Time Electronics
Calibration, Test and Measurement

User Manual

5011
Resistance and Temperature Calibrator

Revision 2206-1

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

T: +44 (0) 1732 355993 | F: +44 (0) 1732 350198
mail@timeelectronics.co.uk | www.timeelectronics.com

© 2022 Time Electronics Ltd.

All rights reserved.
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.

Contents

1 Introduction

1.1 Overview

A versatile, high accuracy calibrator that can be used in a wide range of testing applications. Primarily used as a programmable resistance and RTD source, the 5011 provides precision resistance with a best accuracy of 0.01 % and 1 mΩ resolution (50 Ω to 1 kΩ).

Internal options for increased capabilities can be fitted as per customer requirement. These include DC voltage and thermocouple simulation, DC current, and frequency. The 5011 can be used to cover a wide workload as a laboratory calibrator or be incorporated into an automated test system. A rack mount kit option is also available.

Features

- 1 Ω to 120 MΩ
- 100 ppm basic accuracy
- RTD simulation
- Optional thermocouple simulation
- DCV and DCI options
- 10 MHz frequency option
- RS-232, GPIB, USB interfaces
- Front panel operation
- PC/laptop control via EasyCal software

Internal Factory Fitted Options

- Internal DC voltage and thermocouple simulation – option code 9711
- Internal current option (220 mA max) – option code 9718
- Internal frequency option (10 MHz digital) – option code 9729

External Options

- 19” Rack Mount Kit
- Test Lead Sets
- Soft Carry Case
- Transit Case

1.2 Important Information

Warning: The 5011 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.

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 5011'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

Accuracies quoted are for 1 year at 22 °C ± 3 °C. For temperatures outside the above range apply 0.2 x specification per °C.

Standard features

Resistance

Range	Accuracy	Resolution
1 Ω to 20 Ω	0.01 % ± 10 mΩ	1 Ω
20 Ω to 99.999 Ω	0.01 % ± 10 mΩ	1 mΩ / 5 mΩ*
100 Ω to 999.999 Ω	0.01 % ± 8 mΩ	1 mΩ
1 kΩ to 9.999 kΩ	0.02 % ± 23 mΩ	1 Ω
10 kΩ to 99.999 kΩ	0.01 % ± 1 Ω	1 Ω
100 kΩ to 999.99 kΩ	0.01 % ± 10 Ω	10 Ω
1 MΩ to 9.9999 MΩ	0.02 % ± 100 Ω	100 Ω
10 MΩ to 120 MΩ	0.1 % ± 1 kΩ	1 kΩ

Temperature coefficient ..... less than 50 ppm/°C

Power rating ..... 0.1 W per resistor

Maximum voltage ..... 250 V

Resistance switch Time ..... 250 µs

Operation time ..... 300 ms

* Output setting resolution below 50 Ω is 5 mΩ

PRT Simulation

RTD Type	Alpha coeff	Range	Accuracy
Pt100	0.003850	-180 to -100 °C	0.1 °C
Pt100	0.003850	-100 to 850 °C	0.05 °C

It should be noted that the accuracy of the PRT simulation is determined by the accuracy of the PRT tables (BS EN 60751) published by the British Standards Institute. The 5011 uses precise digital interpretation of the tables to output resistance values that are within the accuracies specified in the table.

Options

Thermocouple simulation

Type	Range °C	Accuracy °C
J	-210 to -50 / -50 to 1200	0.15 / 0.2
K	-200 to -100 / -100 to 1372	0.25 / 0.18
T	-200 to 100 / 100 to 400	0.2 / 0.15
R	-50 to 50 / 50 to 250 / 250 to 1768	1 / 0.7 / 0.6
S	-50 to 500 / 500 to 1768	0.9 / 0.6
B	300 to 800 / 800 to 1820	1.5 / 0.8
N	-200 to 0 / 0 to 600 / 600 to 1300	0.4 / 0.15 / 0.2
E	-200 to 0 / 0 to 1000	0.2 / 0.12

Cold Junction Compensation ± 0.5 °C (applies to ambient changes of less than ± 1 °C at 23 °C). The accuracy of the thermocouple simulation is determined by the accuracy of the 5011's DC voltage function and the accuracy of the standard thermocouple tables (BS EN 60584-1) published by the British Standards Institute. The 5011 uses precise digital interpretation of the tables to output voltage levels that are within the accuracies specified in the table.

DC Voltage* (9711)

Range	Accuracy	Resolution
0 to 20 mV	40 ppm + 4 µV	0.1 µV
20 to 200 mV	40 ppm + 4 µV	1 µV
0.2 to 2 V	40 ppm + 15 µV	1 µV
2 to 20 V	40 ppm + 75 µV	10 µV

DC Current* (9718, requires 9711 option). Compliance Voltage: 10 V

Range	Accuracy	Resolution
0 to 200 µA	150 ppm + 25 nA	0.1 nA
0.2 to 2 mA	120 ppm + 55 nA	1 nA
2 to 20 mA	120 ppm + 200 nA	10 nA
20 to 200 mA	120 ppm + 2 µA	100 nA

* Specifications apply from 10 to 100 % of range. 10 % over range.

Digital frequency / period (9729)

2 V pk/pk approx 0.1 Hz to 10 MHz / 100 ns to 10 s. Accuracy 20 ppm.

1.3.2 General Specifications

Warm up ..... 30 minutes to full accuracy.

Settling time ..... Less than 5 seconds.

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

Temperature performance ..... Operating: 0 to 40 °C.
Full Spec: 23 °C ± °C.
Storage: –10 °C to 50 °C.

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

Line power ..... 100 to 230 V AC 50/60 Hz.
Power Consumption 60 W typical, 80 W maximum.

Dimensions ..... W 450 x D 272 x H 152 mm (18 x 11 x 7 ").

Weight ..... 7 kg (15.4 lbs).

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

1.3.3 Ordering Information

5011 ..... Resistance and Temperature Calibrator

9711 ..... Internal DC voltage and thermocouple simulation

9718 ..... Internal current option (220 mA max)

9729 ..... Internal frequency option (10 MHz digital)

9728 ..... 19 " Universal rack mount kit

9541 ..... Basic test lead set

9796 ..... Premium test lead set

C171 ..... Traceable calibration certificate (Factory)

C115 ..... Accredited calibration certificate (ISO 17025)

9795 ..... Printer and connectivity kit

ECFLA ..... EasyCal Software (see separate datasheet for options)

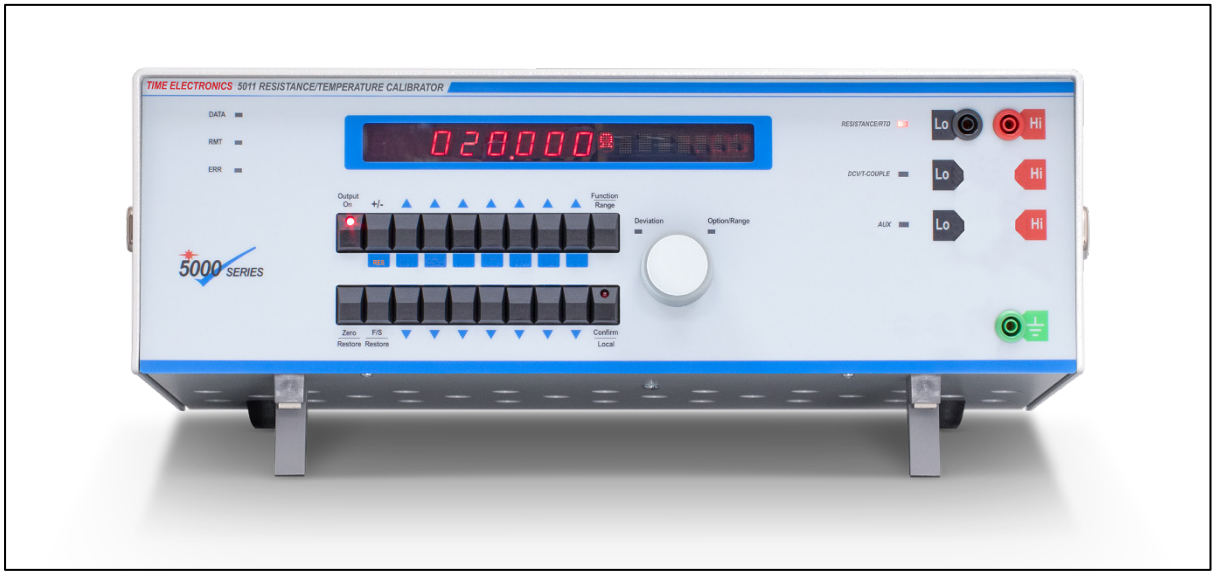
1.4 Installation

1.4.1 Positioning the Instrument

Benchtop Use

The 5011 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 5011 use an alcohol-free wipe such as a ‘durable screenclean 50’.

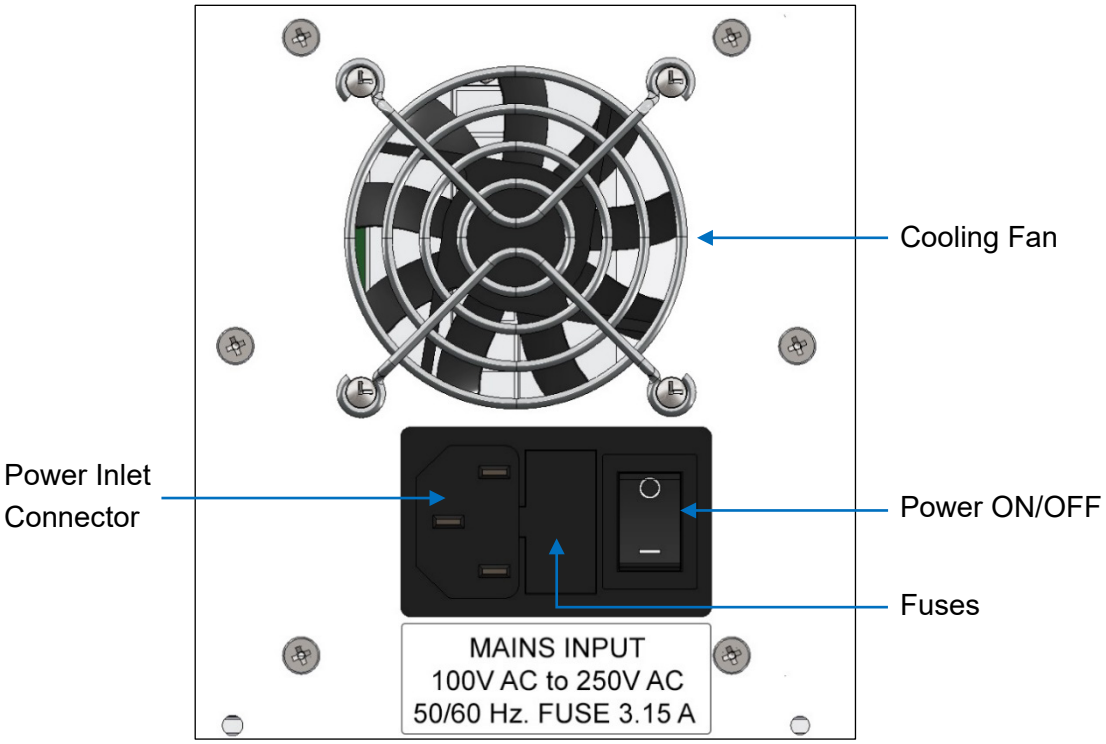
Packaging

The 5011 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

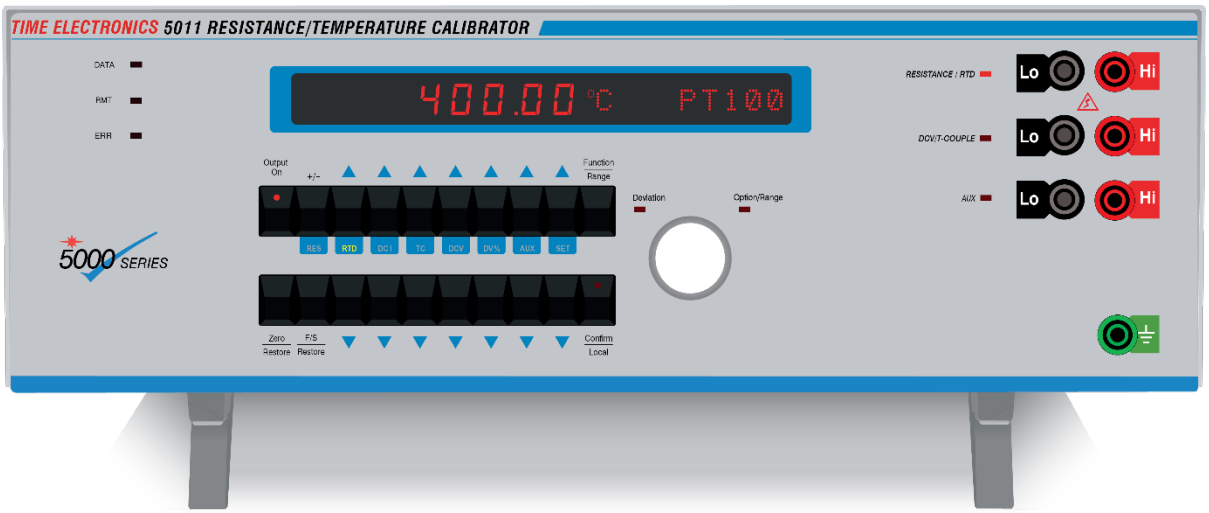
The supply power is connected via a standard IEC Euro connector on the rear panel. The standard voltage supply is 100 to 230 V 50/60 Hz. There are two protection fuses mounted in the IEC connector assemble, both are T3.15 A slow blow.

Mains Power Unit - Rear Panel

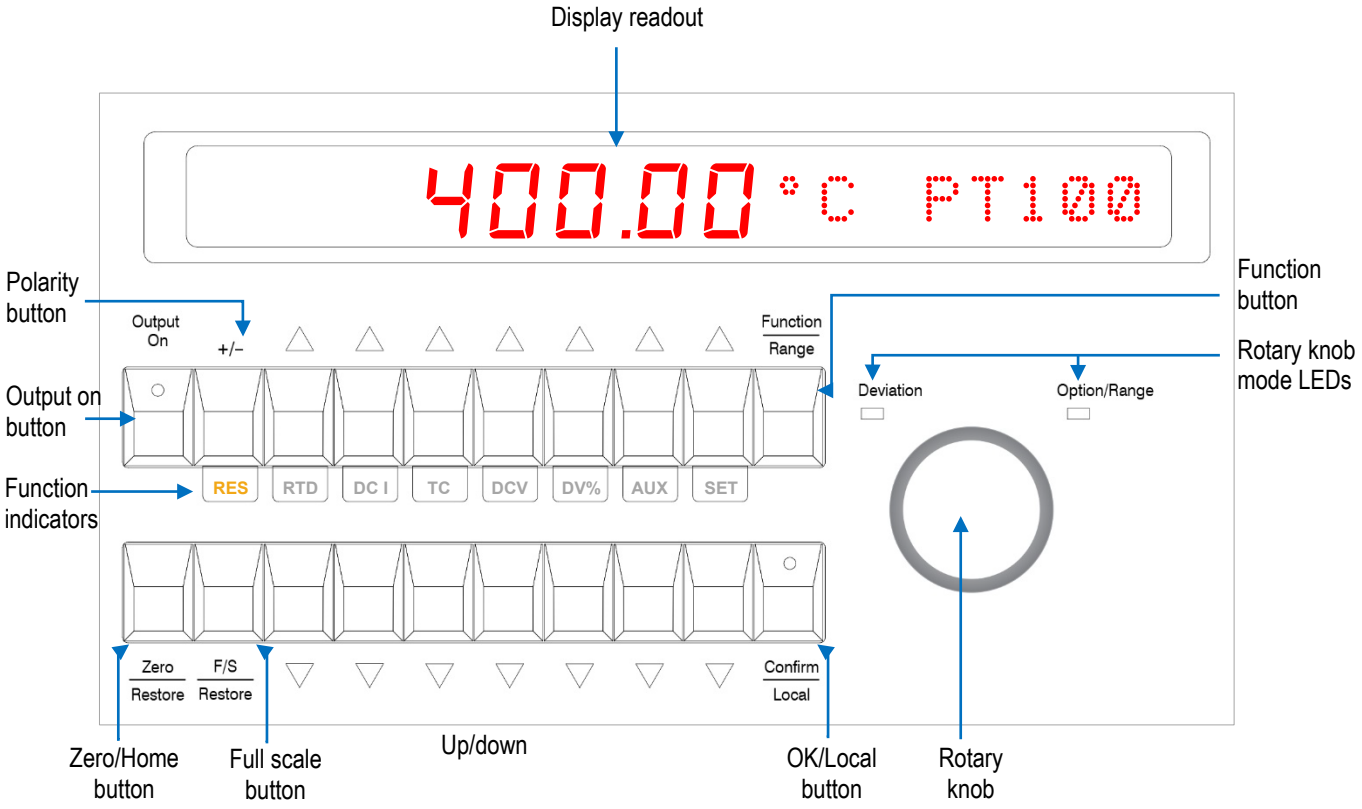


For information on PC communication and settings see the Remote Operation Section.

2 Front Panel Controls



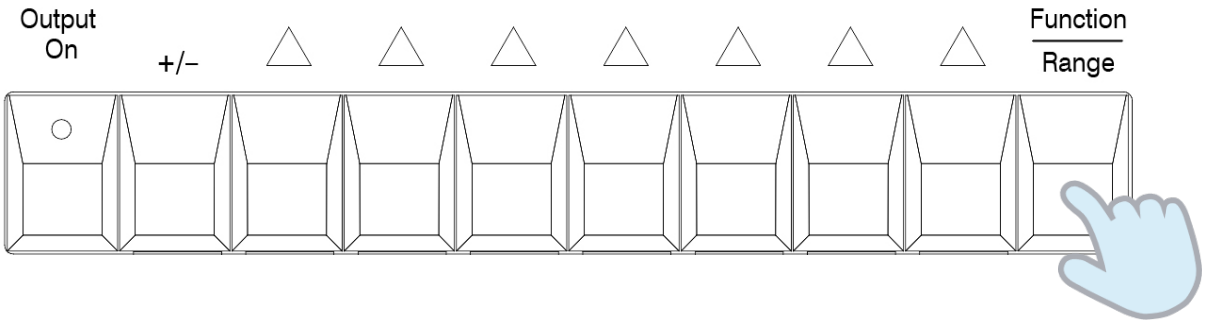
2.1 Keypad and Display



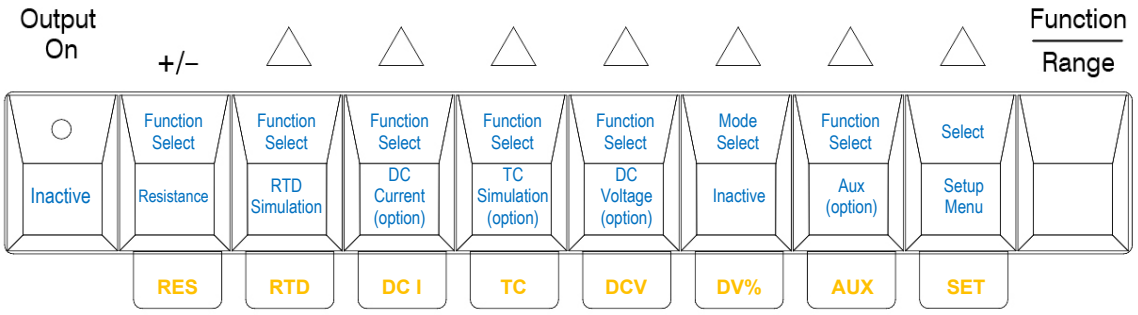
2.2 Keypad Buttons

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:



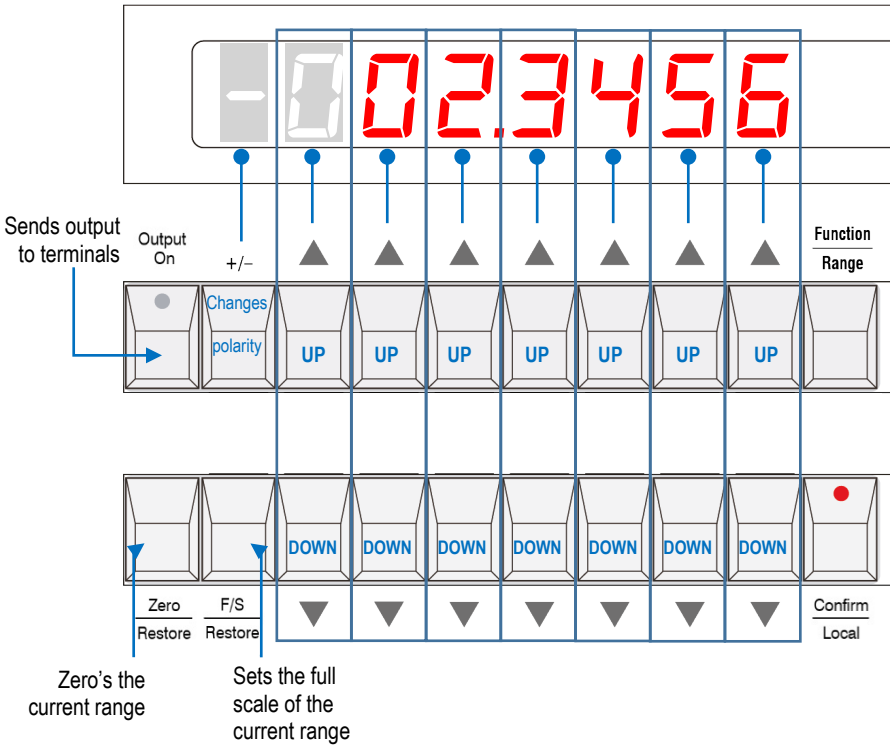
The **Function/Range** button can also be pressed after a function has been selected and is in use. The function indicators will flash show they are selectable. Any modes or setting buttons available for use will also flash. The user can choose to:

- 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: Resistance, DC Voltage (option), DC Current (option), Frequency (option).

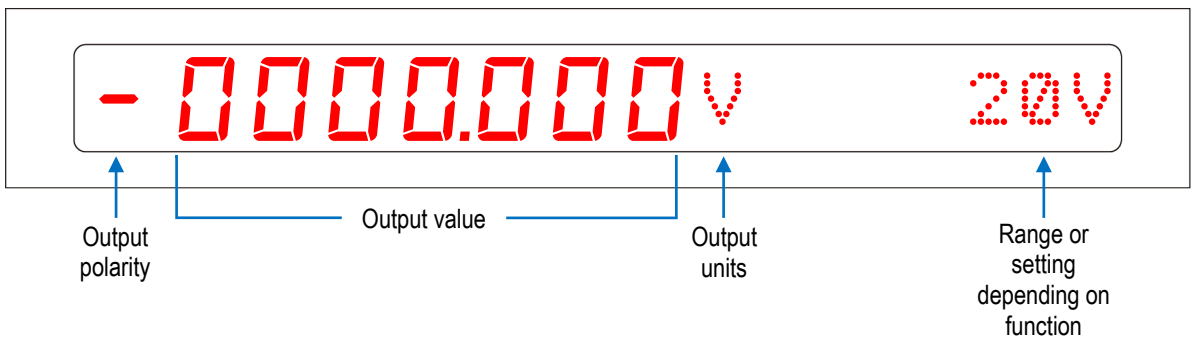
The buttons are in-line with the numerical readout to the as shown below:



2.3 Display Readout

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

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



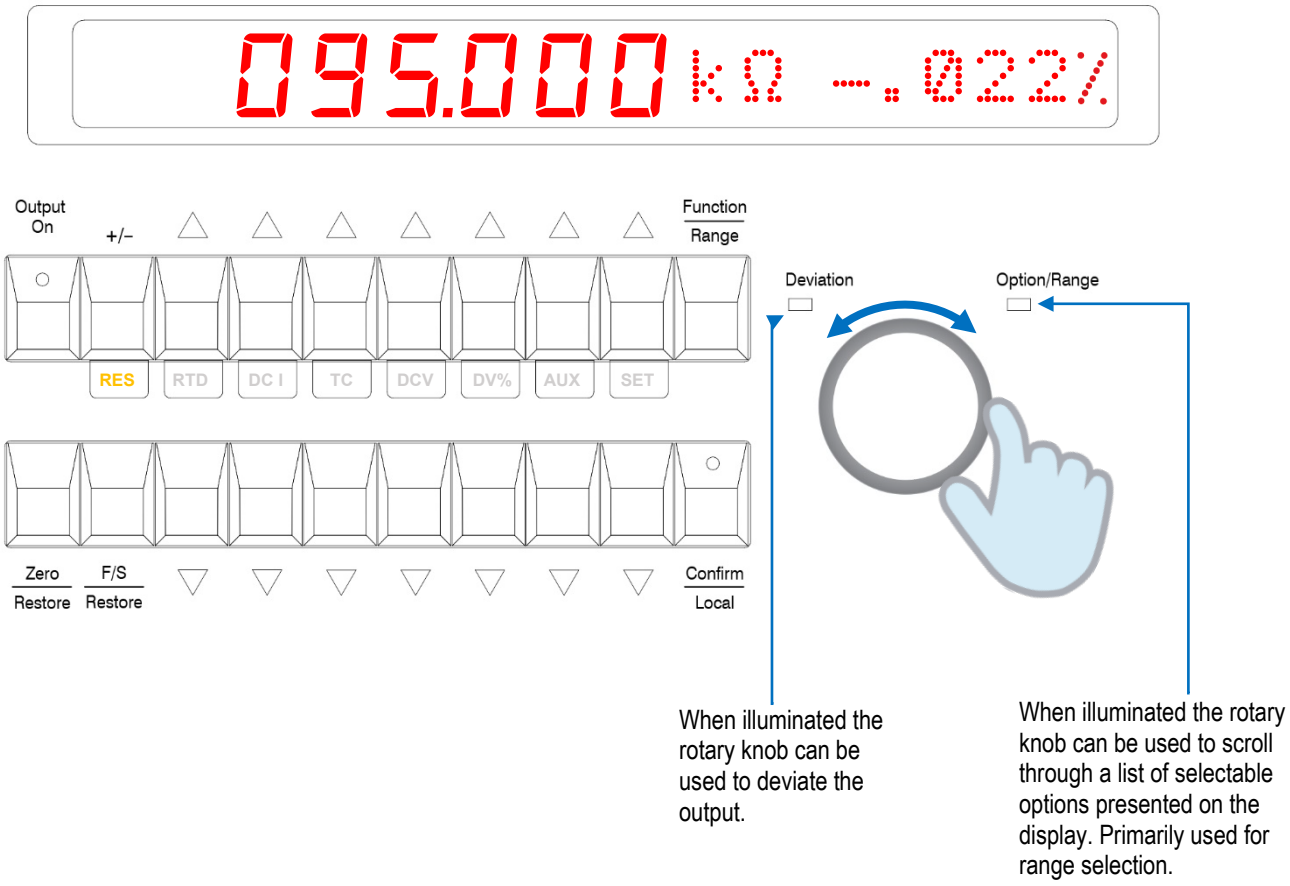
Note: Display resolution depends on the function and operating range.

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.

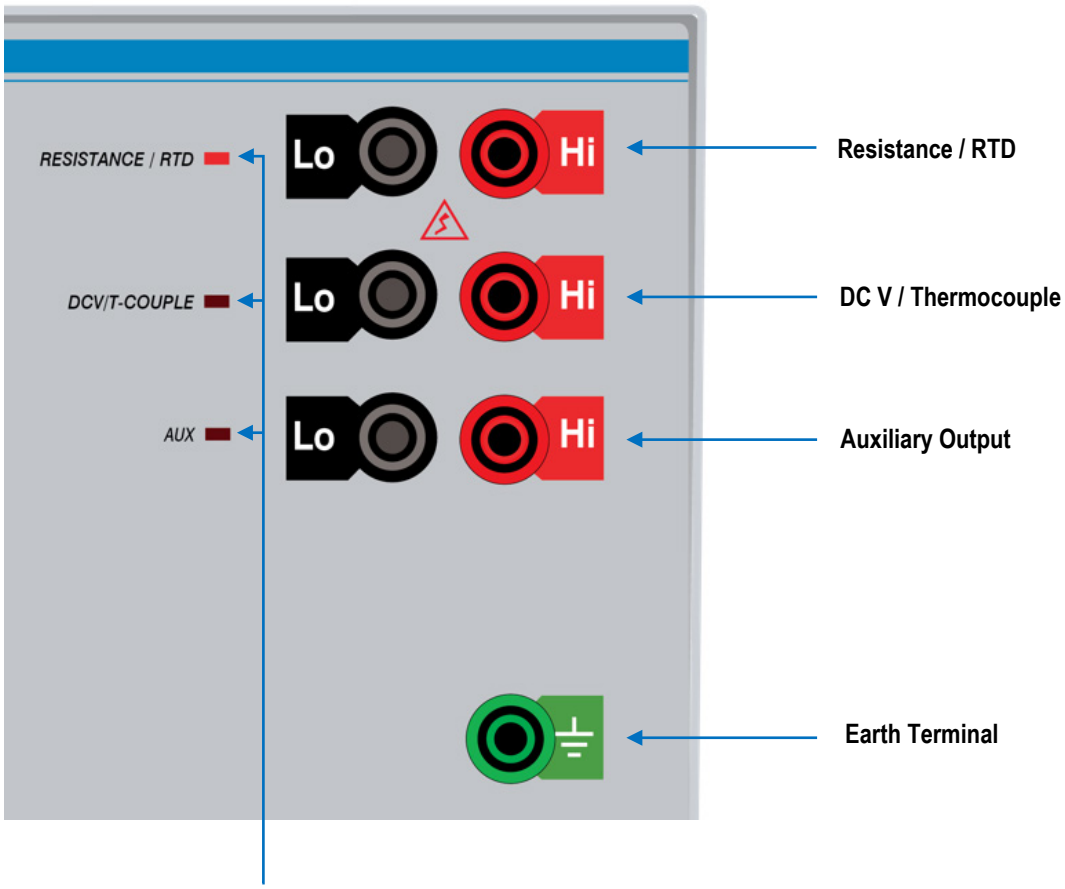
The rotary knob is used for the following:

- Range selection (Resistance, DC V, DC I).
- Function settings (RTD or thermocouple type selection).
- Deviation mode.
- Settings options.



2.5 Terminals

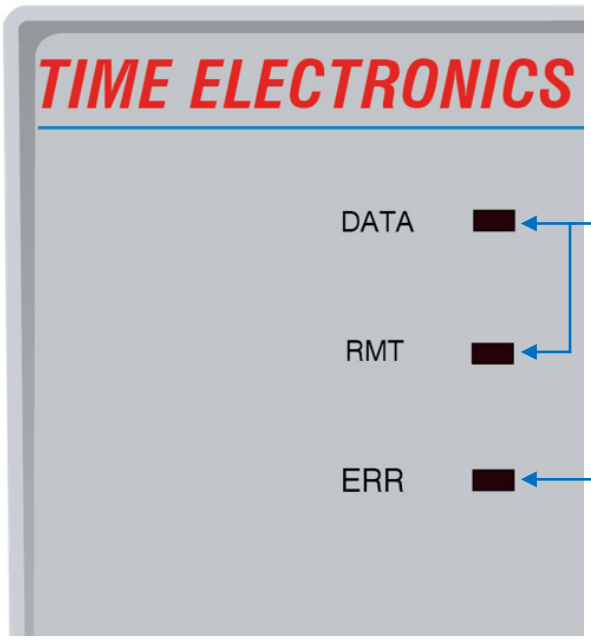
The terminal configuration for the 5011.



Terminal LED Indicators
LED indicates active terminal:

- ON when outputting
- FLASHING when in standby (no output)

2.6 Display LEDs



Data and Remote LEDs

Used to indicate remote mode activity.
See “Remote Operation” section of this manual for more details.

Error LED

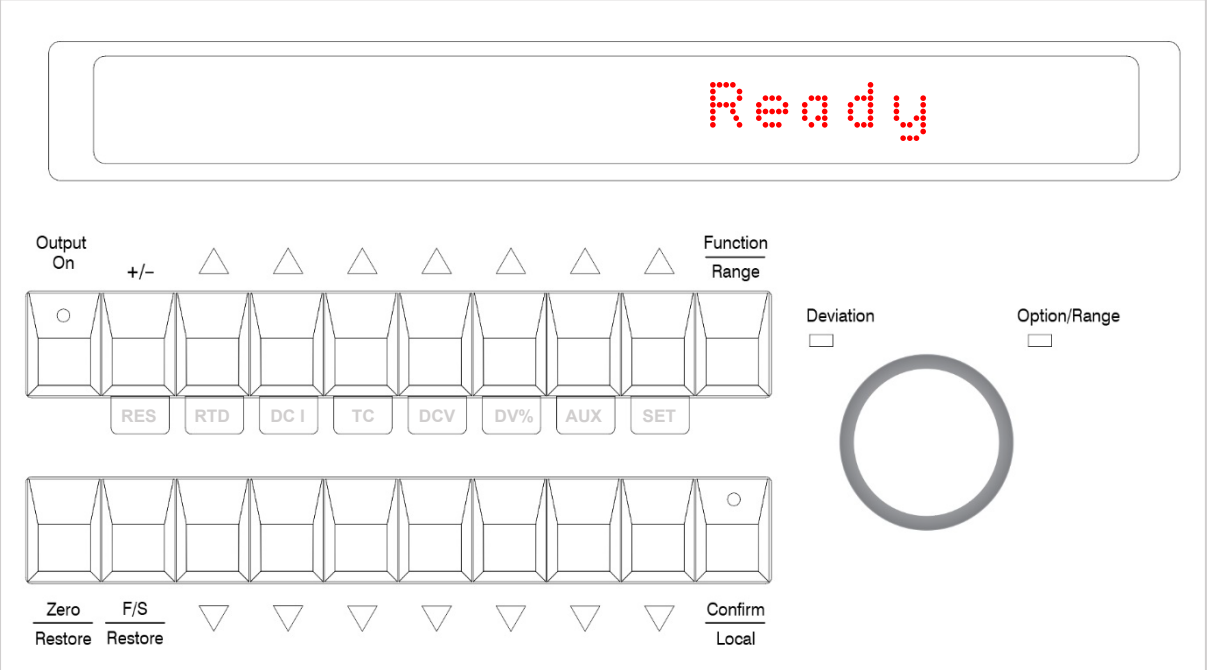
Flashes to indicate an output error condition, e.g. if no load is connected during current output.
Stays lit to indicate a remote interface error.
See “Remote Operation” section for details.

3 Front Panel Operation

3.1 Unit start-up

After switching on, the 5011 goes through a start-up routine that includes:

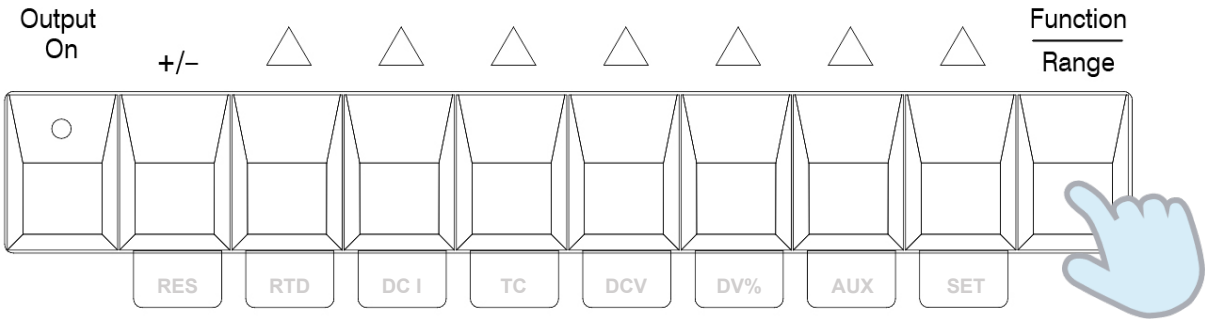
- Instrument self-test and health check routine.
- Front panel LEDs illuminate.
- Sounds the buzzer.
- Displays the model number and the firmware version number.
- Displays the communication type and setting.
- On completion of the start-up routine, the word “Ready” is shown on the display.



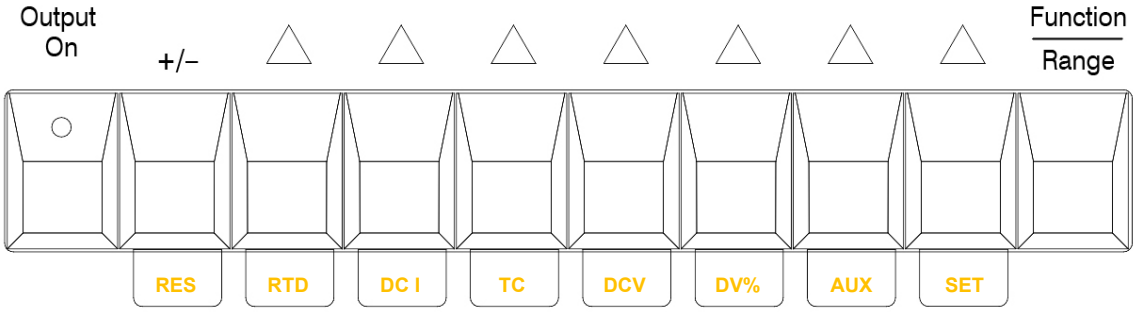
Note:
If any error codes are displayed during start-up, please refer to the “Fault Diagnosis” section later in this manual.

3.2 How to select a Function

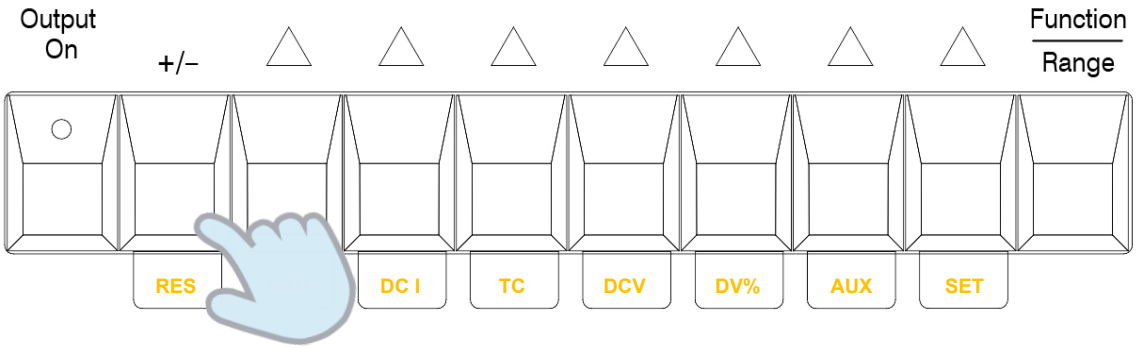
1. Press the "**Function**" button.



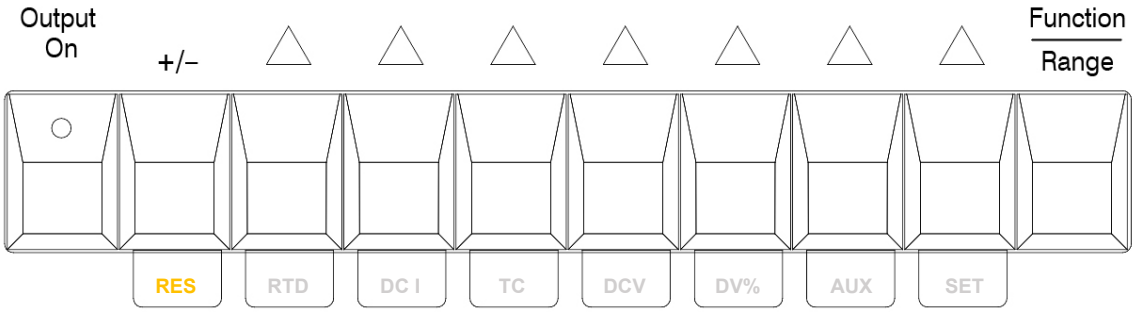
2. The function indicators will then flash to prompt a selection.



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



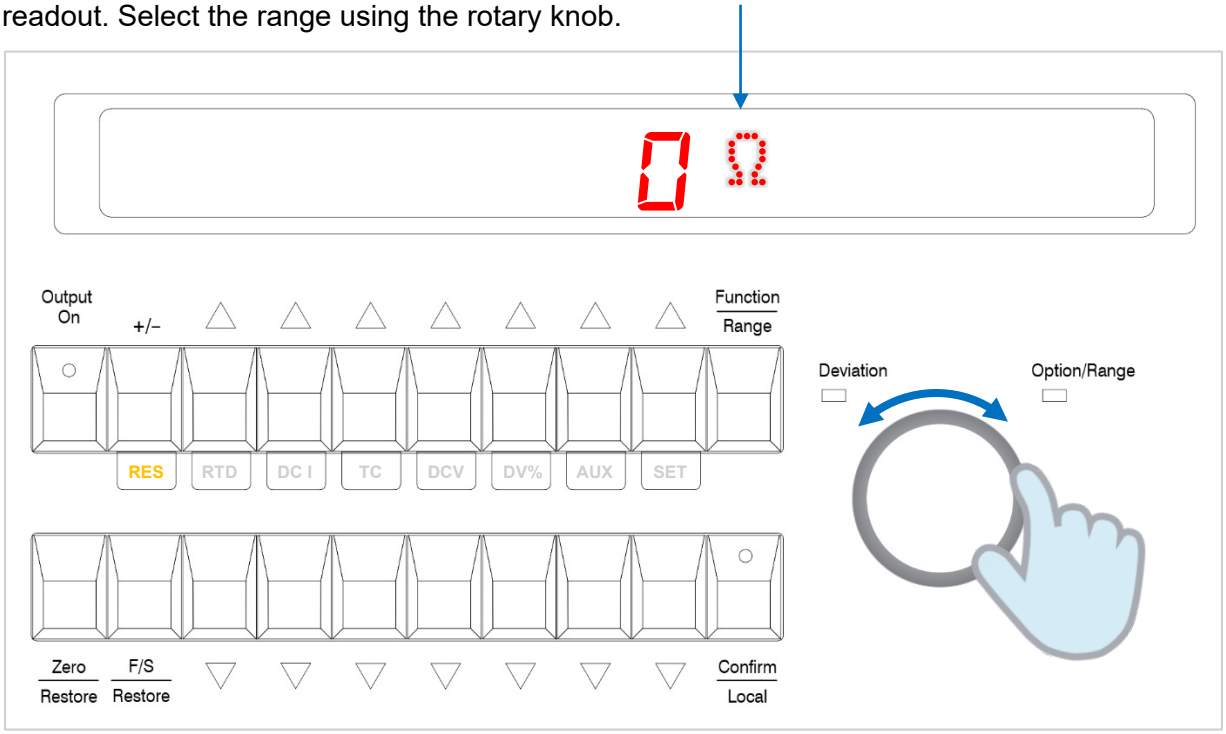
Once pressed, the function (RES) will be the only indicator to remain illuminated, showing it is the selected function.



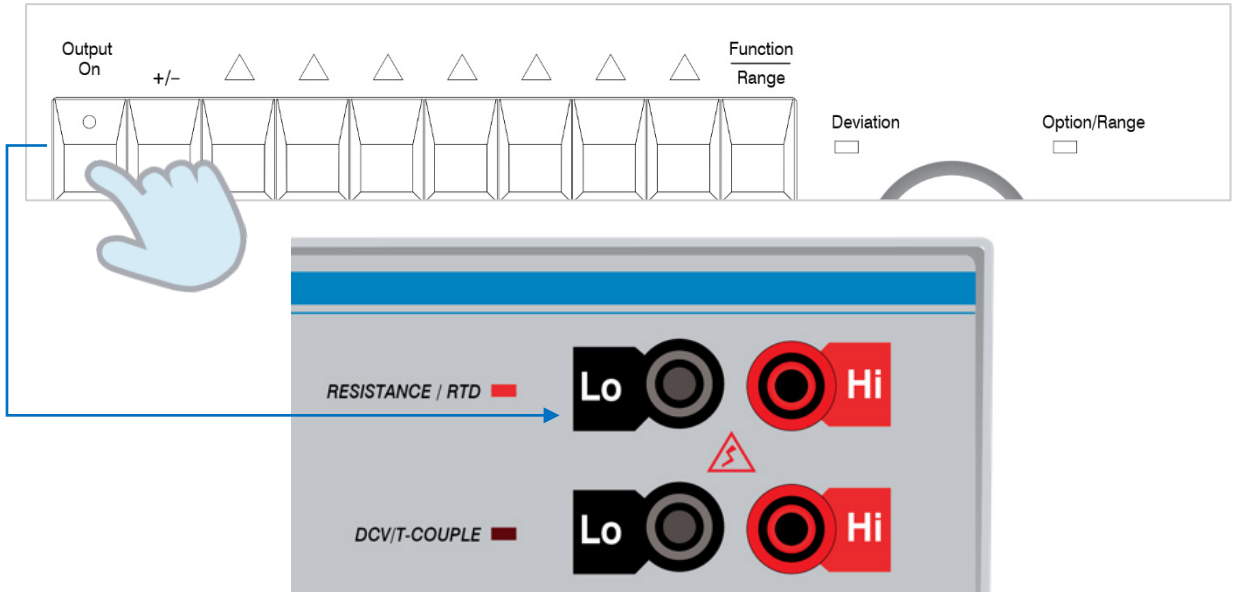
3.3 Resistance **RES**

To select the resistance function, press the "**Function**" button followed by "**RES**" button.

The variable resistance ranges are indicated by the flashing ohms units on the display readout. Select the range using the rotary knob.



Press the "**Confirm**" button once the required range is selected.
Then set the required resistance value using the "**Up (∆) / Down (∇)**" buttons.
Deviation mode is available. To use press the "**Function**" button, then "**DEV**" button.
Connect the output to the terminals by pressing the "**Output On**" button.



Note: External lead resistance must be subtracted from the final output value.

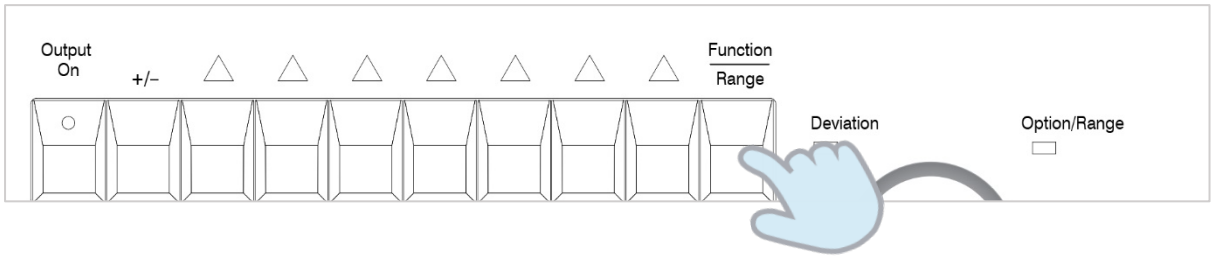
3.4 Using Deviation Mode **DV%**

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

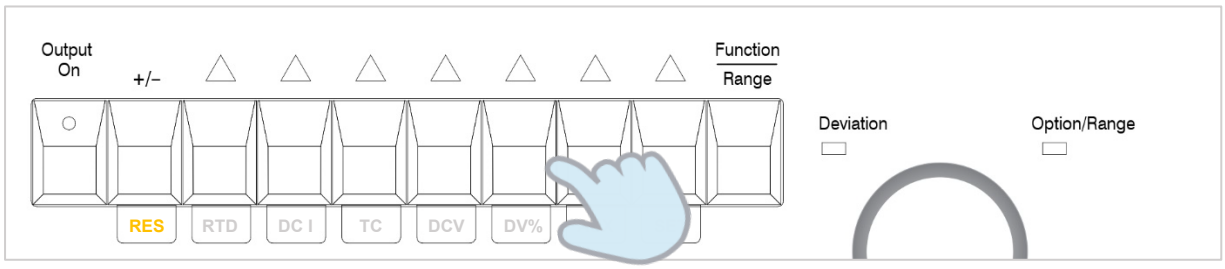
- Fine deviation: 0.001%
- Medium deviation: 0.01%
- Coarse deviation: 0.1%

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

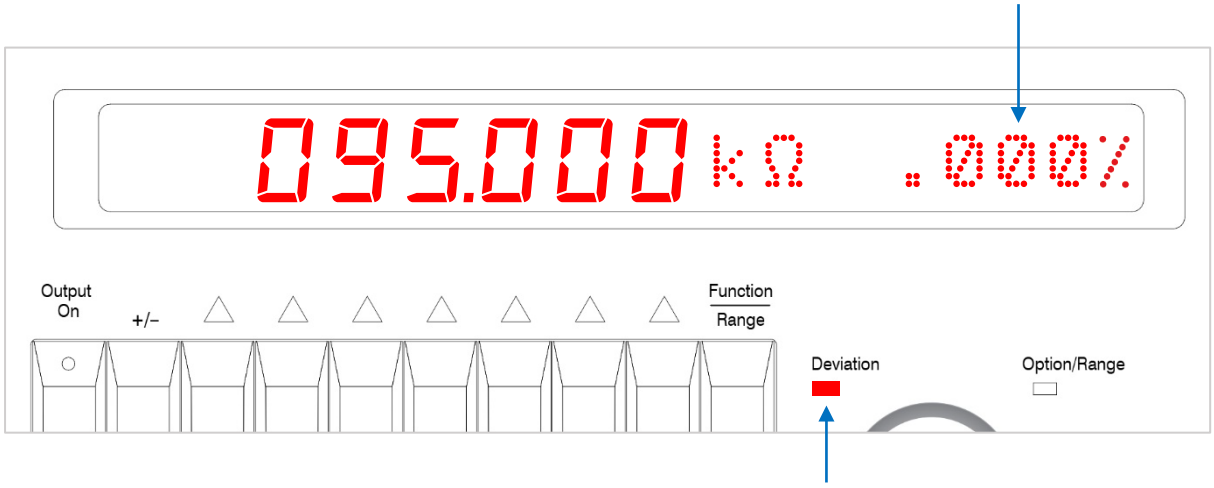
1. To use Deviation mode start by pressing the "**Function**" button.



2. Then press the "**DV%**" button.

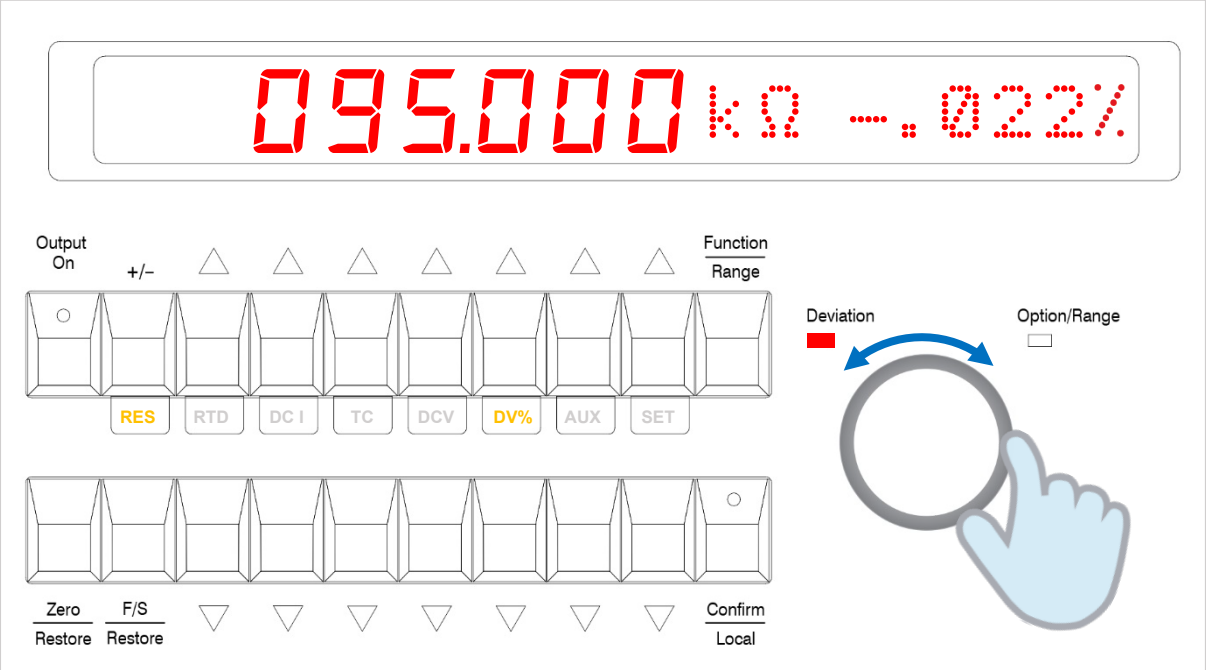


The right-hand side of the display then shows the deviation figure in + or - % terms.



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.

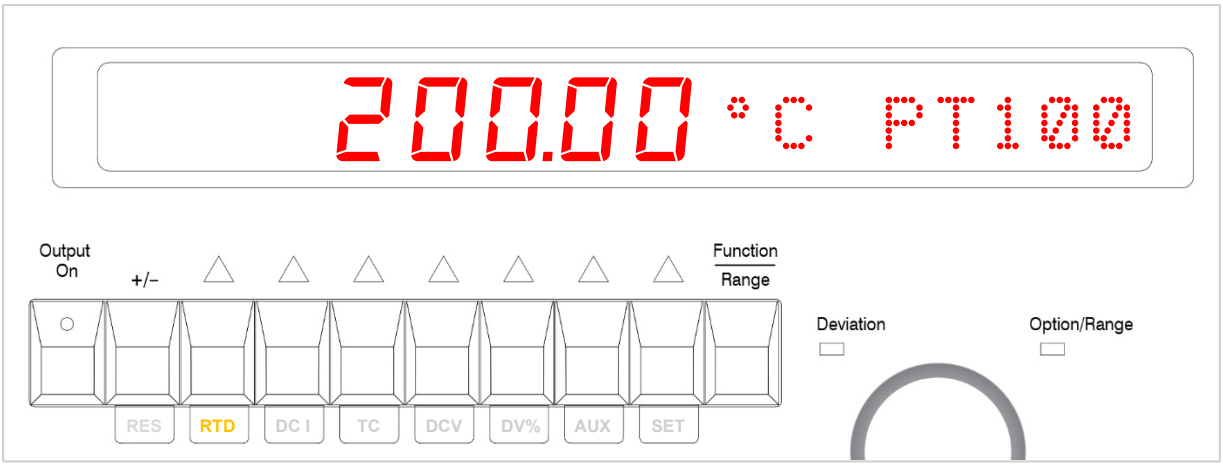


Note: It is not possible to adjust the deviation if the output setting is zero, since the deviation is a percentage of value. The deviation will be displayed as zero percent in this case.

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

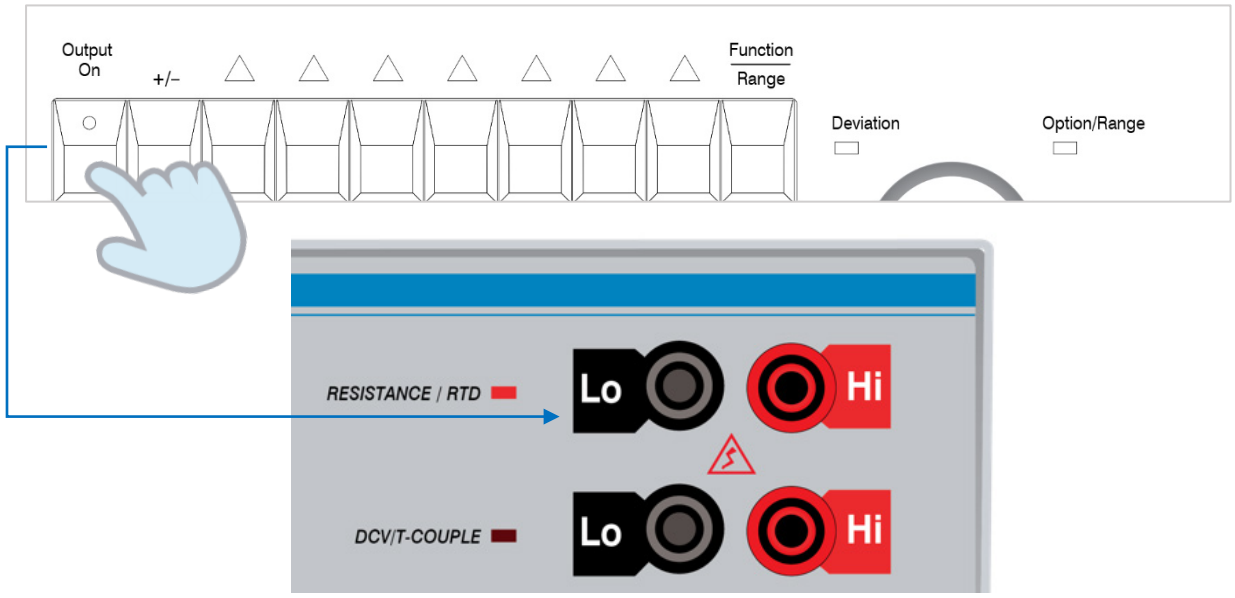
3.5 Pt100 Simulation **RTD**

To select the Pt100 function, press the “**Function**” button followed by “**RTD**” button.



Then set the required temperature value using the “**Up (Δ) / Down (∇)**” buttons.
Deviation mode is available. To use press the “**Function**” button, then “**DEV**” button.
In deviation mode the PT100 indication is replaced by the % up/down setting.

Connect the output to the terminals by pressing the “**Output On**” button.

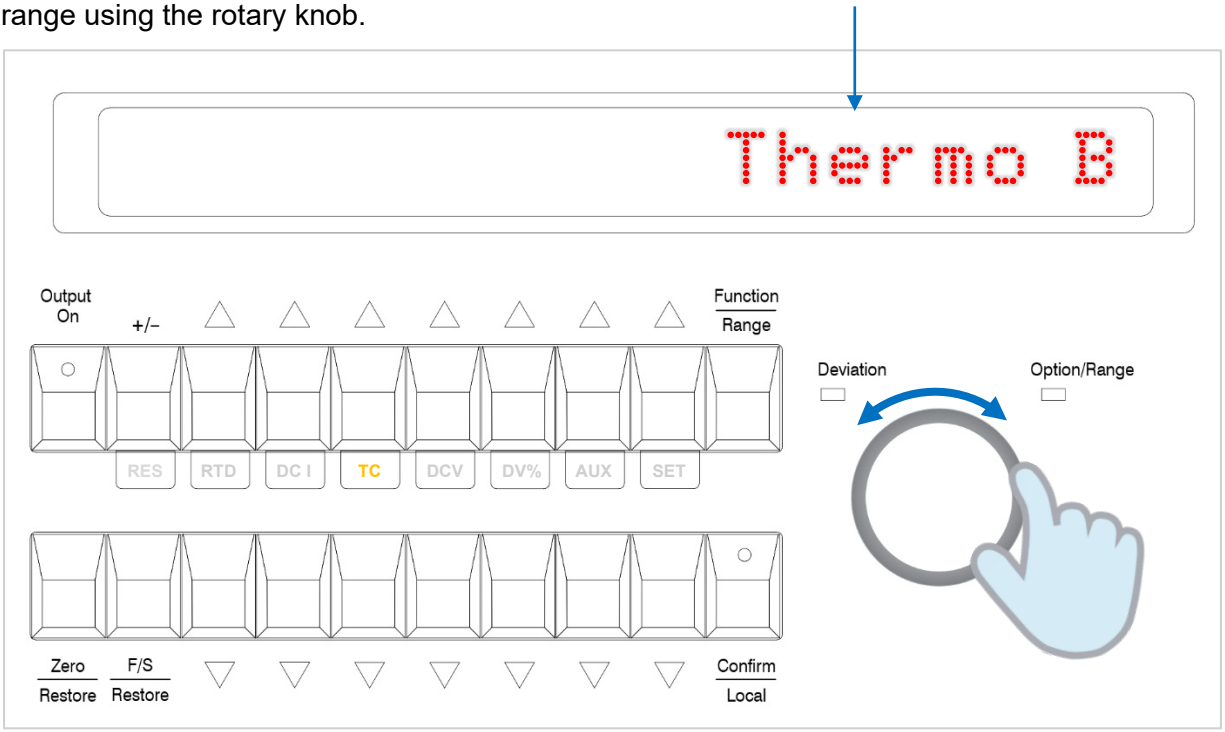


To change the units of temperature used (Celsius, Fahrenheit or Kelvin), use the Setup menu.

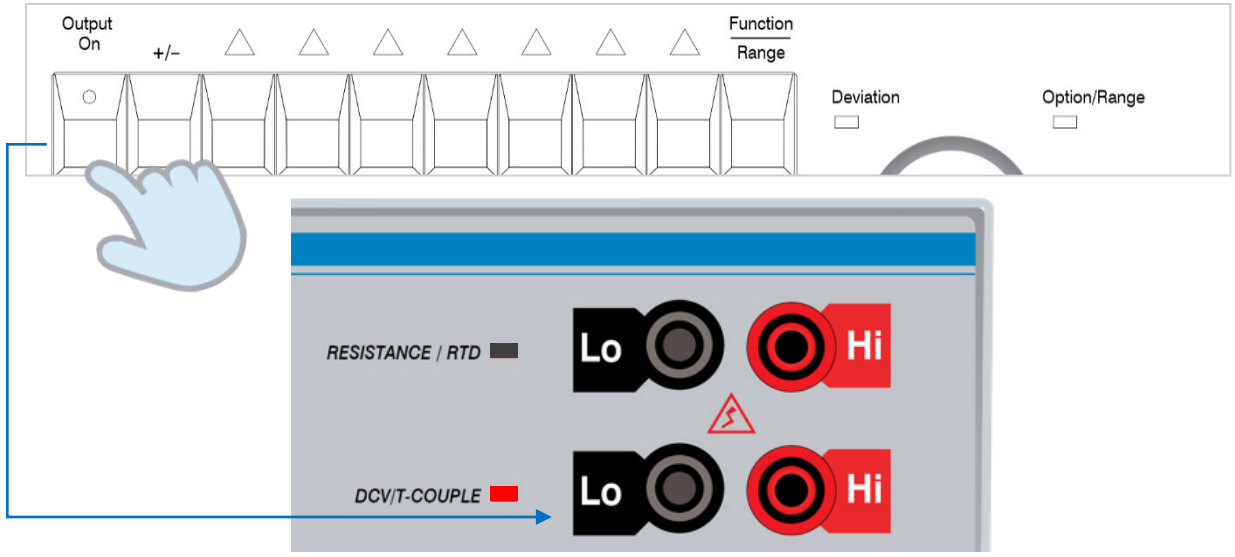
3.6 Thermocouple Simulation (option) TC

To select the thermocouple simulation function, press the "**Function**" button followed by "**TC**" button.

The 8 thermocouple types are indicated by the flashing on the display readout. Select the range using the rotary knob.



Press the "**Confirm**" button once the required thermocouple type is selected.
Then set the required temperature value using the "**Up (Δ) / Down (∇)**" buttons.
Deviation mode is available. To use press the "**Function**" button, then "**DEV**" button.
Connect the output to the terminals by pressing the "**Output On**" button.



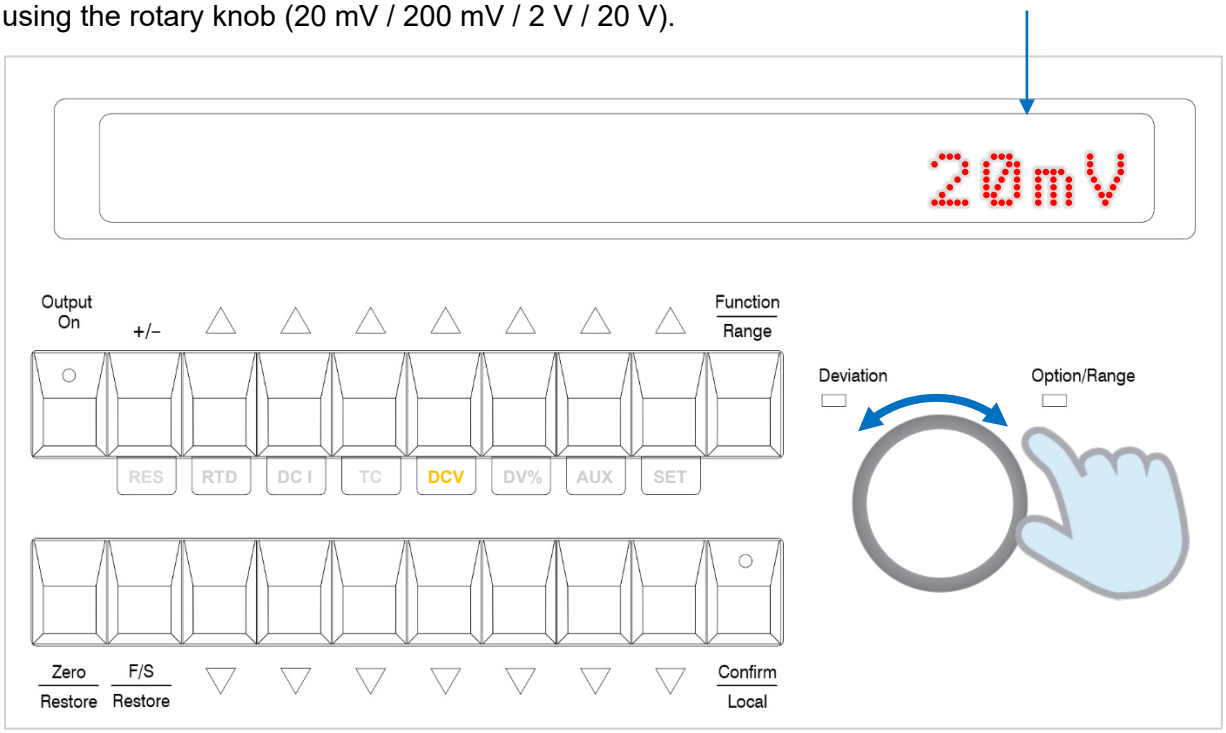
To change the units of temperature (Celsius, Fahrenheit or Kelvin), use the Setup menu.
Note: Thermocouple outputs are cold junction compensated.

3.7 DC Voltage or Current (option) **DCV DCI**

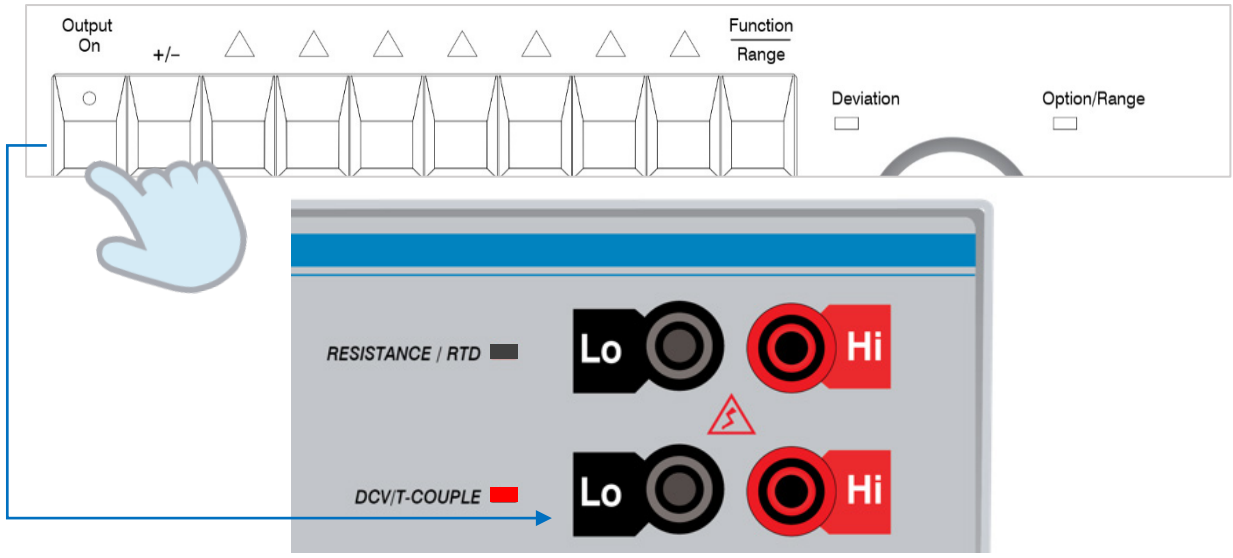
DC Voltage and DC Current have common operation steps. Shown here is DC V.

To select the DC Voltage function, press the "**Function**" button followed by "**DCV**" button.

The function ranges are indicated by the flashing on the display readout. Select the range using the rotary knob (20 mV / 200 mV / 2 V / 20 V).



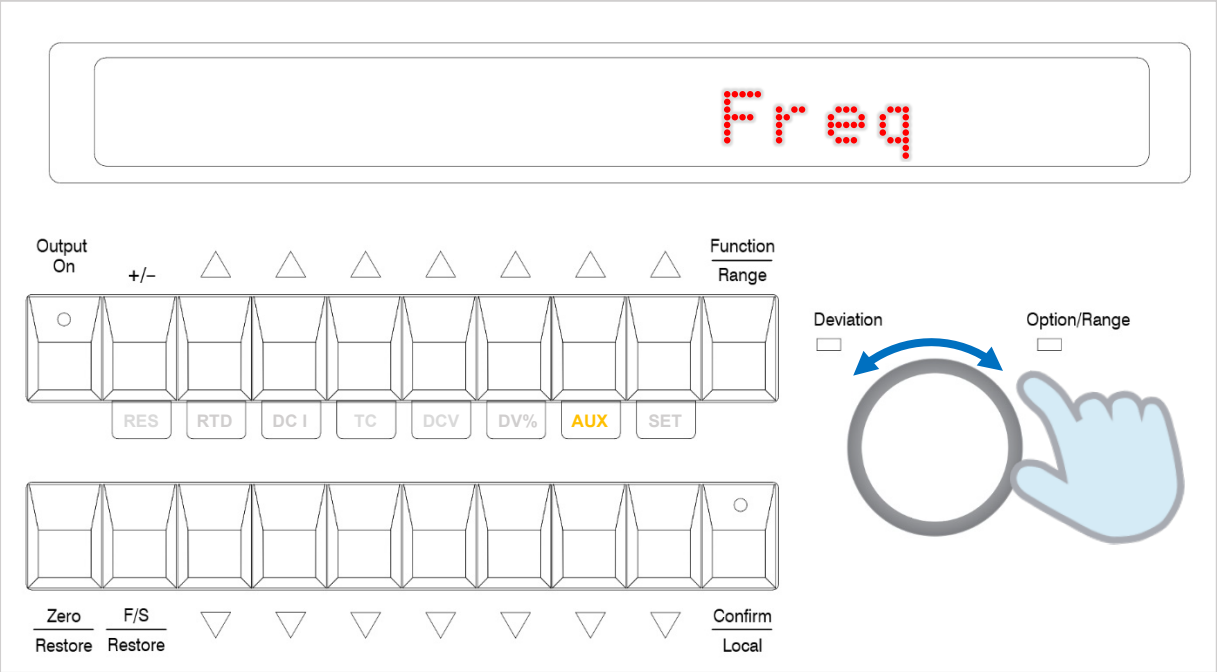
Press the "**Confirm**" button once the required range is selected.
Then set the required voltage value using the "**Up (Δ) / Down (∇)**" buttons.
Deviation mode is available. To use press the "**Function**" button, then "**DEV**" button.
Connect the output to the terminals by pressing the "**Output On**" button.



3.8 Digital Frequency (option) **FREQ**

Variable output setting 0.1 to 10MHz.
Select function AUX. Using the rotary knob, choose either Freq or Period.

The display flashes to prompt selection of either frequency or period.



Press the “**Confirm**” button once the required function is selected.

Using the rotary knob, choose the frequency or period range, Hz, kHz or MHz.

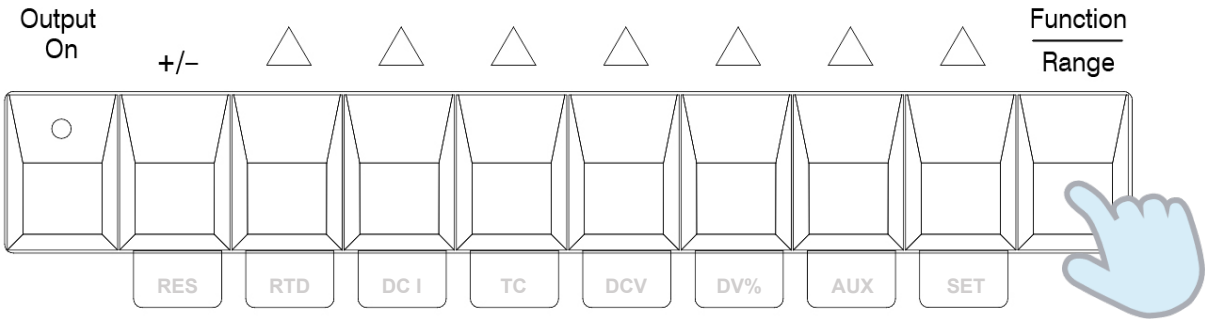
Then set the required frequency or period value using the “**Up (Δ) / Down (∇)**” buttons.

Deviation mode is available. To use press the “**Function**” button, then “**DEV**” button.

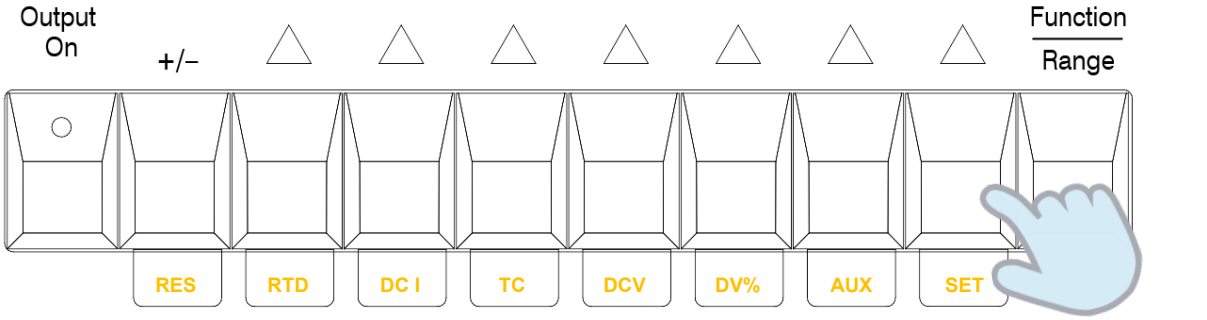
Connect the output to the terminals by pressing the “**Output On**” button.

3.9 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.

3.9.1 Options/Settings Summary

Readout	Option/Setting
Dev Rsln	**Deviation Resolution** Set of deviation resolution to: 0.001 % (fine), 0.01 % (medium) or 0.1 % (coarse) per step.
°C/°F/K	**Temperature Units** Degrees Celsius (°C), Degrees Fahrenheit (°F), or Kelvin (K).
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.
Use CJC	**Use Cold Junction Reference** Set to Off or Internal. Sets the method of cold junction reference for thermocouples.

3.9.2 Deviation Resolution (Dev Rsln)

Deviation Resolution is the first menu shown when you enter the setup menu.
It can be used with resistance, TC, DC V, DC I, and frequency functions.

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.

3.9.3 Temperature Units (°C/°F/K)

Temperature units can be changed in the Setup menu. These units are shown on the display readout when using the temperature functions. 3 units are available:

- Degrees Celsius (°C)
- Degrees Fahrenheit (°F)
- Kelvin (K)

Setting Method:

1. Press "**Function**" button, then press "**SET**" button.
2. Use the rotary knob and scroll to option °C/°F/K
3. Press "**Confirm**" button.
   Display now reads the temperature unit currently selected.
4. Change the unit using the rotary knob.
5. Once selection is made, press "**Confirm**" button.

3.9.4 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.

3.9.5 Cold Junction Reference Setting (Use CJC)

For selection of the cold junction reference to be used when simulating thermocouples. There are 2 options:

- Internal: Uses the internal CJ reference.
- Off: This setting disables any cold junction reference.

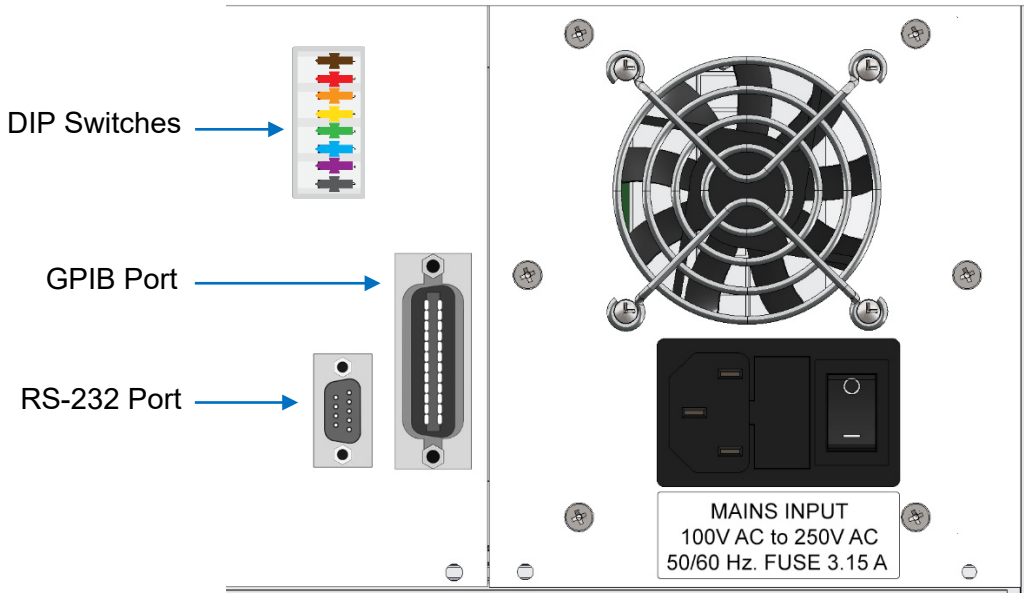
Setting Method:

1. Press "**Function**" button, then press "**SET**" button.
2. Use the rotary knob and scroll to option Use CJC
3. Press "**Confirm**" button.
   Display now reads the currently selected reference setting.
4. Adjust the setting using the rotary knob.
5. Once selection is made, press "**Confirm**" button.

4 Remote Operation

4.1 Communications Interface

The 5011 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 5011 switched off, locate the DIP switches on the rear panel.



4.1.1 For RS-232 / USB Adaptor Communications

You will need a straight-through RS-232 lead, male connector at one end, female connector at the other end. Set the DIP switches as indicated below.

DIP Switch	Setting
1	ON (RS232)
2	Does not matter
3	ON for software (XON/XOFF) handshaking OFF for no software handshaking
4	ON for hardware (RTS/CTS) handshaking OFF for no hardware handshaking
5	ON for 9600 baud OFF for 19.2K baud
6	*Does not matter*
7	*Does not matter*
8	*Does not matter*

When the unit is next started, “RS232” will be displayed in the alphanumeric window to confirm the setting.

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	*Does not matter*

The GPIB address of the 5011 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)

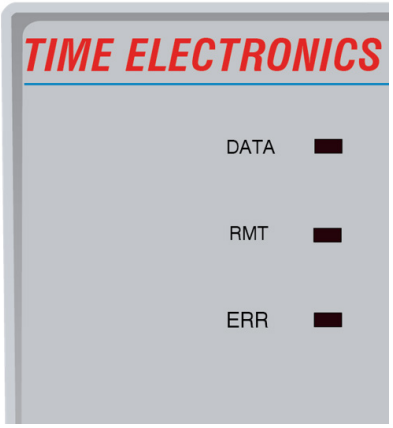
Added together, 16+4+2 gives the address required, 22. In this case, the DIP switches for address 2, 3, and 5 are set to the ON position. The remaining address DIP switches are set to the OFF position.

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



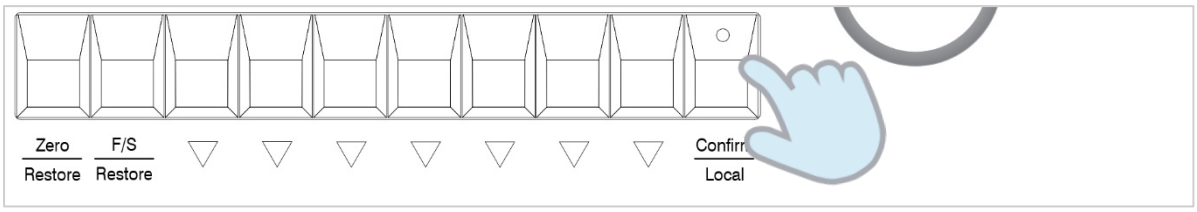
There are 3 LEDs located on the left-hand side of the unit's front panel.
These indicate the status of the unit in remote mode:

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 well 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
SRES 100KR
THERM 75.6C
```

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.)

Discrete Parameters

A discrete parameter has a limited set of choices. For example:

[:SOURce]:THERmocouple:TYPE {B|E|J|K|N|R|S|T}

In this case, choose one of the options separated by the vertical bar. These are examples of valid commands:

```
SOUR:THER:TYPE B
THER:TYPE J
SOUR:THER:TYPE N
```

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

RESISTANCE

[:SOURce]:SRESistance[:LEVel][:IMMediate][:AMPLitude] <ohms>

Select the resistance function and set the output level. <ohms> can be any value from 1 to 120MR.
Example:

```
sres 2.5mr
```

selects the resistance function and sets the output to 2.5 megaohm

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

Query the present resistance output.

Example:

```
sres?
> 2500000
```

RTD

[:SOURce]:RTD:TYPE {PT100}

Select the RTD simulation function and set the type of RTD to be simulated (PT100 on 5011).
Example:

```
rtd:type pt100
```

selects the rtd simulation function type PT100

[:SOURce]:RTD:TYPE?

Query the type of RTD simulation selected.

Example:

```
rtd:type?
> PT100
```

[:SOURce]:RTD[:LEVel][:IMMediate][:AMPLitude] <temperature>

Set the temperature to be simulated by the RTD function. <temperature> can be any temperature value supprted by the selected RTD simulation. Units can be c (Celsius), f (Fahrenheit) or K (Kelvin). If the units are specified, then these become the default units for any future temperature simulation.

Example:

```
rtd 12.5C
```

sets the simulated output temperature of the RTD function to 12.5 deg C.

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

Query the present RTD simulation temperature. The value is returned in the temperature units last used (default is Celsius).

Example:

```
rtd?
> 12.5
```

VOLTAGE

[: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
```

CURRENT

[:SOURce]:CURRent:RANGe <amps>

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

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
```

THERMOCOUPLE

[:SOURce]:THERmocouple:TYPE {B|E|J|K|N|R|S|T}

Select the thermocouple simulation function and set the type of thermocouple to be simulated (type B, E, J, K, N, R, S or T).

Example:

```
ther:type k
```

selects the thermocouple simulation function type K

[:SOURce]:THERmocouple:TYPE?

Query the type of thermocouple selected.

Example:

```
ther:type?
> B
```

[:SOURce]:THERmocouple[:LEVel][:IMMediate][:AMPLitude] <temperature>

Set the temperature to be simulated by the thermocouple function. <temperature> can be any temperature value supported by the selected thermocouple simulation. Units can be c (Celsius), f (Fahrenheit) or K (Kelvin)

Example:

ther 75.8

sets the simulated output temperature of the thermocouple function to 75.8, using the temperature units last used.

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

Query the present thermocouple simulation temperature. The value is returned in the temperature units last used (default is Celsius).

Example:

```
ther?
> 875.4
```

OTHER COMMANDS

[: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: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:LOCal

Puts the unit into local operation mode. The unit's keypad is enabled.

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:

```
syst: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:

```
syst:err:coun?
> 2
```

:SYSTem:VERSion?

Query the version of SCPI supported by the unit.

Example:

```
syst:vers?
➢  1999.0
```

:UNIT:TEMPerature {C|CEL|F|FAH|K}

Set the units to be used for future temperature settings and queries. The units selected are stored in non-volatile memory and remain selected the next time the unit is switched on.

Example:

```
unit:temp f
```

sets unit of temperature to degrees Fahrenheit

:UNIT:TEMPerature?

Query the units of temperature being used.

Example:

```
unit:temp?
> C
```

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,5011,0,1.0.0

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.

9811 /19 / & 20 Legacy Commands

The 5011 supports the older Time Electronics 98 series command set.

RESISTANCE

`1000.1`

Sets the output level to 1000.1 <ohms> can be any value from 1 to 120MR.

The value is set in ohms.

`T`

Queries the present resistance output, set remotely or by the front panel.

LOCAL MODE

`L`

Enters the unit into local mode, enabling the front panel controls.

Note: The G.E.T command is not supported.

5 Fault Diagnosis

5.1 Startup Errors

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

Error Displayed	Meaning
Error 22	Voltage source 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 34	Resistance 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).

5.2 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.

5.3 Mains-generated Interference

It is recommended that the 5011 be operated from a clean AC mains power supply. It is strongly recommended that a filtered mains stabiliser is used. The effects of interference entering the 5011 are crashing of one of more of the many microcontrollers located inside the unit.

Time Electronics maintain a technical support service and in the event of difficulty we are ready to provide technical advice by telephone, fax, or email.

6 Re-Calibration

The 5011 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 5011 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.

7 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.

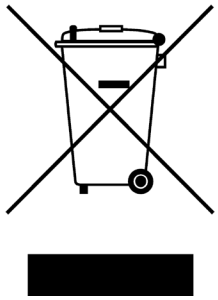
Send the instrument, shipping charges paid to:

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.