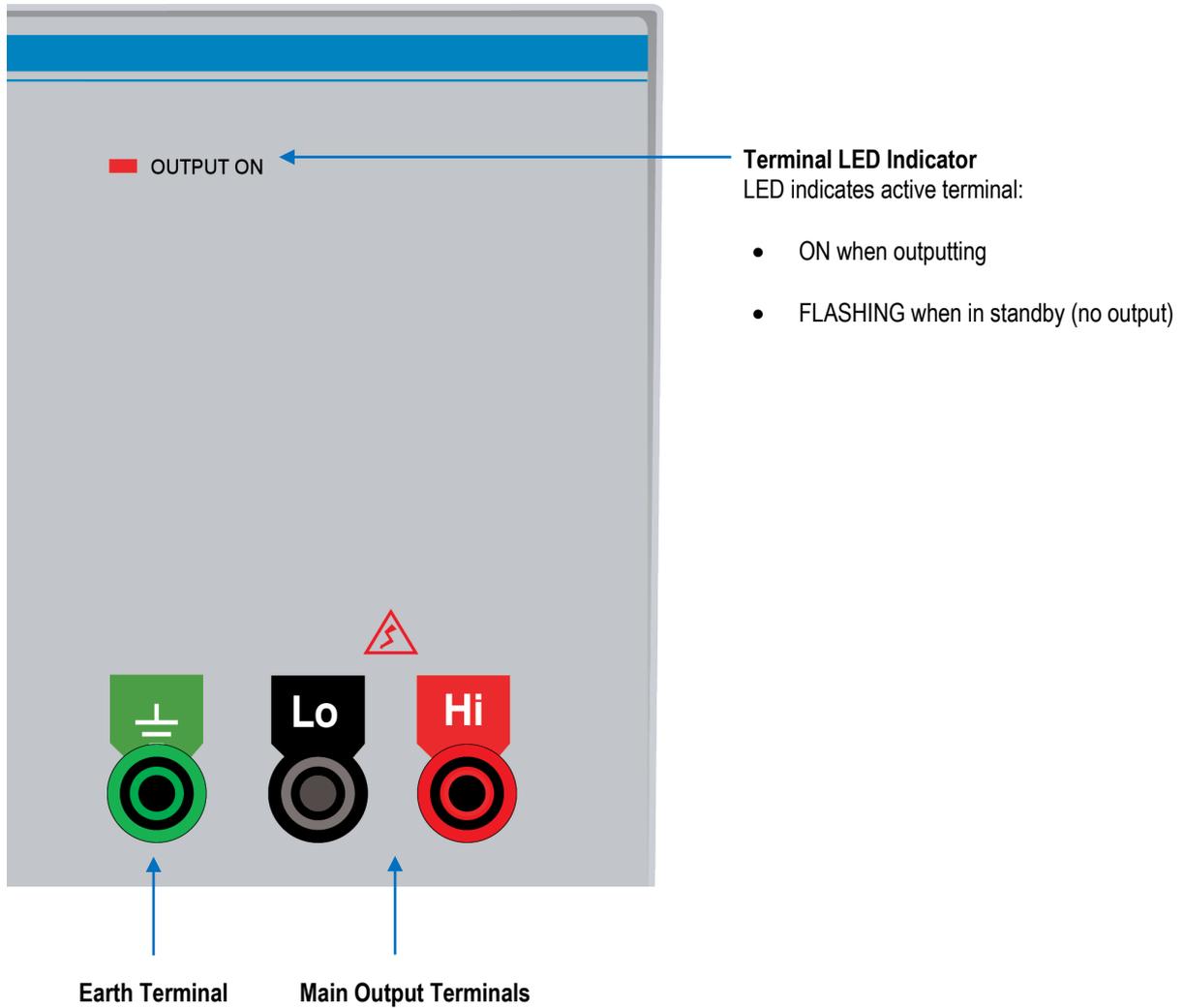


When illuminated the rotary knob can be used to deviate the output.

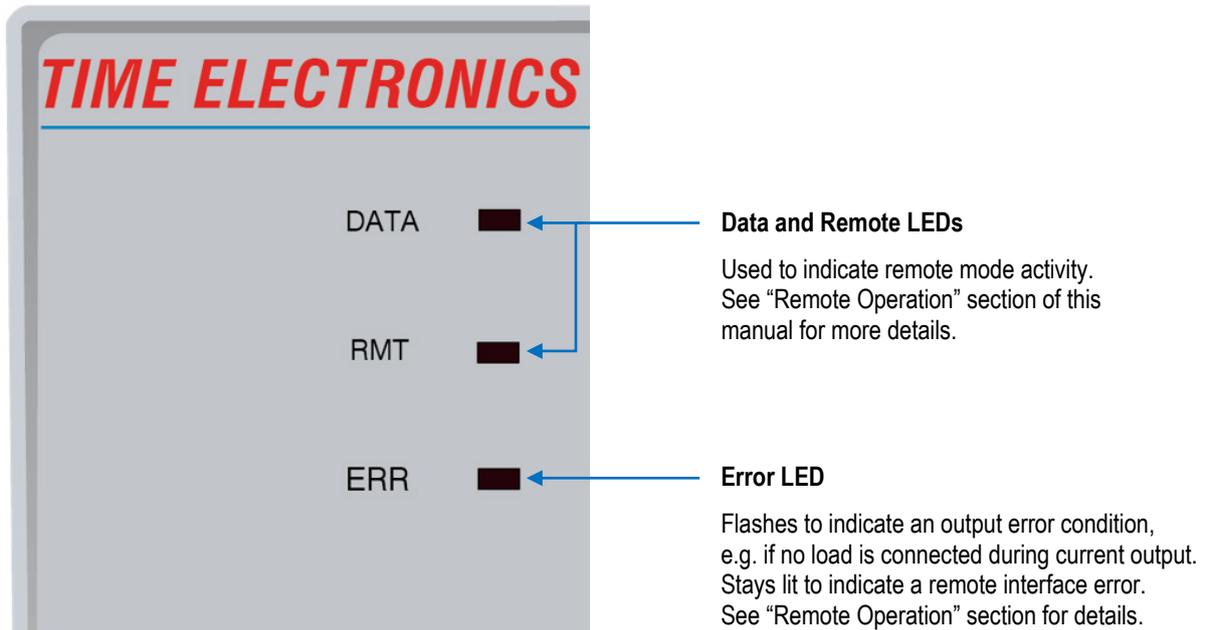
When illuminated the rotary knob can be used to scroll through a list of selectable options presented on the display. Primarily used for range selection.

2.5 Terminals

The terminal configuration for the 5018.



2.6 Display LEDs

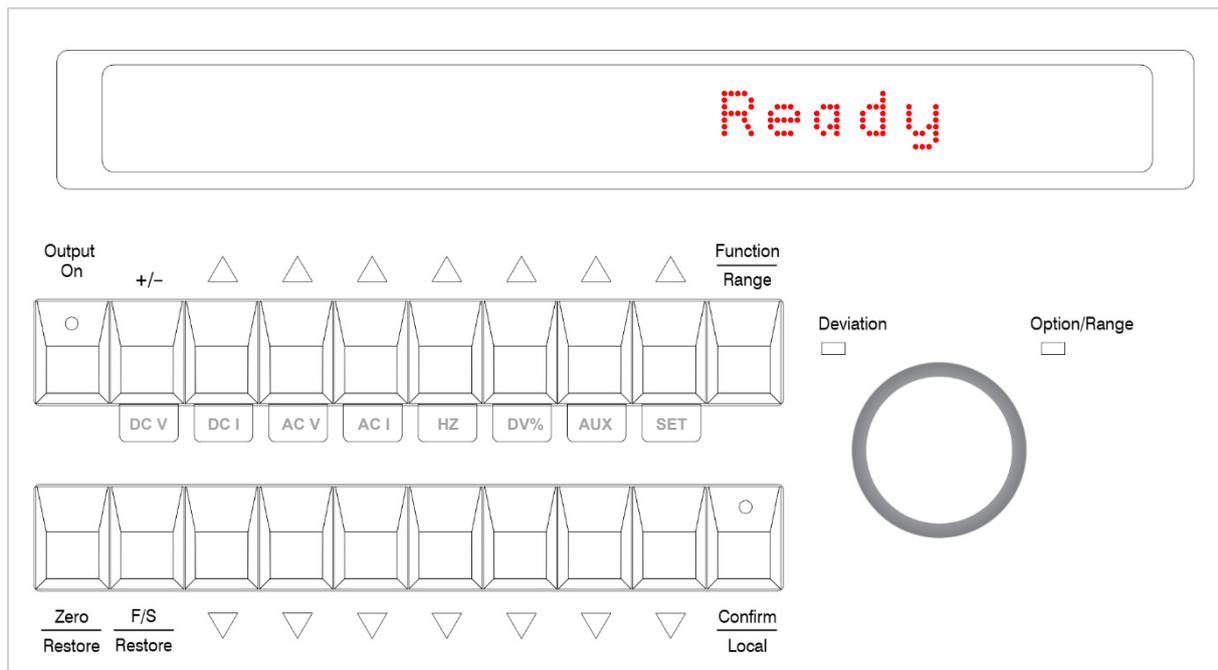


3 Front Panel Operation

3.1 Unit start-up

After switching on, the 5018 goes through a start-up routine that includes:

- Instrument self-test and health check routine.
- Front panel LEDs illuminate.
- Sounds the buzzer.
- Displays the model number and the firmware version number.
- Displays the communication type and setting.
- On completion of the start-up routine, the word “Ready” is shown on the display.

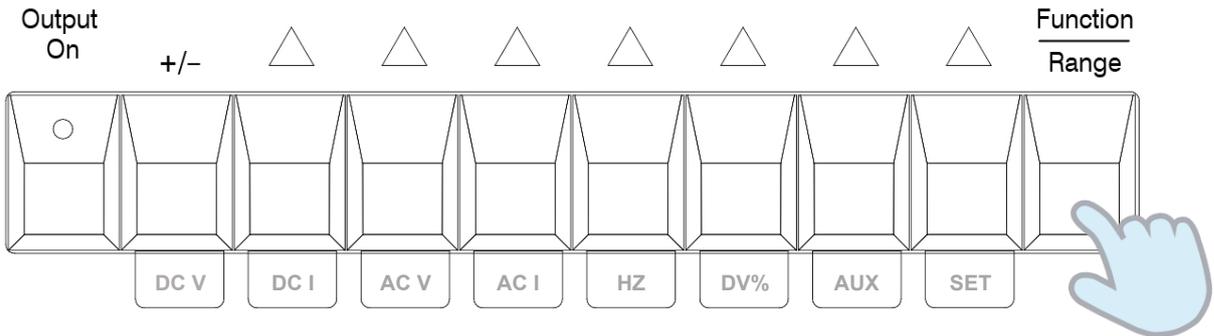


Note:

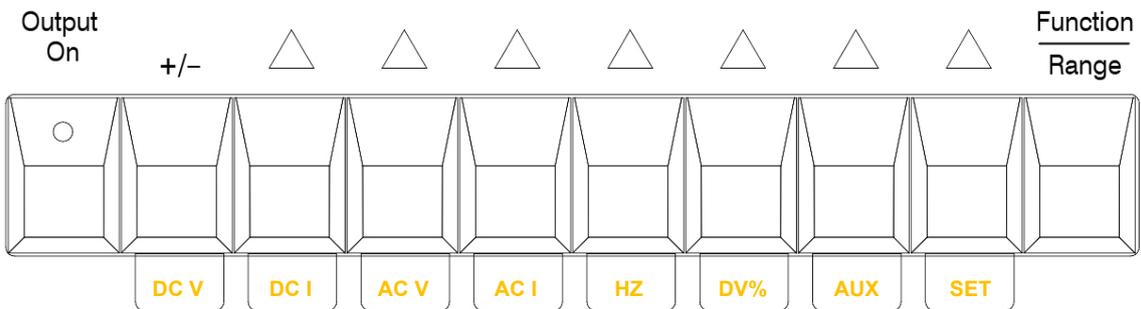
If any error codes are displayed during start-up, please refer to the “Fault Diagnosis” section later in this manual.

3.2 How to select a Function

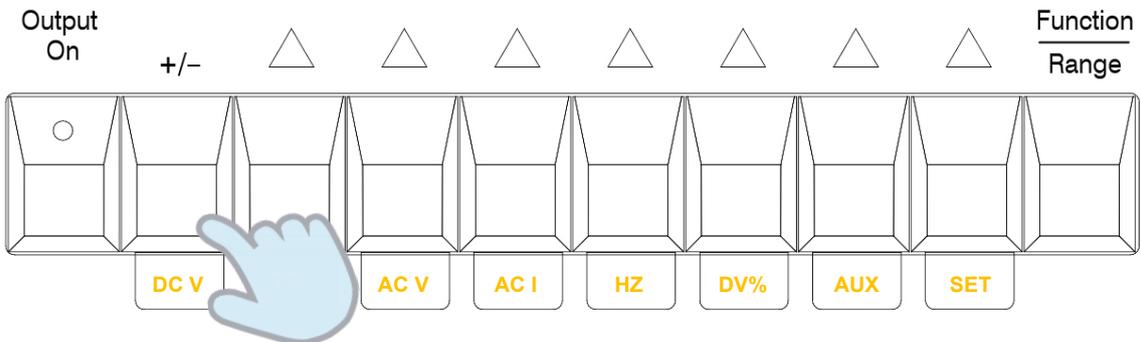
1. Press the **"Function"** button.



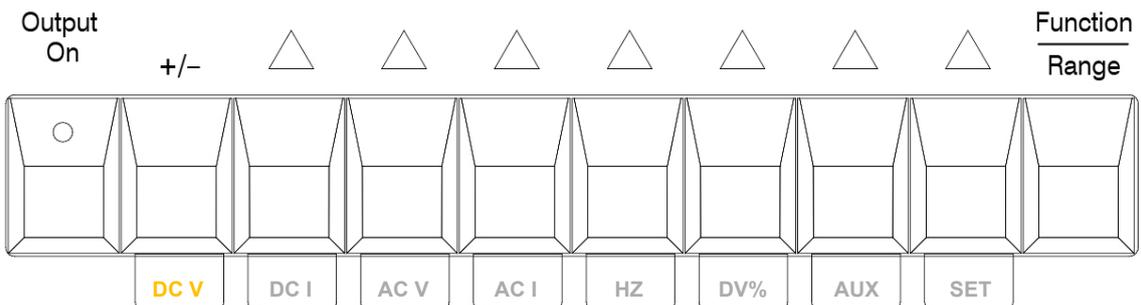
2. The function indicators will then flash to prompt a selection.



3. Select the desired function by pressing adjacent button. In this example **DC Voltage**.



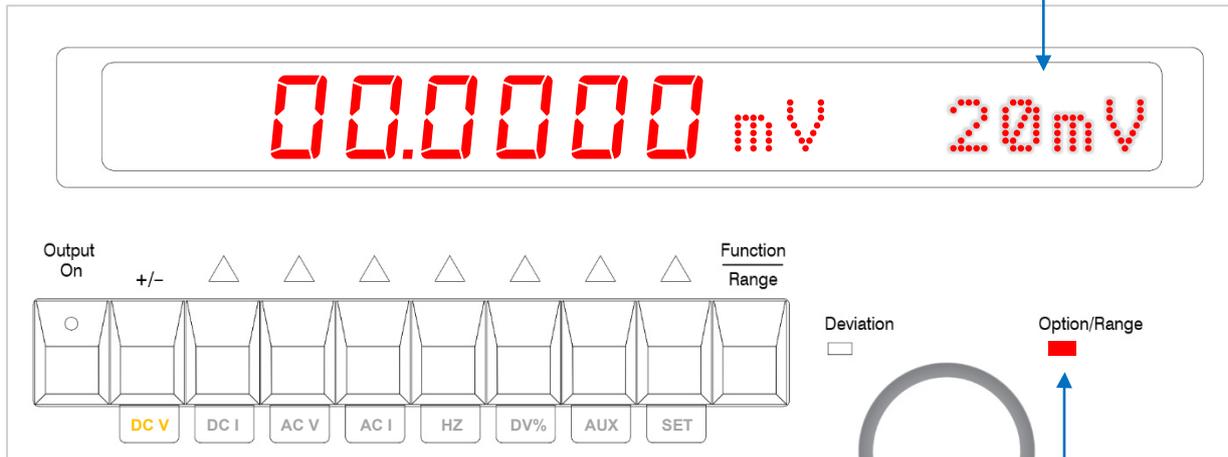
Once pressed, the function (DC V) will be the only indicator to remain illuminated, showing it is the selected function.



3.3 DC Voltage or Current **DCV DCI**

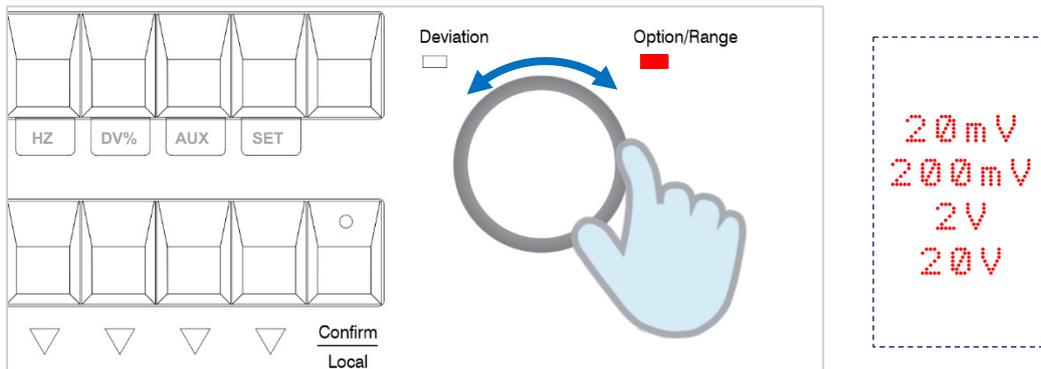
DC Voltage and DC Current have common operation steps. Shown here is DC V.

1. Press the **“Function”** button then **“DC V”** button.
2. The function range will now flash in the right-hand side of the display.



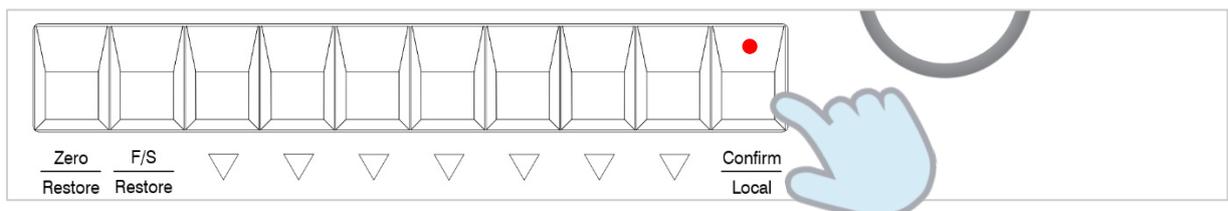
The **“Option/Range”** LED flashes to prompt selection using the rotary knob.

Adjust the knob to the required range.

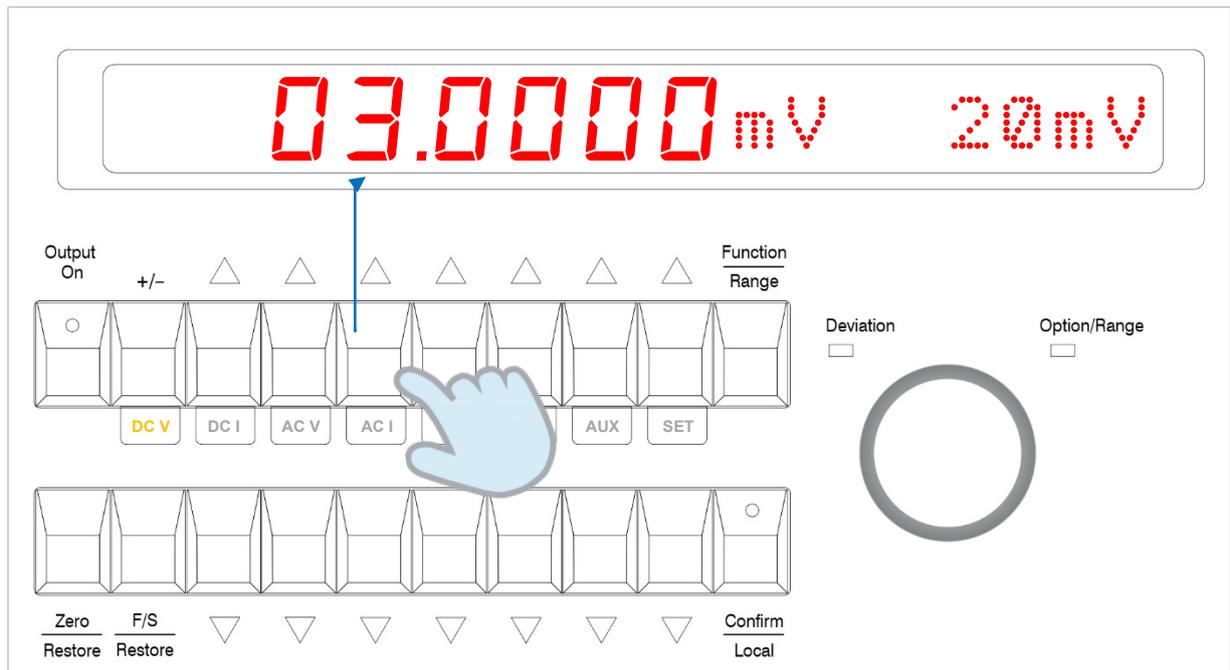


Note: if DC high voltage options are present 200 V and 1 kV ranges will be selectable

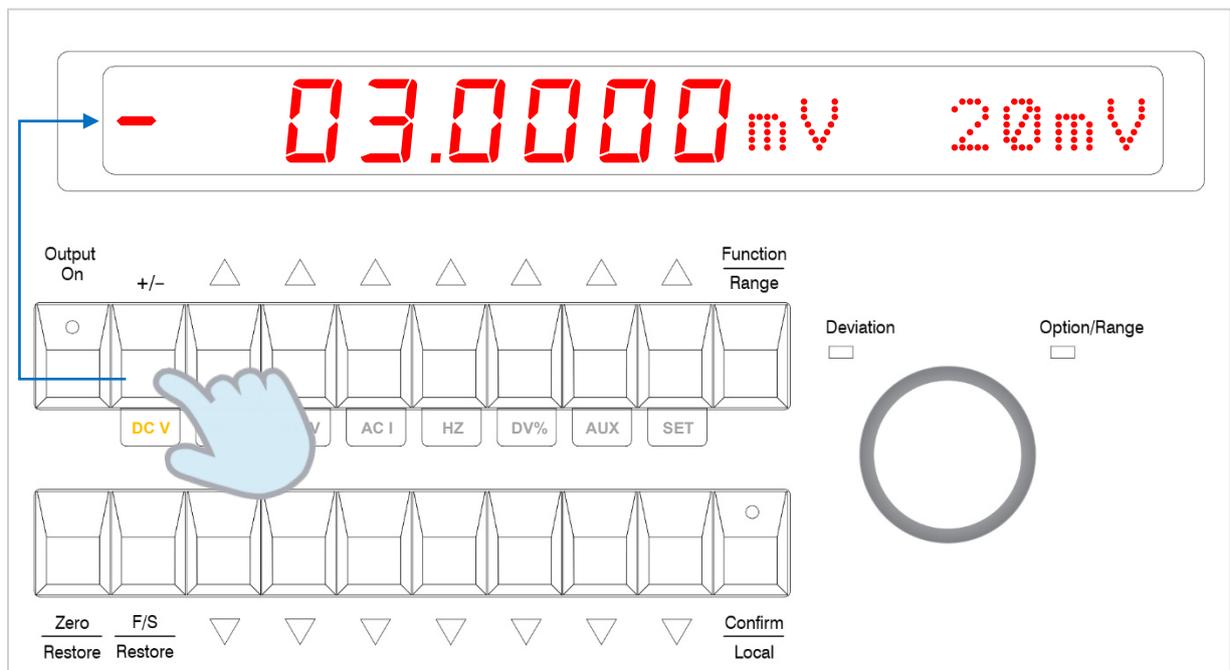
When the required range is displayed, press the **“Confirm”** button as highlighted by the flashing LED.



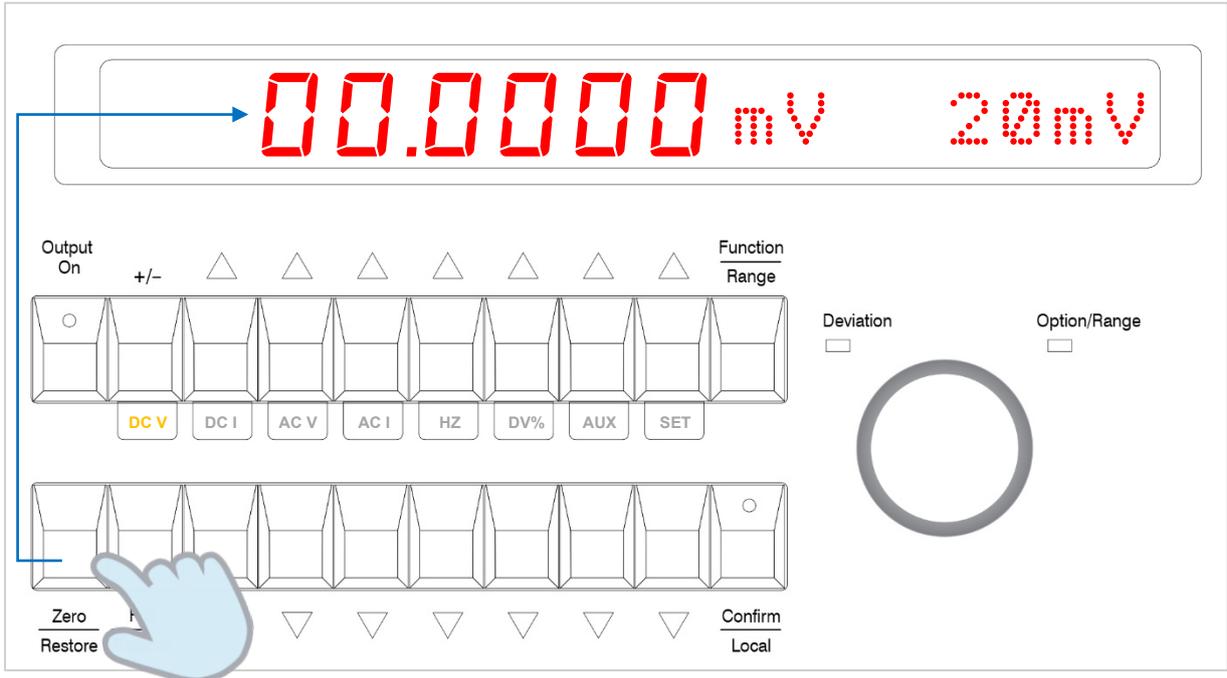
- To set the required output voltage, increment or decrement the individual digits by using the “Up (Δ) or Down (∇)” buttons.



The polarity of the output can be changed by pressing the “+/-” button.

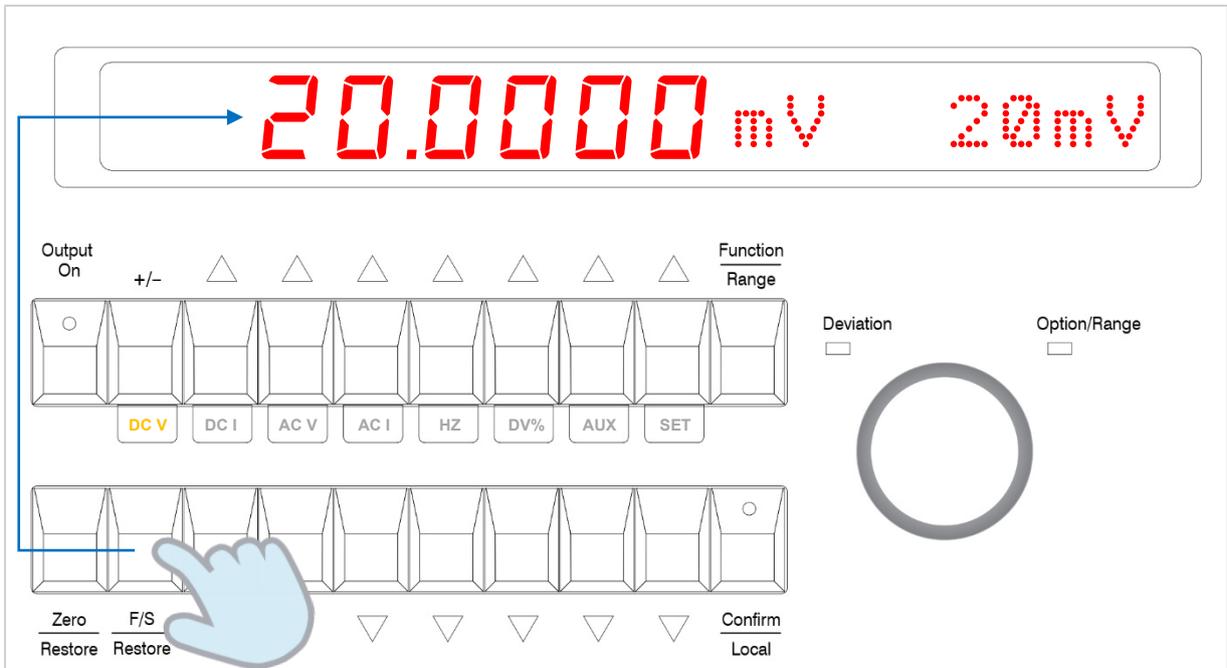


It is possible to set the output to zero in one step by pressing the “Zero” button.



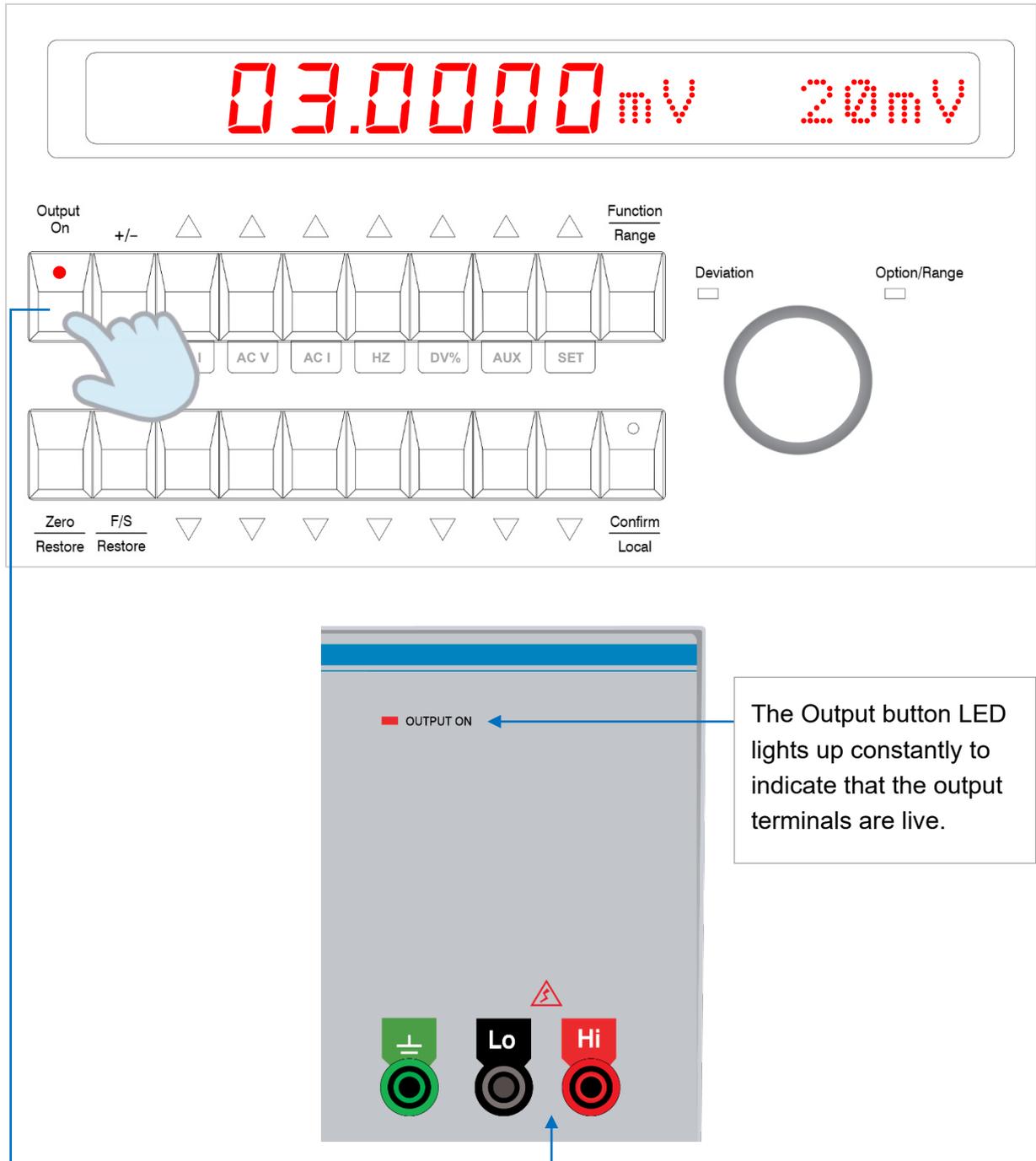
Return to the previous setting by pressing the “Zero” button once more.

Full-scale of the present range can also be selected in one step by pressing the “F/S” button.

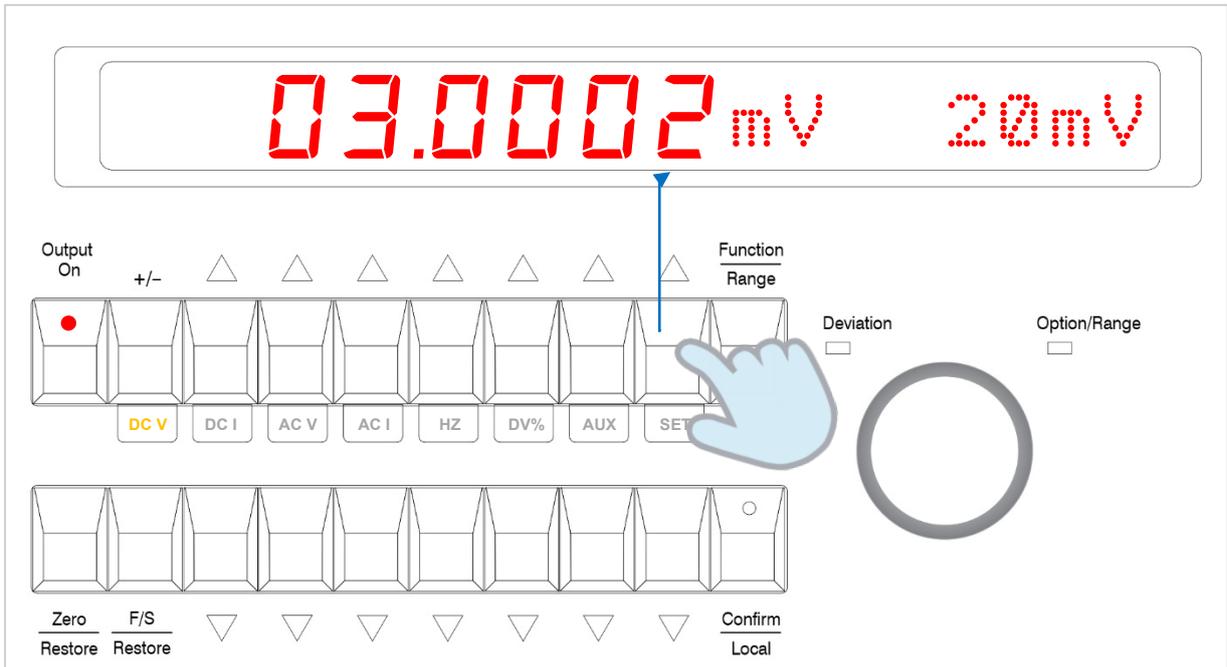


Return to the previous setting by pressing the “Full Scale” button once more.

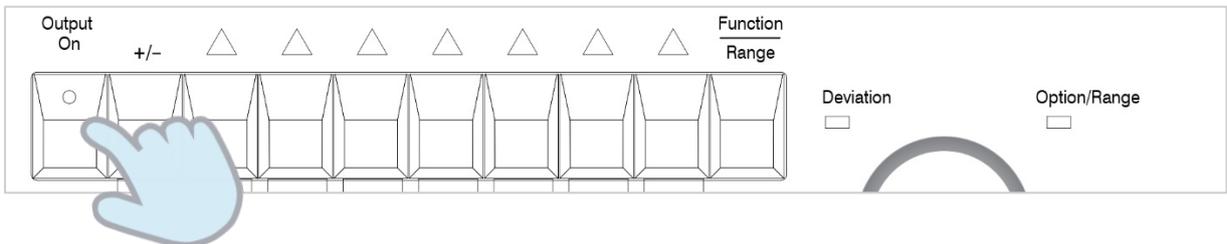
4. Output is initially disconnected from the output terminals. This is indicated by the LED on the Output On button flashing (on for 25% of the time, off for 75% of the time). In addition, the LED beside the output terminals also flashes. Connect the signal to the output terminals by pressing the “**Output On**” button.



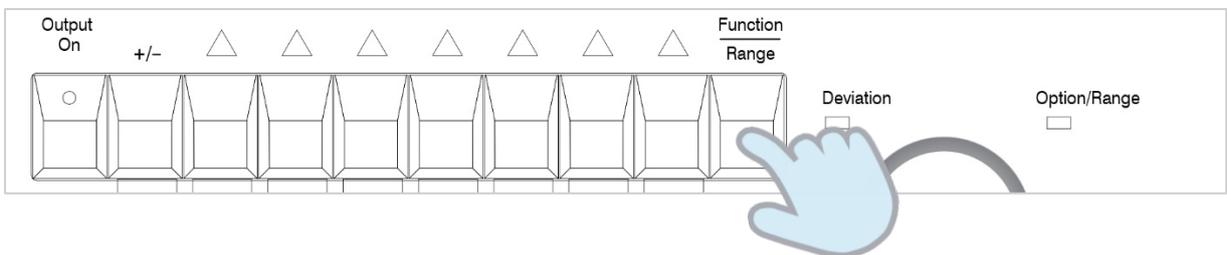
5. To change the output level, the **Up (Δ) / Down (∇)** buttons can be used at any time.



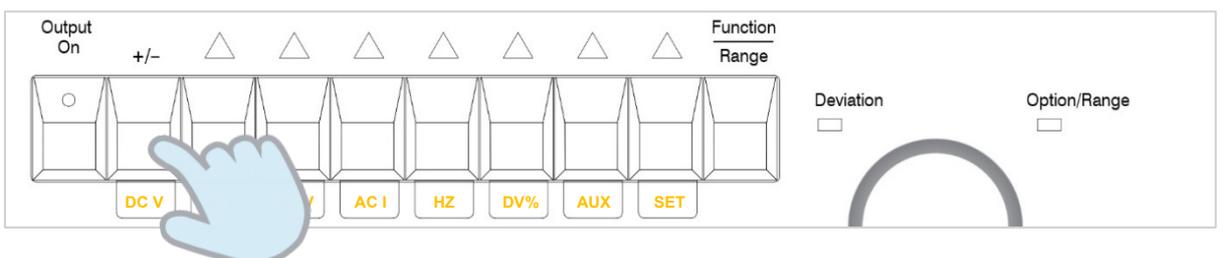
If necessary, the output can be turned off by pressing the **“Output On”** button.



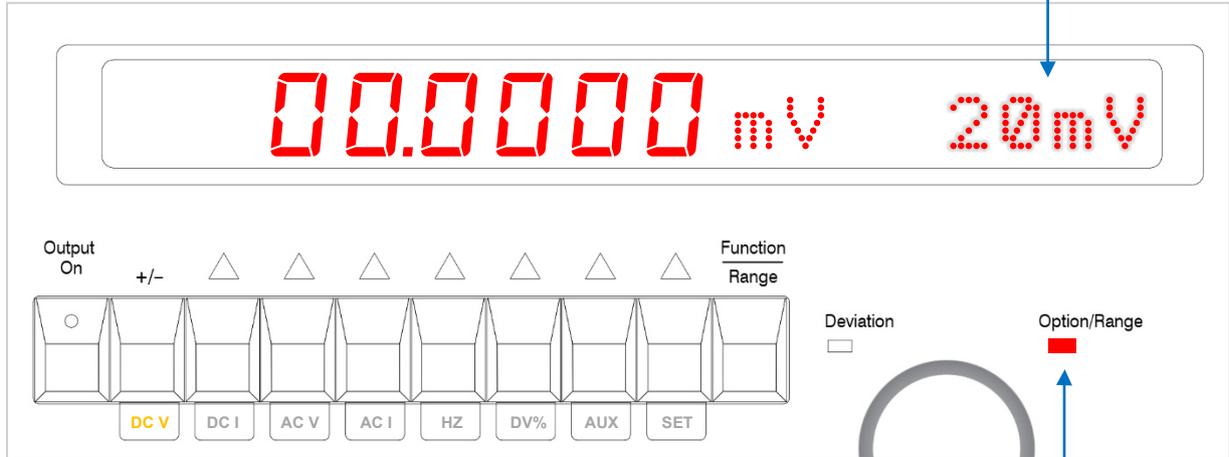
6. To change range, press the **“Function/Range”** button.



Now reselect the present function. For example, for DC volts, press the **“DC V”** button.

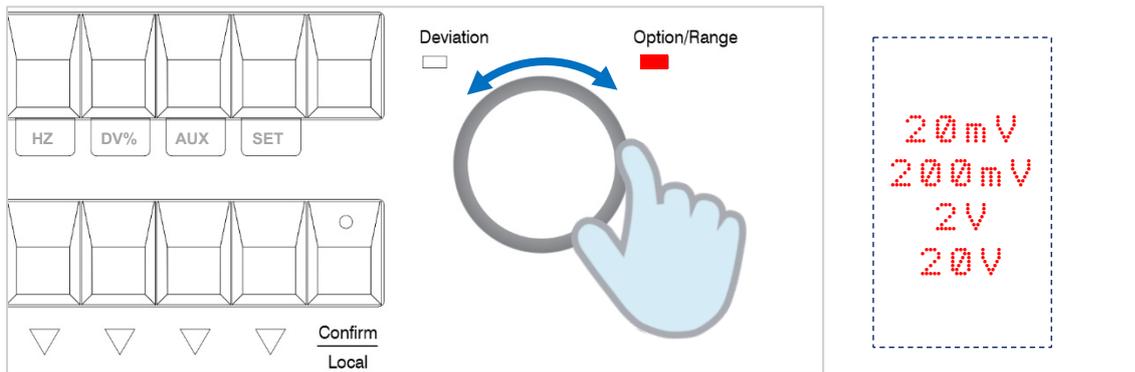


The present range will be shown flashing in the right-hand display. Next is a repeat of step 2 to 5, but select the new range required.

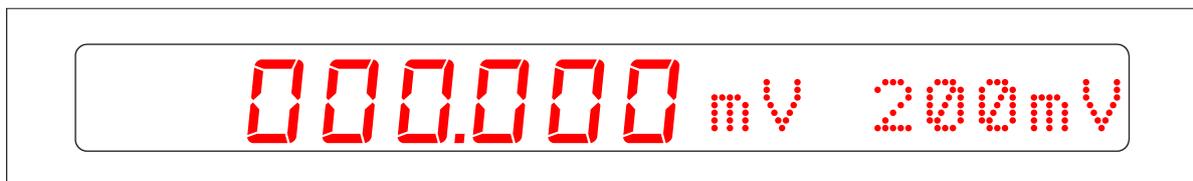
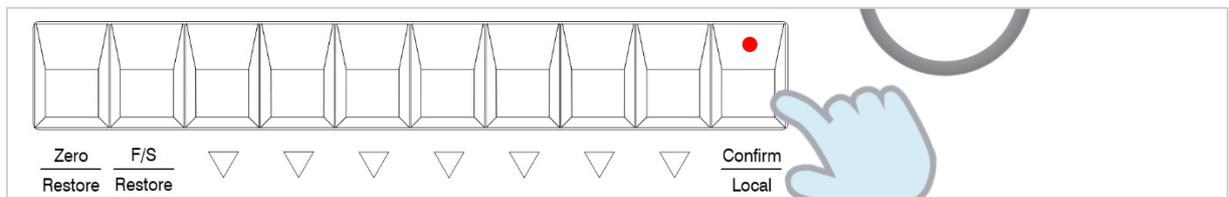


The “**Option/Range**” LED flashes to prompt selection using the rotary knob.

Adjust the knob to the required range.



When the required range is displayed, press the “**Confirm**” button as highlighted by the flashing LED.



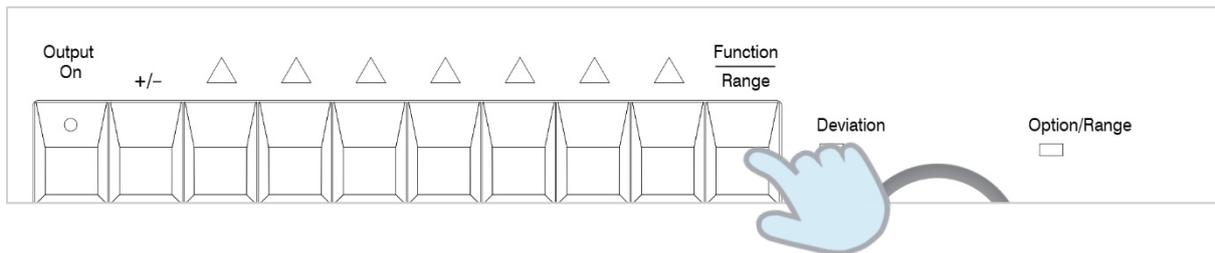
3.4 Using Deviation Mode DV%

This feature allows the output to be deviated in percentage steps. There are 3 options:

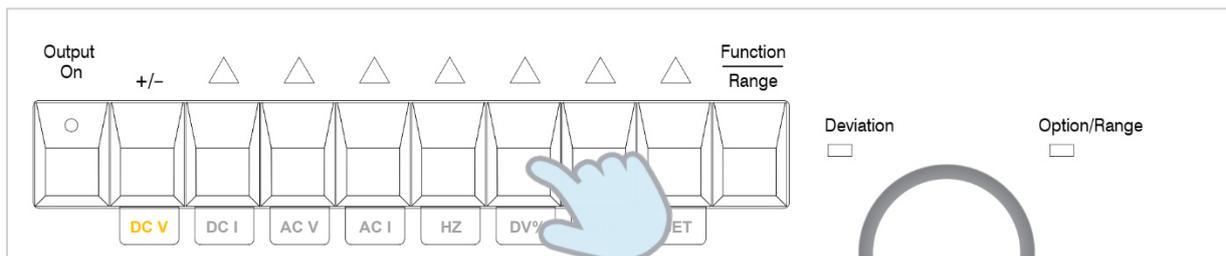
- Fine deviation: 0.001%
- Medium deviation: 0.01%
- Coarse deviation: 0.1%

The preference can be set in the Setup menu. See *Setup Menu* section.

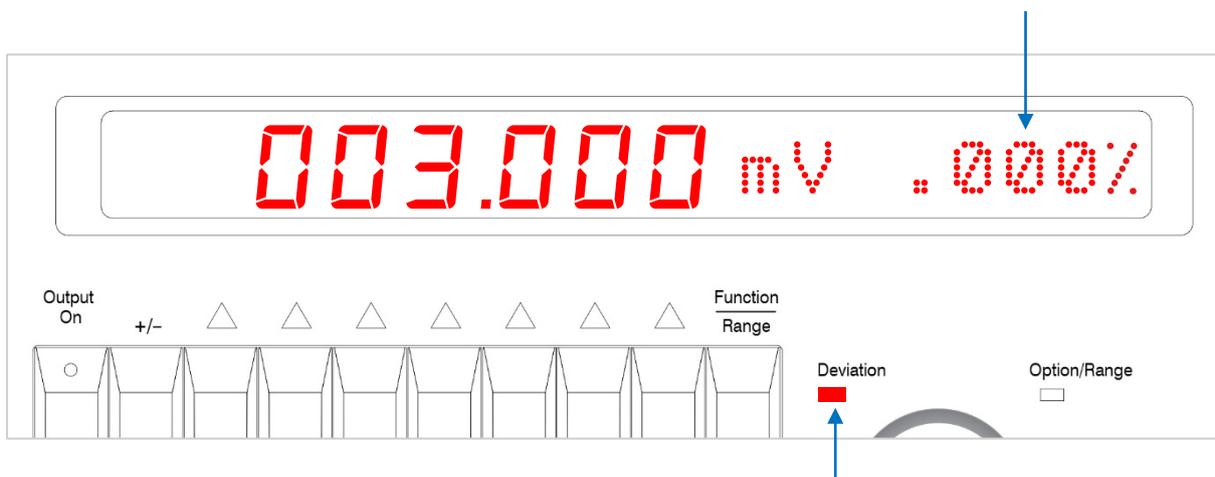
1. To use Deviation mode start by pressing the “**Function**” button.



2. Then press the “**DV%**” button.

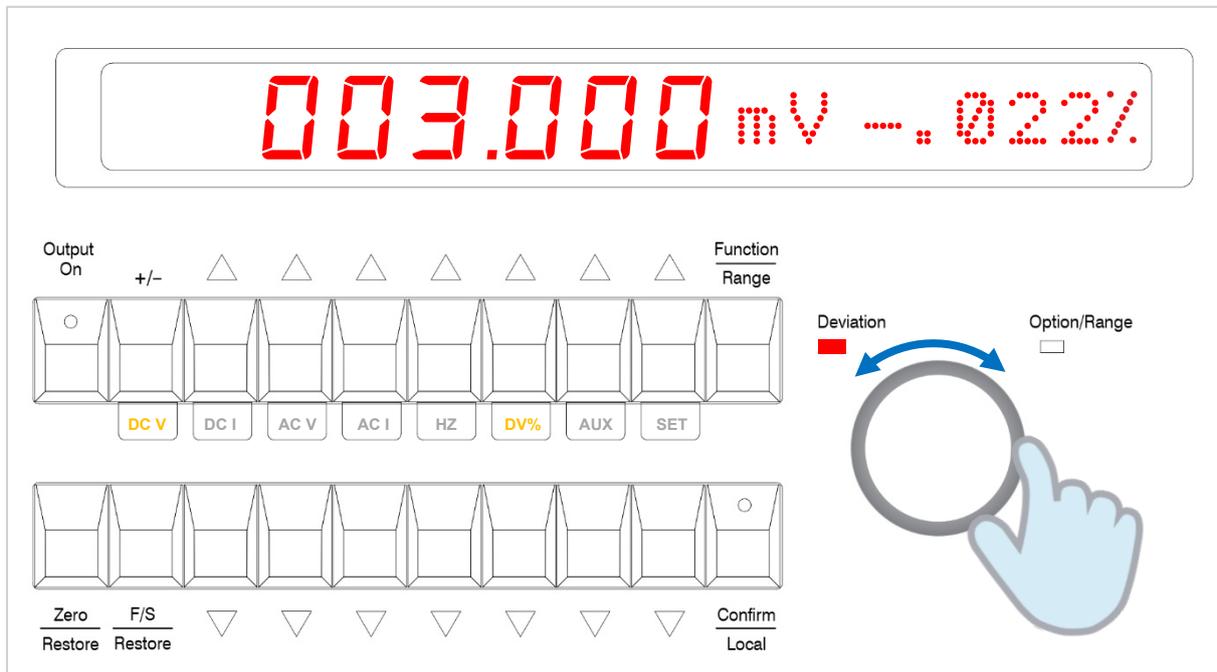


The right-hand side of the display then shows the deviation figure in + or - % terms.



Deviation mode is highlighted by illumination of the “Deviation” LED. This prompts the use of the rotary knob.

3. To adjust the deviation, turn the rotary knob clockwise to increase, and anticlockwise to decrease.



Note: It is not possible to adjust the deviation if the output setting is zero, since the deviation is a percentage of value. The deviation will be displayed as zero percent in this case.

4. To turn off Deviation mode press the “**Function**” button followed by the “**DV%**” button.

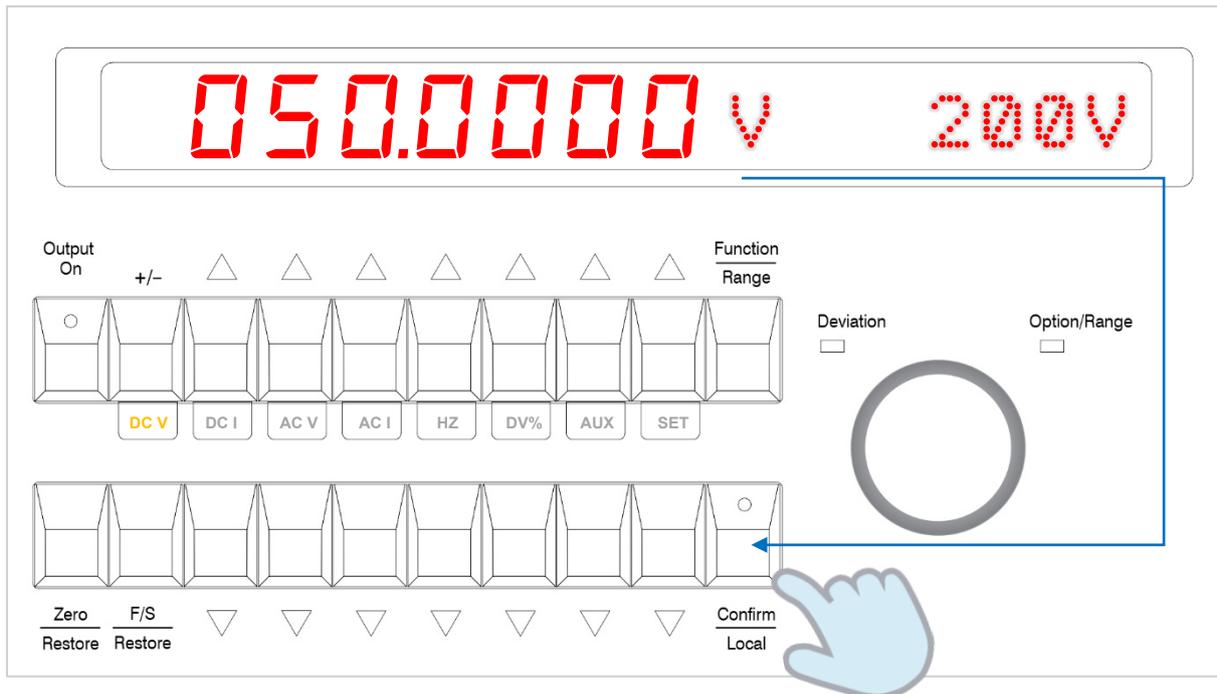
3.5 Safety Interlock Feature

When a high voltage option (code 9720 or 9721) is fitted there is a safety interlock feature incorporated for voltages above 40V.

This ensures that the user must perform an additional action before the signal will appear at the terminals.

The feature is indicated by both the readout units designator and OK button LED flashing.

To accept the voltage, press the “**Confirm**” button.

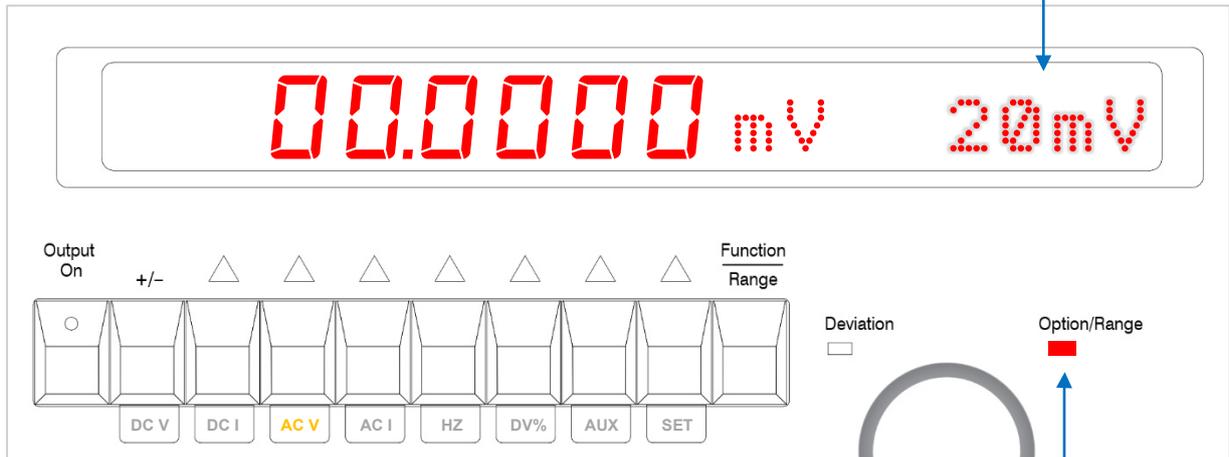


Also, at voltages above 40V the user is warned by an internal beeper sounding every 4 seconds.

3.6 AC Voltage or Current (option) **ACV ACI**

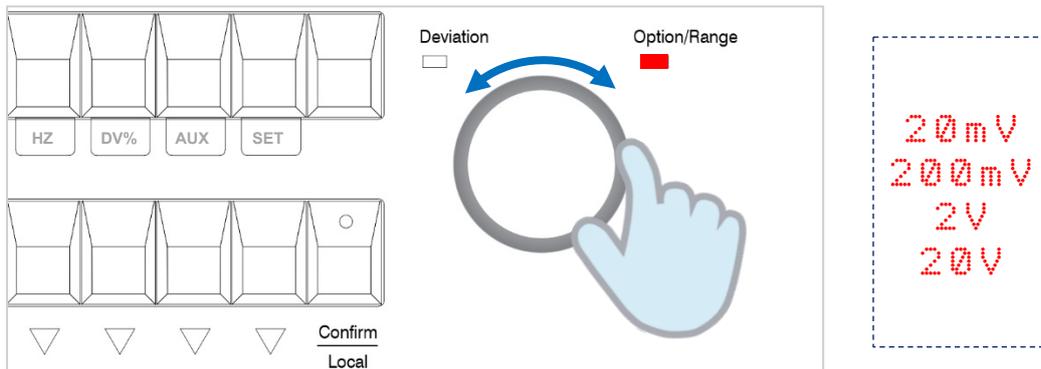
AC Voltage and AC Current have common operation steps. Shown here is AC V.

1. Press the “**Function**” button then “**AC V**” button.
2. The function range will now flash in the right-hand side of the display.

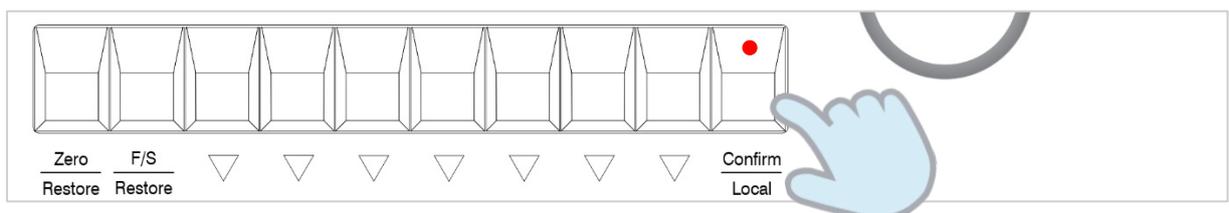


The “**Option/Range**” LED flashes to prompt selection using the rotary knob.

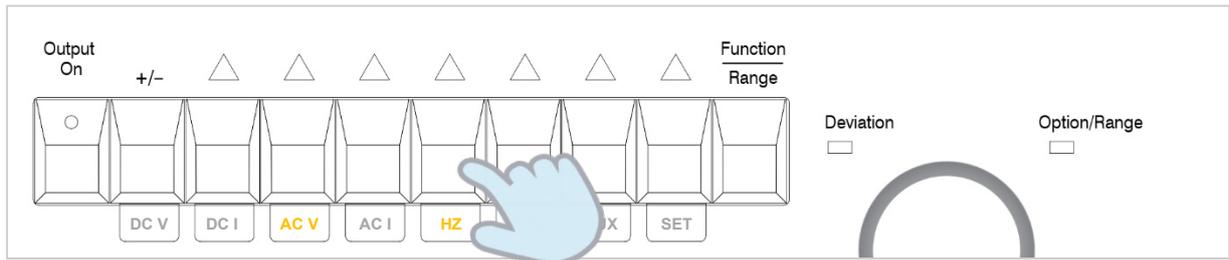
Adjust the knob to the required range.



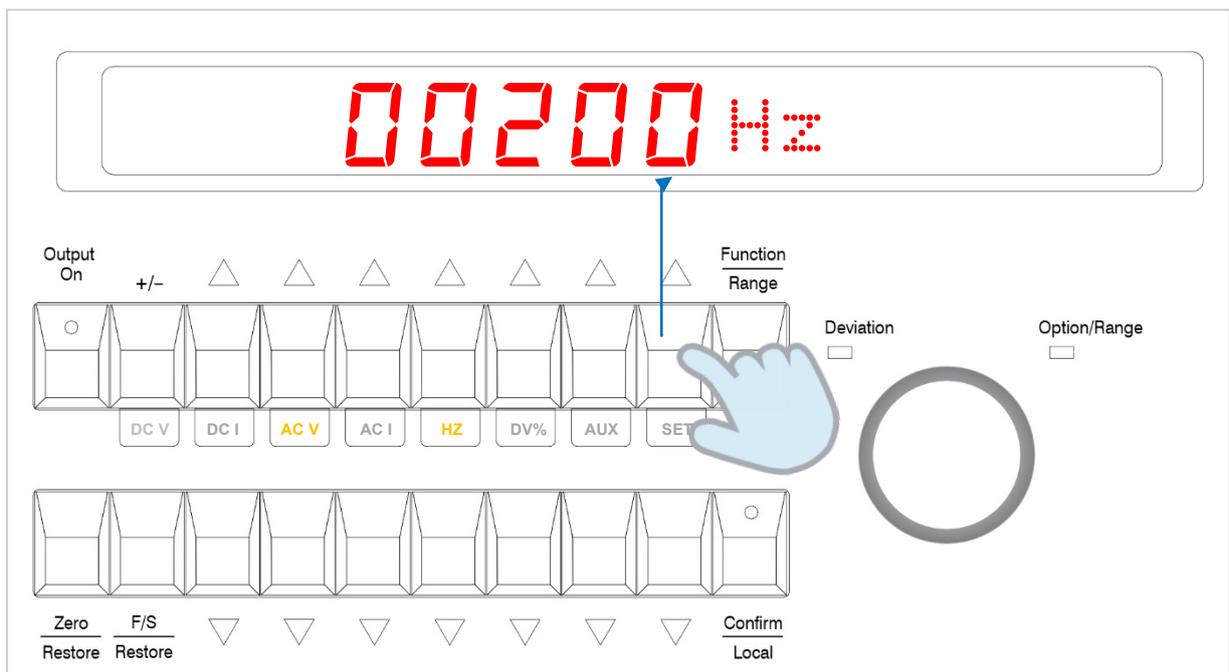
When the required range is displayed, press the “**Confirm**” button as highlighted by the flashing LED.



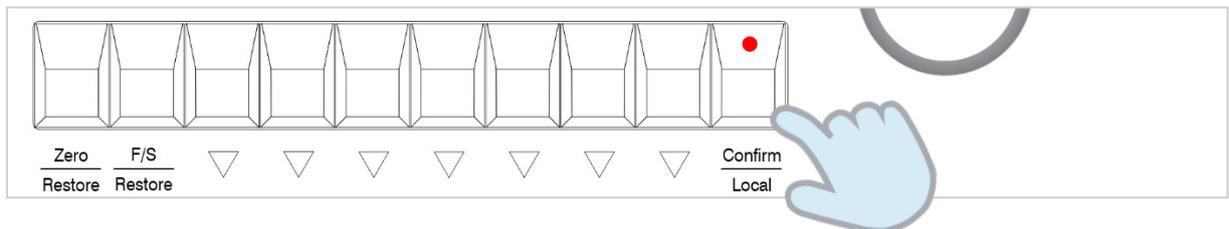
3. The frequency can be set by pressing “Function” button followed by the “Hz” button.



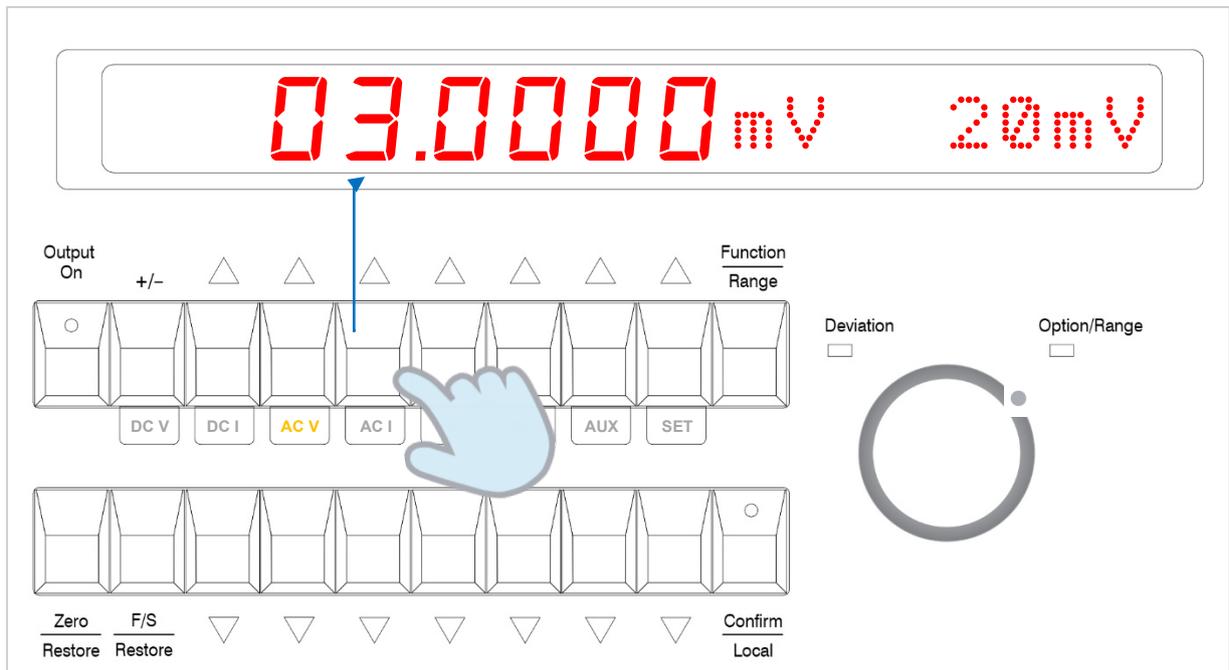
Select the frequency using the “Up (Δ) / Down (∇)” buttons.



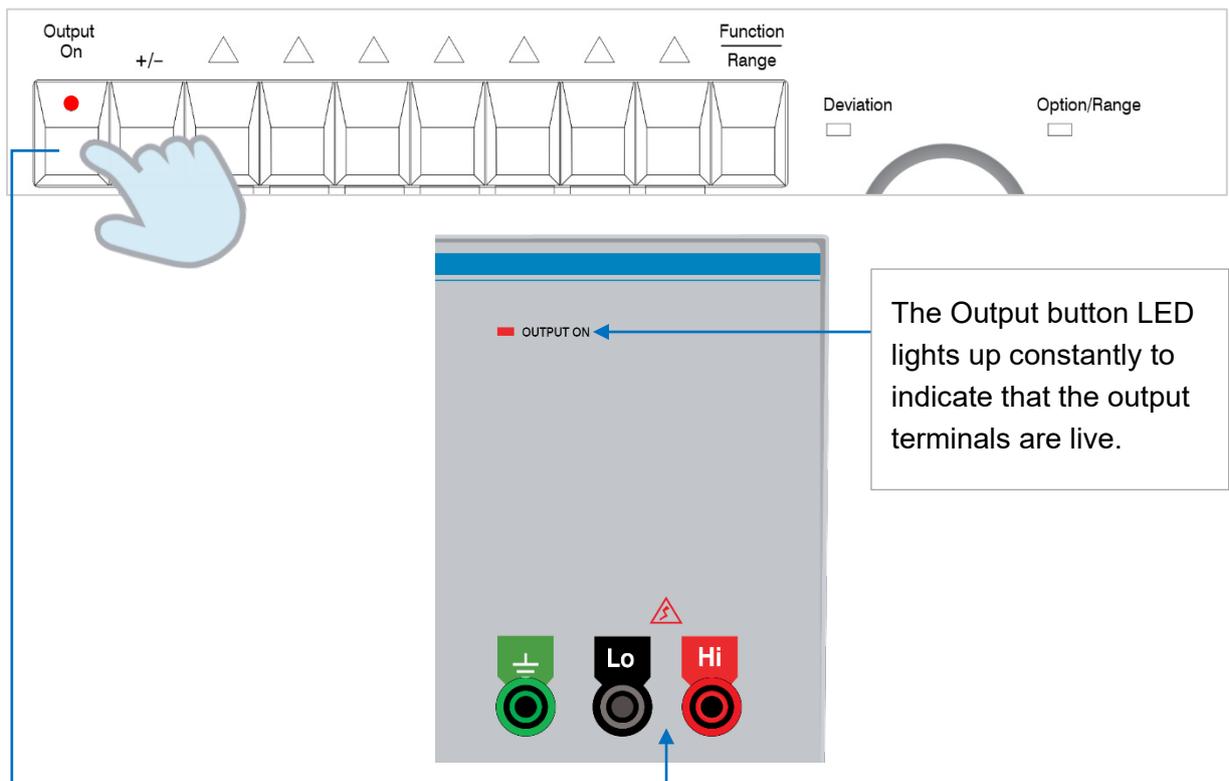
Then press the “Confirm” button to set it.



- Once the frequency is set, the display readout will show the output voltage and operating range. The output value can be entered using the “Up (Δ) / Down (∇)” buttons.

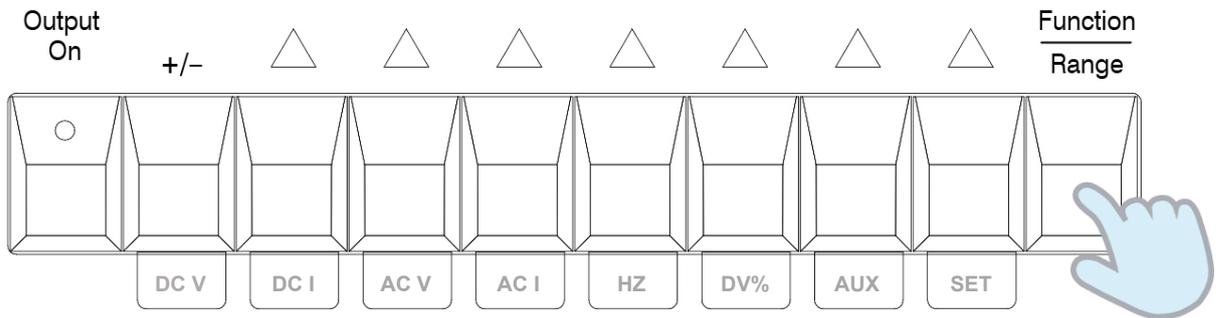


- Output is initially disconnected from the output terminals. The LED on the Output On button flashes to indicate this. The LED beside the output terminals also flashes. Connect the signal to the output terminals by pressing the “Output On” button.

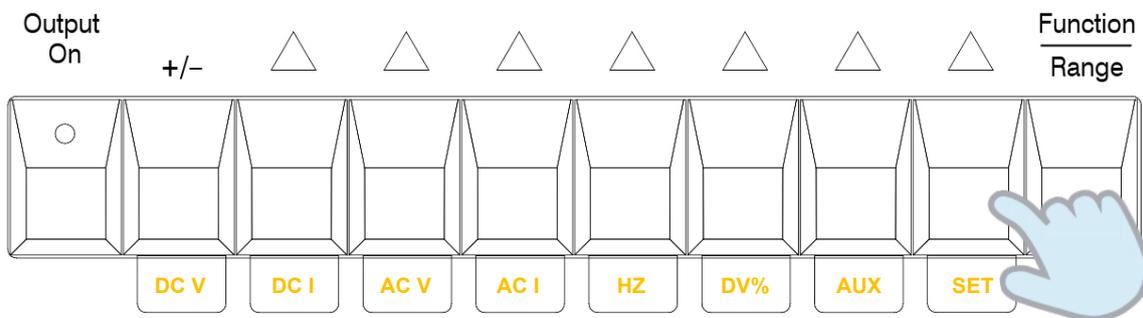


3.7 Setup Options **SET**

1. Press the “**Function**” button.



2. The function indicators will then flash to prompt a selection. Press the “**SET**” button.



Once pressed, you will access the Setup Menu.

Use the rotary knob to scroll through the various options.

Press the “**Confirm**” button to store any new setting.

Alternatively, press the “**SET**” button to exit the Setup Menu without making any changes.

The settings in the Setup Menu are stored in non-volatile memory. This means they are retained even when power to the unit is switched off.

3.7.1 Options/Settings Summary

Readout	Option/Setting
Dev Rs In	Deviation Resolution Set of deviation resolution to: 0.001 % (fine), 0.01 % (medium) or 0.1 % (coarse) per step.
Click	Click Set to On or Off. If on, then an audible click will be heard when the rotary knob scrolls from one setting/option to another.
Ramp	Ramp Set to On or Off. If on, then an audible click will be heard when the rotary knob scrolls from one setting/option to another.

3.7.2 Deviation Resolution (Dev Rsln)

Deviation Resolution is the first menu shown when you enter the setup menu. It can be used with DC V, DC I, AC V, AC I.

This feature allows the output to be deviated in percentage steps. There are 3 options:

- Fine deviation: 0.001%
- Medium deviation: 0.01%
- Coarse deviation: 0.1%

Setting Method:

1. Press “**Function**” button, then press “**SET**” button.
Now in the Setup menu, Option **Dev Rsln** appears first on the list.
2. Press “**Confirm**” button.
Display now reads the deviation resolution setting currently selected.
3. Adjust the setting using the rotary knob.
4. Once selection is made, press “**Confirm**” button.

3.7.3 Rotary Knob Scroll Sound (Click)

The Click option is a feature that can be set so that an audible click/beep is heard when the rotary knob scrolls from one setting/option to another. It is a user preference feature.

Setting Method:

1. Press “**Function**” button, then press “**SET**” button.
2. Use the rotary knob and scroll to option **Click**
3. Press “**Confirm**” button.
Display now reads the setting currently selected, ie On or Off.
4. Change the setting using the rotary knob.
5. Once selection is made, press “**Confirm**” button.

3.7.4 Ramp

Ramping is selected via the Setup menu. *See the Ramping section for details of this operation.*

Setting Method:

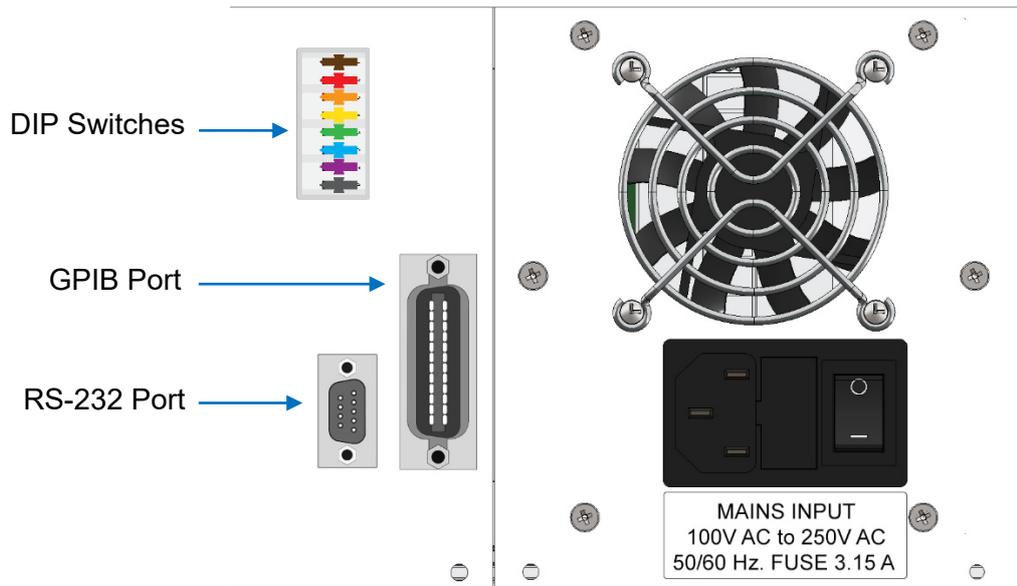
1. Press “**Function**” button, then press “**SET**” button.
2. Use the rotary knob and scroll to option **Ramp**
1. Press “**Confirm**” button.
Display now reads the setting currently selected, ie Off.
2. Change the setting using the rotary knob.
3. Once selection is made, press “**Confirm**” button.

4 Remote Operation

4.1 Communications Interface

The 5018 may be controlled by a PC via a RS-232, USB or GPIB.

The unit must first be configured for the type of communications being used. With the 5018 switched off, locate the DIP switches on the rear panel.



4.1.1 For RS-232 / USB Adaptor Communications

A straight-through (pin to pin) RS232 lead, male to female is supplied with the unit. Set the DIP switches as indicated below. Note the unit must be restarted for any new setting to apply.

DIP Switch	Setting
1	ON (RS232)
2	<i>Does not matter</i>
3	<i>Does not matter</i>
4	<i>Does not matter</i>
5	<i>Does not matter</i>
6	<i>Does not matter</i>
7	<i>Does not matter</i>
8	<i>Does not matter</i>

When the unit is next started, "RS232" will be displayed to confirm the setting.

The RS232 communication settings are 9600 baud rate, no parity, 8 data bits & 1 stop bit.

When using the USB adaptor, connect this to the RS232 port on the 5025. After installing the driver and connecting the device to a PC, check 'Device Manager' to see which comm. port the USB adaptor has been assigned.

4.1.2 GPIB Communication

Use a standard GPIB cable. Set the DIP switches as indicated below.

DIP Switch	Setting
1	OFF (GPIB)
2	Does not matter
3	Address 1 (ON=1, OFF=0)
4	Address 2 (ON=2, OFF=0)
5	Address 3 (ON=4, OFF=0)
6	Address 4 (ON=8, OFF=0)
7	Address 5 (ON=16, OFF=0)
8	<i>Does not matter</i>

The GPIB address of the 5018 may be set between 0 and 30 (although address 0 is usually reserved for the GPIB controller, i.e. the PC).

Convert the address into settings of the Address 1-5 DIP switches. For instance, if the address required is 22, then set the Address DIP switches to ON so that their values add up to 22, i.e.:

Address 5 (ON=16)

Address 3 (ON=4)

Address 2 (ON=2)

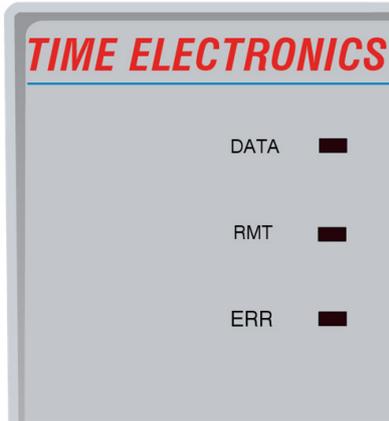
Added together, $16+4+2$ gives the address required, 22. In this case, the DIP switches for address 2, 3, and 5 are set to the ON position. The remaining address DIP switches are set to the OFF position.

When the unit is next started, "GPIB" will be displayed in the alphanumeric window to confirm the setting. The address will be shown to the right of "GPIB", e.g. "GPIB 22" means GPIB address 22.

4.1.3 Entering Remote Mode

The unit will automatically enter remote mode as soon as it receives a command on the remote interface. While in remote mode, the keypad will be disabled apart from the Confirm/Local key.

LED Displays in Remote Mode



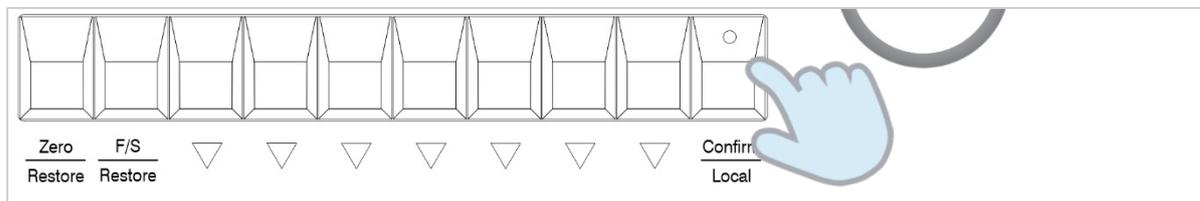
There are 3 LEDs located on the left-hand side of the unit's front panel. These indicate the status of the unit in remote mode:

LED	Usage
Data	Blinks to indicate reception/transmission of data through the RS-232 port.
Remote	Lights up when the unit is in remote mode. Goes out when the unit is in local mode.
Error	Lights up when an invalid remote command is received. Stays on until the error is read (the SYSTem:ERRor? command) or the error buffer is cleared (e.g. by a *CLS command).

4.1.4 Returning to Local Mode

The unit will return to local mode when either:

- a) The "OK/Local" key is pressed



- b) The unit receives the **SYSTem:LOCAL** remote command (see Commands for details).

4.2 Remote Commands

4.2.1 Introduction to SCPI

The 5011's remote commands follow the SCPI standards. If you are already familiar with SCPI, then you can skip this section.

SCPI commands are based on a tree-like hierarchy. Associated commands are grouped together under a common node (or root), into "subsystems". For example, here is a part of the SOURce subsystem:

```
SOURce:
  VOLTage:
    RANGE <voltage>
    RANGE?
    [LEVEl:] [IMMediate:] [AMPLitude] <voltage>
    [LEVEl:] [IMMediate:] [AMPLitude]?
  FREQuency:
    [:CW] <Hz>
    [:CW]?
  FUNCTion
    [:SHAPE] {DC|SINusoid}
    [:SHAPE]?
```

SOURce is the root keyword of the command. VOLTage, FREQuency and FUNCTion are second-level keywords, RANGE is a third level keyword, and so on. A colon (:) is used to separate different levels of keywords.

Command Format Used in this Section

For example, take this command:

```
[ :SOURce ] :VOLTage :RANGE <volts>
```

The commands are shown as a mixture of lower and upper case letters. The upper case letters represent the short form of the keyword, while the mixture of upper and lowercase letters represent the long form. For instance:

```
SOURCE      is the long form
SOUR        is the short form
```

You may use either the long form or the short form of any keyword. However you must not use a cross between the two, e.g. SOURC is invalid and will generate an error.

Please note that SCPI is case-insensitive and it does not matter what case you enter the commands in. The use of lower and upper case letters in the command formats is purely to show the long and short forms of the commands.

Braces ({, }) are used to enclose a set of choices for a given parameter. The braces should not be entered.

A vertical bar (|) is used to separate multiple parameter choices.

Triangle brackets (<,>) are used to indicate a value you need to specify for the parameter. For example, with the command above a valid command would be:

```
SOUR:VOLT:RANG 10
```

If a parameter or command keyword is enclosed in square brackets ([,]) then it is optional and can be omitted. The brackets should not be entered. For example if the command specification is this:
[:SOURce]:VOLTage:RANGe <volts>
then these commands are equivalent:

```
SOUR:VOLT:RANG 10  
VOLT:RANG 10
```

Command Separators

A colon (:) is used to separate command keywords from a lower-level keyword. For example:

```
SOUR:VOLT:RANG 20
```

You must separate a command from its first parameter with one or more spaces. For example:

```
SOUR:VOLT:RANG_20
```

You may include a series of commands in the same command line (up to 250 characters). To separate the commands use a semi-colon (;). For example:

```
SOUR:VOLT:RANG 20;LEV 10
```

That is the same as entering these separate commands:

```
SOUR:VOLT:RANG_20  
SOUR:VOLT:LEVEL 10
```

Use a colon **and** a semi colon to link commands from different levels of the tree. For example:

```
FUNC SIN;:FREQ 300;:SOUR:VOLT:RANG 20;:OUTP ON
```

That is the same as this series of commands:

```
FUNC SIN  
FREQ 300  
SOUR:VOLT:RANG 20  
OUTP ON
```

Query Commands

You can query the setting of most commands by appending a question mark (?) to the command. For example:

```
SRES?
```

This will return the Resistance setting in ohms.

Parameter Types

Numerical Parameters

Commands that accept numerical values as parameters also allow units to be specified, e.g. mV, uA, C (deg C), kR (kilo-ohms). For instance all of these are valid:

```
VOLT 10MV  
VOLT 0.01  
VOLT 1e-2
```

If you do not specify the unit then the default unit will be used (i.e. the unified units – volts, amps, ohms, seconds, Hz, Henrys etc.)

Boolean Parameters

A Boolean parameter is used where the setting is either true or false, on or off. The value may be entered as **ON** or **OFF**. In addition it may be entered as a number – a non-zero number is treated the same as **ON**, and zero is treated the same as **OFF**. For example, with this command specification:

```
:OUTPut[:STATe] <Boolean>
```

These are valid commands:

```
OUTPut ON  
OUTPut 1  
OUTPut OFF  
OUTPut 0
```

SCPI Command Terminator

Each command line must end with a command terminator. In the case of GPIB, this may be either through use of the IEEE488 EOI (End Or Identity) message, or using a Carriage Return (ASCII 13) or Linefeed (ASCII 10) character, or any combination of the three.

In the case of RS232, the command terminator must be a Carriage Return or a Line Feed character or both.

Note: A command terminator always resets the SCPI tree to the root level.

4.2.2 Command Set

[:SOURce] :VOLTage :RANGe <volts>

Select the voltage function and a range. <volts> may be 20mv, 200mv, 2V, 20V, 200V or 1kV.

Example:

volt:rang 20

selects the voltage function and 20V range

[:SOURce] :VOLTage :RANGe ?

Query the present voltage range.

Example:

volt:rang?

> 0.2

[:SOURce] :VOLTage [:LEVel] [:IMMediate] [:AMPLitude] <volts>

Set the voltage output in the present voltage range.

Example:

volt 150.67mv

sets the output voltage to 150.67mV

[:SOURce] :VOLTage [:LEVel] [:IMMediate] [:AMPLitude] ?

Query the present voltage output.

Example:

volt?

> 1.7352

[:SOURce] :CURRent :RANGe <amps>

Select the current function and a range. <current> may be 200ua, 2ma, 20ma, 200ma, 2a or 20a.

Example:

curr:rang 2ma

selects the current function and 2mA range

[:SOURce] :CURRent :RANGe ?

Query the present current range.

Example:

curr:rang?

> 0.002

[:SOURce] :CURRent [:LEVel] [:IMMediate] [:AMPLitude] <amps>

Set the current output in the present current range.

Example:

curr 0.5
sets the output current to 500mA

[:SOURce] :CURRent [:LEVel] [:IMMediate] [:AMPLitude] ?

Query the present current output.

Example:

curr?
> 0.025

[:SOURce] :FREQuency [:CW | :FIXed] <Hz>

Set the frequency of the AC voltage or AC current function. <Hz> is an integer between 0 and 20kHz for AC volts in the 20V range or lower. For other ranges the maximum frequency settable is as per the specification section of this manual.

Example:

freq 1.2kHz
sets the AC frequency to 1.2kHz

[:SOURce] :FREQuency [:CW | :FIXed] ?

Query the frequency of the AC voltage or AC current function.

Example:

freq?
> 1200

[:SOURce] :FUNCTion [:SHAPE] {DC | SINusoid}

Select shape of the voltage and current functions. Selecting "DC" will make the present and future functions output in DC volts or DC amps. Selecting "SINusoid" will make the functions output in AC volts or AC amps. This setting is remembered until the unit is reset or turned off. At startup, this setting is "DC".

Example:

func sin
selects AC output

[:SOURce] :FUNCTion [:SHAPE] ?

Query the shape of voltage and current functions.

Example:

func?
> DC

[:SOURce] :NONE

Set all outputs off and return the unit to the “Ready” state. Note, the unit is still in remote mode operation.

Example:

none

:OUTPut[:STATe] <Boolean>

Turns output from the terminals on (if <Boolean> is ON) or off (if <Boolean> is OFF). At startup, the default state is ON.

Example:

outp on

turns output on

:OUTPut[:STATe]?

Query the terminal output state.

Example:

outp?

> 0

:SYSTem:LOCa1

Puts the unit into local (keypad) operation mode.

:SYSTem:REMote

Puts the unit into remote (GPIB/RS232) operation mode. The unit's keypad is disabled apart from the “Local/Confirm” button. If pressed once while in remote operation, the unit will return to local operation.

Note also that the unit is automatically switched from local to remote operation if it receives a command over the GPIB/RS232 port.

:SYSTem:ERRor[:NEXT]?

Query the oldest error code in the remote error buffer. The error code is also deleted from the remote error buffer. If no errors are present in the buffer, then it returns “0”.

Example:

sys:err?

> -380

:SYSTem:ERRor:COUNT?

Query the number of errors in the unit's remote error buffer. The buffer has room for 64 entries.

Example:

sys:err:coun?

> 2

:SYSTem:VERSion?

Query the version of SCPI supported by the unit.

Example:

```
syst:vers?  
> 1999.0
```

:SYSTem:UNIT:INFormation?

Query the version numbers of the unit's firmware and the modules within the unit. The format of the returned information is one line of text per module:

```
<Board Code>,<Software version>
```

:SYSTem:MODule:VSource:TEMPerature?

Query the temperature of the voltage source module inside the unit. The temperature returned is in the currently selected temperature units.

Example:

```
syst:mod:vs:temp?  
> 38.2
```

IEEE488.2 Compliant Commands

***CLS**

Clear the remote error buffer.

***IDN?**

Query the identity of the unit. The information returned is in standard SCPI format, i.e.:

```
TIME ELECTRONICS,5018,0,1.0.0
```

where 1.0.0 is the version number of the unit's firmware.

***OPC?**

Returns "1" when the previous command has completed operating.

***RST**

Make the unit perform a complete reset. All output is turned off and unit returns to Ready state.

***WAI**

Waits for the last command to complete before continuing. Since all commands to the 5011 are treated sequentially, this command is redundant, but is kept for SCPI-compatibility.

Remote Error Codes

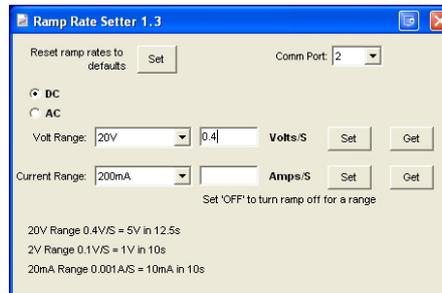
When an error occurs during remote operation, e.g. if an invalid command is received, then an error code is added to the remote error buffer. In addition, a beep is emitted and the Error LED on the front panel lights up.

The error codes may be retrieved, oldest error first, using the **:SYSTEM:ERROR[:NEXT]?** and **:SYSTEM:ERROR:COUnT?** commands.

Code	Description
-102	Syntax error in the command line.
-104	Invalid data type. For example, a number was entered where a string was required.
-108	Too many parameters.
-109	Not enough parameters.
-113	Undefined header. The command was not recognised.
-131	Invalid suffix. A number was given but the units were not valid.
-151	Invalid string, e.g. a quote was missing.
-221	Settings Conflict. The command was incompatible with the present state. For example, a voltage output was request while the unit was not in a voltage range.
-222	Data out of range. The value of one/more parameters was outside range allowed.
-224	Illegal parameter value. The parameter given was beyond the allowed limits.
-350	Too many errors. An error has occurred but the buffer of error codes is full.
-380	Internal Error. A problem has occurred with the operation of the unit. Restart the unit before continuing.

5 Ramping

The 5018 ramping rate is set in volts per second or amps per second via remote commands. A simple application is available which enables the user to set the ramp rate values. Connection via RS232 from a PC to the 5018 is required.



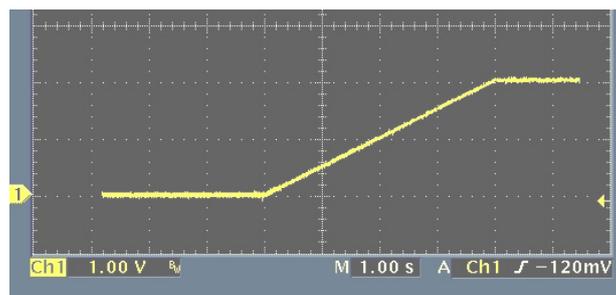
The ramp rate is held in non-volatile memory, so settings are retained even if the unit is switched off. Ramping is precisely controlled by the 5018's internal micro-processor and does not require connection to a PC to perform the actual ramping function.

The ramping option can be set to on or off via the 5018 front panel by pressing the 'function' button followed by the 'Set' button and selecting the ramp on/off option. This enables the 5018 to operate in normal output mode if required.

To ramp to a required value, first set the output off. Select the required value and turn the output on. The 5018 will then ascend to the set value. Turning the output off will also invoke a descending ramp.

During the ramping period the front panel (or any remote commands) will not respond. To interrupt a ramp, a power cycle is required.

Voltage		
Range	Min (Slow)	Max (Fast)
20mV	1uV/s	20 V/s
200mV	10uV/s	200 V/s
2V	100uV/s	2000 V/s
20V	1mV/s	20000 V/s
Current		
200uA	0.5uA/s	0.2A/s
2mA	5uA/s	2A/s
20mA	50uA/s	20A/s
200mA	500uA/s	200A/s



An oscilloscope trace showing a ramp from 0V to 2V in 4 seconds

5.1 Remote Commands

The 5018 must be put into the correct range before sending the ramp rate command.

:VOLTage:RAMP:RATE	Set the voltage ramp rate for the select range in Volts/Sec. (smooth ramping)
:VOLTage:RAMP:RATE?	Query the ramp rate
:CURRent:RAMP:RATE	Set the current ramp rate for the select range in A/Sec. (smooth ramping)
:CURRent:RAMP:RATE?	Query the ramp rate
SYSTem:UNIT:RAMP:ENABLE	Set ramping mode to on or off
SYSTem:UNIT:RAMP:ENABLE?	Query ramp enable

Example:

```
func dc,; volt:range 2;;volt:ramp:rate 0.5
```

Sets the 2V range to ramp at 0.5V/s.

6 Fault Diagnosis

6.1 Startup Errors

If the unit displays one or more error codes at startup, then refer to this table:

Error Displayed	Meaning
V/I Cal!	The voltage and current calibration factors are invalid. The unit should be calibrated/recalibrated before the voltage and current functions are used again.
Error 20	HV module not found. This could indicate an error with that module or a problem with the main control board.
Error 22	Voltage source module not found. This could indicate an error with that module or a problem with the main control board.
Error 23	AC synth module not found. This could indicate an error with that module or a problem with the main control board.
Error 24	Current module not found. This could indicate an error with that module or a problem with the main control board.
Error 25	Matrix relay module not found. This could indicate an error with that module or a problem with the main control board.
Error 30	Non-volatile settings are invalid. They have been set to default values. Check the setup options are correct.
Error 67	Internal communications error. This may be due to a problem with the main board's processor, the main internal comms bus or a slave module problem (e.g. a board badly seated in the bus).

6.2 Basic Troubleshooting

Problem	Cause
Unit does not function at all	Check Mains fuses on the rear panel. Both are 3.18A anti-surge for 230V AC units and 6A for 110V AC units.
Remote Mode: No communications with unit	Check the comms cable is the correct type (e.g. a straight-through cable if using RS232). Check the configuration DIP switches on the 5011 agree with the comms settings of the PC.

7 Re-Calibration

The 5018 should be re-calibrated at recommended intervals in order to ensure its outputs remain within specification. Normally re-calibration is done at 12 month intervals.

The 5018 calibration software and manual are supplied separately and only available by request from Time Electronics.

It is recommended that the unit is returned to Time Electronics or an authorised service centre for re-calibration.

8 Warranty and Servicing

Warranty

Time Electronics products carry a one-year manufacturer's warranty as standard.

Time Electronics products are designed and manufactured to the highest standards and specifications to assure the quality and performance required by all sectors of industry. Time Electronics products are fully guaranteed against faulty materials and workmanship.

Should this product be found to be defective, please contact us using the below details. Inform us of the product type, serial number, and details of any fault and/or the service required. Please retain the supplier invoice as proof of purchase.

This warranty does not apply to defects resulting from action of the user such as misuse, operation outside of specification, improper maintenance or repair, or unauthorized modification. Time Electronics' total liability is limited to repair or replacement of the product. Note that if Time Electronics determine that the fault on a returned product has been caused by the user, we will contact the customer before proceeding with any repair.

Product Registration

You can register your product at: www.timeelectronics.com/contact/product-registration
Registering your product will enable us to maintain a record of purchase for your warranty. You can also use the web form to provide feedback about our products and services.

Calibration and Repair Services

Time Electronics offers repair and calibration services for all the products we make and sell. Routine maintenance by the manufacturer ensures optimal performance and condition of the product. Periodic traceable or accredited calibration is available.

Contacting Time Electronics

Online:

Please visit www.timeelectronics.com and select Technical Support from the Contact links. From this page you will be able to send information to the Time Electronics service team who will help and support you.

By phone:

+44 (0) 1732 355993

By email:

mail@timeelectronics.co.uk

Returning Instruments

Prior to returning your product please contact Time Electronics. We will issue a return merchandise authorization (RMA) number that is to accompany the goods returning. Further instructions will also be issued prior to shipment. When returning instruments, please ensure that they have been adequately packed, preferably in the original packing supplied. **Time Electronics Ltd will not accept responsibility for units returned damaged.** Please ensure that all units have details of the service required and all relevant paperwork.

Send the instrument, shipping charges paid to:

Time Electronics Ltd

Unit 5, TON Business Park, 2-8 Morley Road,
Tonbridge, Kent, TN9 1RA.
United Kingdom.

Tel: +44(0)1732 355993

Fax: +44(0)1732 350198

Email: mail@timeelectronics.co.uk

Web Site: www.timeelectronics.com

Disposal of your old equipment



1. When this crossed-out wheeled bin symbol is attached to a product it means the product is covered by the European Directive 2002/96/EC.
2. All electrical and electronic products should be disposed of separately from the municipal waste stream via designated collection facilities appointed by the government or the local authorities.
3. The correct disposal of your old appliance will help prevent potential negative consequences for the environment and human health.
4. For more detailed information about disposal of your old appliance, please contact your city office, waste disposal service or return to Time Electronics.