Time Electronics
Calibration, Test and Measurement

# User Manual

## 5075
## Digital Multimeter

Revision 2301-1

**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

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 Safety Guidelines

This manual contains information and warnings, which the operator should follow to ensure their own safety and continued operation of the instrument.

The 5075 has been designed as a class 1 instrument, requiring a protective ground connection.

Protection is assured by a direct connection via the power cable from ground to exposed metal parts and internal ground screens. The line connection must only be inserted in a mains power outlet provided with a protective earth conductor, continuity of the ground conductor must be assured between the socket and the instrument.

Always ensure that when measuring high voltages, the V+ and V– input terminals are connected correctly. (V+ connected to the most positive potential with respect to earth and V– to the nearest potential to earth).

If any sign of malfunction or if the instrument shows visible signs of damage, the instrument should be repaired only by a skilled engineer who is aware of the potential hazards associated with mains operated equipment.

**Maximum Voltages Between Terminals**

Do not exceed these specified voltages between terminals otherwise serious damage will result.

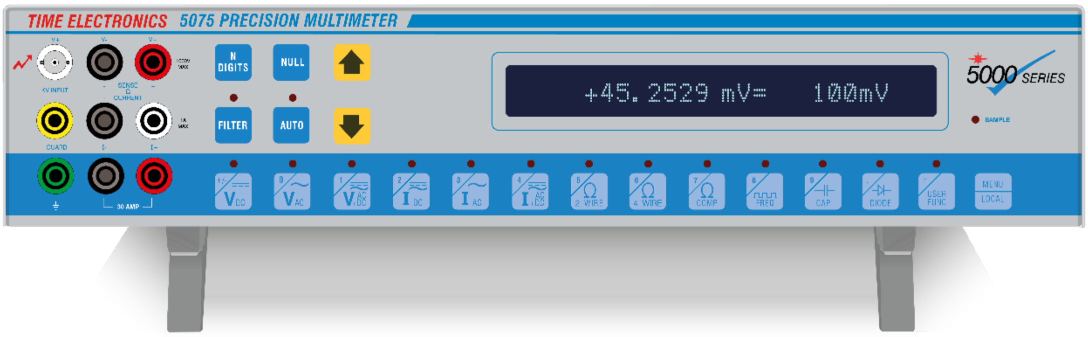
| | |
|---|---|
| Between V+ and V– terminals | **< 1100 V DC / 300 V AC RMS** |
| Between High Voltage and V– terminals | **< 10 kV DC / 3 kVAC RMS** |
| Between V– and Guard | **< 200 V DC / AC Vp** |
| Between Guard and Earth | **< 500 V DC / AC Vp** |

Before disconnecting the equipment under test, switch off the output, and disconnect the test leads, especially when connected to equipment capable of delivering a high voltage (High back EMF's can damage the 5075).

**Interruption of the protective mains earth conductor, either internal or external to the instrument is potentially hazardous.**

**The terminals marked with this symbol carry the potential of the source under test. These terminals and any other connections to the source could carry lethal high voltages and at no time should they be touched during a high voltage test. Switch off the source before attempting to rectify any problems associated with the test.**

# 2 Introduction




The 5075 is a benchtop digital multimeter combines high performance and accuracy with simple operation. With speed and precision, it measures from nanovolts to 10 kV, from picoamps to 30 Amps, from nano-ohms up to 1 GΩ, and from picofarads to 300 μF. It is ideal for users requiring a cost-effective DMM with multiple functions and exceptional resolution and accuracy up to 7½ digits.

This makes the 5075 a versatile solution to essential laboratory calibration and verification, covering a wide range of applications with excellent measurement capabilities, whilst maintaining reliability and performance.

The Auto Dynamic Filter (ADF) mode allows the 5075 to automatically select the most suitable filter. For a fast-changing signal or for when the signal is first connected the reading is displayed almost immediately, but if the input remains constant, the filter time is increased to provide a more stable accurate reading. If the input were disconnected the filter would immediately return to the fastest integration setting.

Operation is simple, all major functions from range selection to null require just one key press. The large 24 digit display shows clearly the range and reading and can even show the time to the next sample if required. Other functions can be easily selected from a scrolled menu.

Functions for diode/zener diode tests, max/min, peak hold and continuity checks are available and also various audible warnings can be selected. A bar graph function allows the user to program high and low pass/fail limits and switch to the bar display mode. This will give an audible and visual indication to the user of the component's specification.

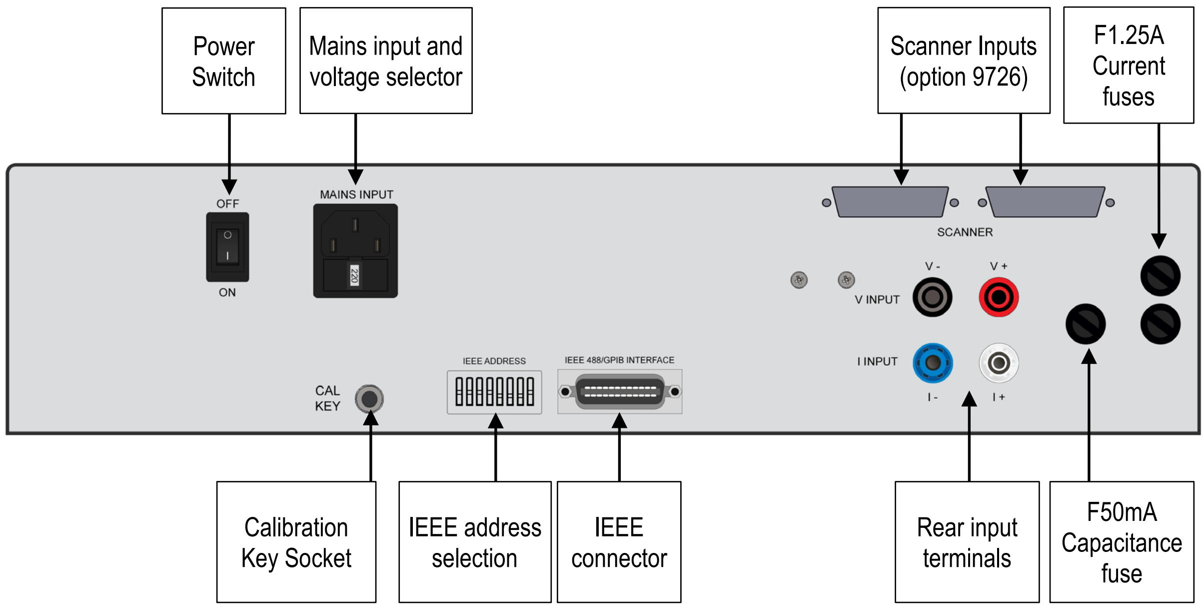
A low thermal 4 wire, 10-channel scanner option, allows multiple inputs to be displayed or compared without the additional cost and inconvenience of a separate switching arrangement.

The 5075 can be controlled via Time Electronics EasyCal software to automate the calibration process. This provides increased speed of calibration and consistency of results.

# 3 Installation

This chapter contains information about the power requirements, fuses and installation of the instrument into a 19” rack mount frame.

## 3.1 Rear Panel




## 3.2 Grounding Requirements

The multimeter is supplied with a three core AC power lead. This lead must be connected to a single-phase utility mains supply that has its ground conductor connected to an electrical earth (safety ground). The power socket and cable both comply with IEC safety standards.

**For continued protection against electrical shock, always ensure that the instrument is properly earthed.**

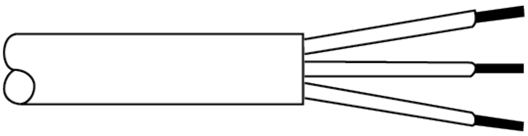
## 3.3 Power Requirements

You can operate the multimeter from a single-phase source rated at 110 V AC, 220 V AC, or 240 V AC 50/60 Hz.

Line voltage may vary by up to 10 % but must not exceed 250 V AC.

The power lead must be wired in accordance with the diagram below.

Be sure that the voltage setting on the instrument is correct before connecting to a power source and that the correct fuse has been installed.




The wire colour coding may differ depending upon the lead supplied for the destination country. Normally an IEC approved molded wall plug will be supplied as part of the lead.

## 3.4 Setting the Line Voltage

To alter the line voltage setting, firstly remove the power lead from the instrument.

Remove the fuse holder/voltage setting cartridge from the power connector then locate and remove the fuse holder.

Rotate until the correct voltage setting is displayed in the window.

Install the correct fuse and replace the cartridge (800 mA for 220/240 V AC or 1.6 A for 110 V AC).

## 3.5 GPIB (IEEE 488) Connection

This instrument implements the requirements of the IEEE - 488/1978 standard.

The connection is made by a standard 24 pin IEEE connector mounted on the rear panel. The IEEE address is selected by a DIP switch again on the rear of the instrument. Refer to Chapter 7 for IEEE operations.

## 3.6 Bench Use

The instrument may be used free standing by using the tilt feet on the base.

The front panel terminals are permanently connected inside the instrument to the rear panel terminals. Before making any connection to the front panel terminals, ensure that any rear panel terminations have been removed (or vice versa).

## 3.7 19” Rack Mounting

Refer to Figure 3.1, removing the feet and Figure 3.2, rear fixing detail.

To mount the instrument in a 19” rack you must first have the 19” rack mount kit (part # 9728).

First remove the two front tilt feet and two rear standard feet from the base of the instrument and then remove the two carrying handles.

With the cover in place, fix the two mounting brackets to each side of the instrument using the two fixing holes and the M5 screws.

Locate the rear support fixings as in Figure 3.2 on the rack and fix using the screws provided.

Mount the instrument in the rack, locating the two ‘ears’ in the rear support fixings.

Fix the front of the unit to the frame using the screws provided.

Decide which terminals are going to be used. Only one set of connections should be made to the front or rear terminals.

**Figure 3.1**

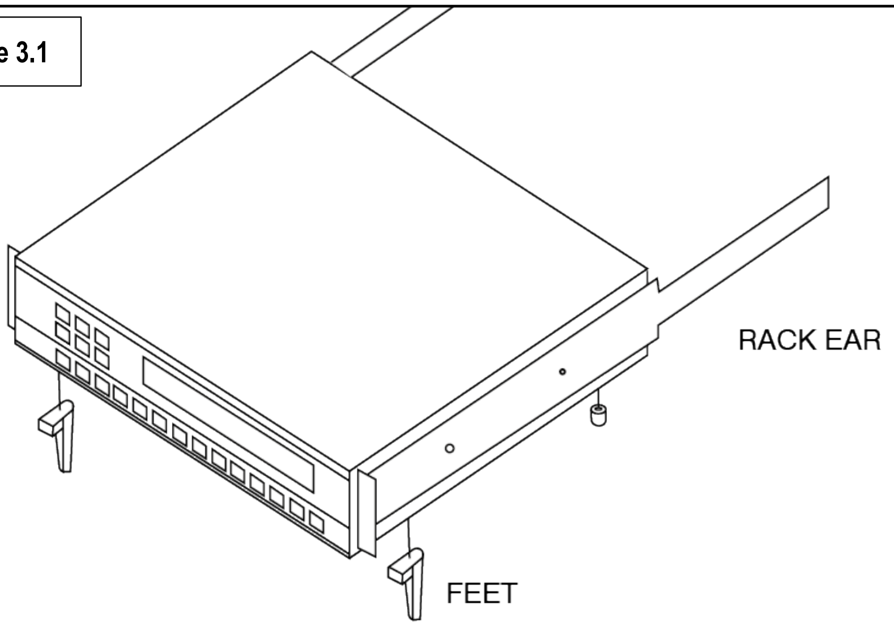
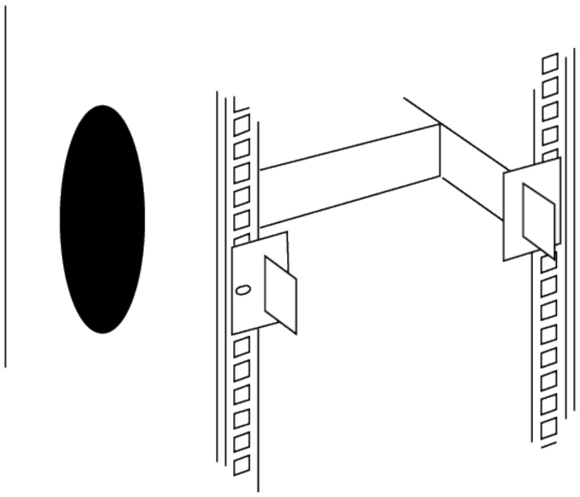



**Figure 3.2**



# 4 Basic Operation Procedure

This chapter provides an introduction into the operation of the instrument. The more advanced features and functions may be found in the next section.

Before operating the DMM ensure that the mains voltage setting is correct and that the correct fuse has been installed. Refer to section 3.4 for further information.

Also check for any options that may have been installed such as the AC / frequency option or the Scanner option.

## 4.1 Switching On

The mains power switch is mounted on the rear of the instrument.

When the instrument is powered up, the 5075 will default to DC volts and auto-range. The display then shows the measured voltage and the mode of operation. The LED's above the keys will also show which mode of operation has been selected.

The initial state at power on is:

- **Function DCV**
- **Range Auto**
- **Resolution digits**
- **Filter 500ms**
- **Auto Dynamic Filter On**
- **Dual Display Off**

30 minutes after power on the unit should be near its specification and after 2 hours it will be within specification. Therefore, to use the instrument to its full specification allow it to warm up for at least 2 hrs.

The 5075 will perform an internal calibration of the full scale, zero and linearity of its A/D converter every 5 minutes or when the internal temperature changes by more than one degree Celsius. This will take less than 1 second.

During this time the display will show:

If this message is displayed on start-up, the 5075 will require recalibration.
Refer to Re-Calibration in section 8 for further information. This may or may not disappear after a few seconds, depending on the options set in the user menu.

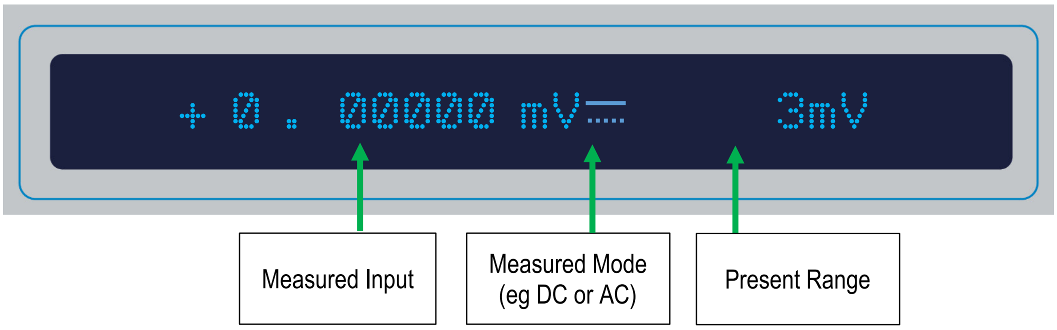

## 4.2 The Display

The 5075 has a multipurpose display. Not only will it display the measured value, but it will also display its range and function.

The display may also be used in a ‘dual display’ mode to simultaneously display the frequency of an ac voltage or current input.

In addition to this, the display shows the time until the next reading or to show which scanner channel has been selected.

The default display is explained here:



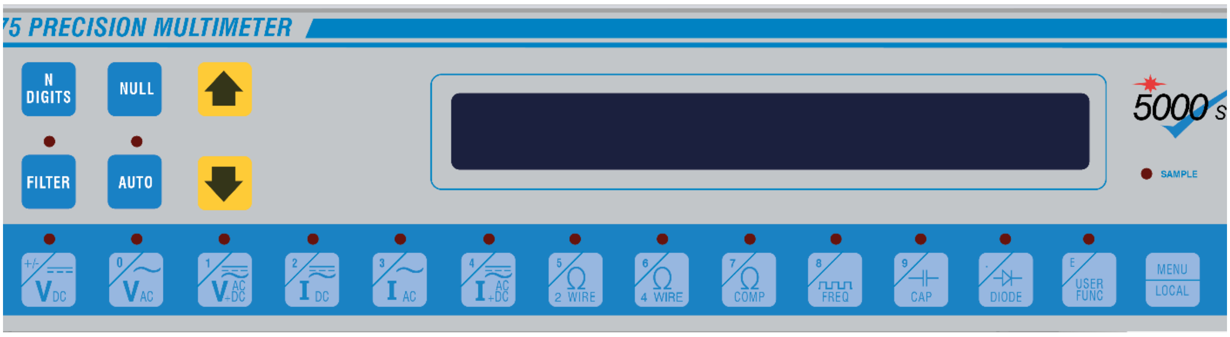

## 4.3 Warning Messages

During operation, the 5075 may display messages indicating attention is required.
For example, the internal temperature may be outside its specifications and will display an error message displaying this.

Also, if the unit is out of its calibration period, a message will be displayed. The message may be set to display whenever an Internal Calibration is performed or it may be set to display and hold, thereby no more calibrations may be performed if calibration is to remain traceable.

Another message ‘noisy’ may appear at the end of the display indicating that the input has a very large amount of noise on it.

## 4.4 Keys




All the main functions such as range change or mode selection can be performed by one key-press.

The LED above the key indicates the measurement function. The range and function may also be seen on the display.

To select a function, simply press the key.

These keys also serve as a numeric keypad for menu operations and are numbered accordingly.

The keys and their functions are detailed as follows in this section.

### 4.4.1 N Digits Key


When pressing this key, the reading resolution is changed between 4, 5, 6 and 7 digits, (the number of digits displayed).

On some low value ranges the resolution has been limited.

For example, the 3 mV range has a 6-digit maximum resolution.

Tables showing the digit resolution in the ranges for differing functions are given in the operational sections later in this manual.

## 4.4.2 NULL Key


The null facility is available on all DC ranges, Ohms and Capacitance. Null is not available on AC or frequency.

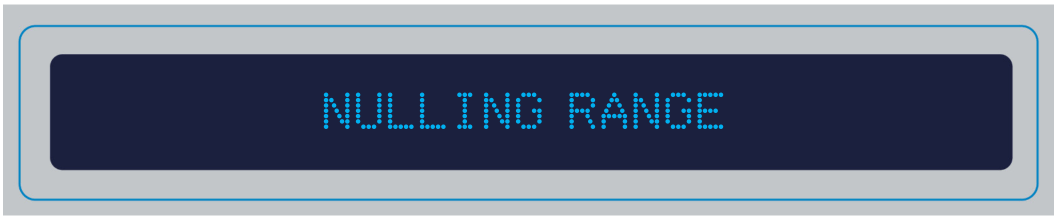
When this key is pressed, the DMM will accept the measured present value as the zero value for the range selected. If auto-range is on, the unit will null each range.

To null only the range being used, switch off auto-range, press the null key, the single range will be nulled.

This is useful for cancelling an offset voltage or for zeroing the value of the test leads on resistance.

To null an offset, either short the end of the test leads or connect to the source and press the null key.

During a null routine for a single range the instrument will display:




If the 5075 is in auto-range 'Nulling Ranges' will be displayed and all ranges will be nulled.

An upper or lower case N will appear in the display to indicate a null value. An upper case N will show that there is a large offset (over 1% of full scale) and the lower case n will indicate a small offset.

All further readings will have the measured null value subtracted.

You may null any value up to the range maximum.

This null value is applied to all readings on the same range. If a new zero input value is applied, you should re-null the DMM as any readings displayed will have the incorrect null subtracted.

At power up the DMM assumes that the null is off.

The null value is lost if the measurement function is changed.

### 4.4.3 FILTER Key


Pressing the filter key will alter the integration time of the reading. Filter times are 150 ms, 250 ms, 500 ms, 1 s, 2 s, 4 s, 8 s, 16 s, 32 s and off.

A unique feature of the 5075 is the Auto - Dynamic Filter which may be enabled in the menu options.

The Auto - Dynamic Filter will automatically choose the most suitable filter time depending upon the stability of the input.

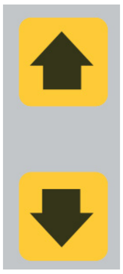
If the input is stable over the first filter period, the next filter time is chosen. The filter time will steadily increase to the maximum filter time set by the filter key.

If this stable input was to suddenly change to a varying input, or if the input was disconnected, the filter time would immediately decrease to a faster integration period.

### 4.4.4 AUTO Key

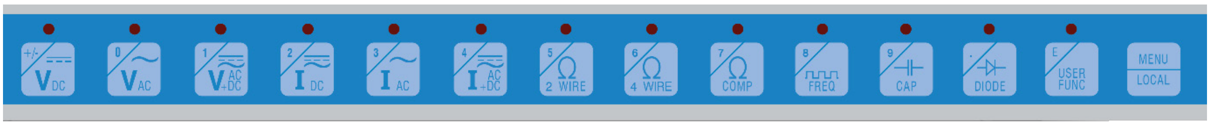

The auto-range (AUTO) key will select the optimum range for the measurement. This will introduce short delay for the operator. The indicator above the keypad will show when the DMM is in the auto-range mode.

To turn the auto-range function off, press the AUTO key once more.
The instrument will then remain on the last range selected by auto-range.



You can manually select a range when the instrument is in measurement mode (displaying a reading or showing Over range). Pressing the **Up Arrow** key will select a higher range and turn the auto-range off. The selected range is shown on the display. Pressing the **Down Arrow** key will select a lower range. Pressing this key will also turn the auto-range off. The selected range is shown on the display.

### 4.4.5 USER FUNC and MENU Keys




Pressing the USER FUNC key will display the last option selected in the menu. Pressing the MENU key will display the menu options. See section 5.1 Menu Options for further details.

See section 4 for user functions, menu operations and features.

Pressing the LOCAL key whilst the unit is in remote control will return control back to the front panel. Any other front panel key will not function under IEEE remote control.

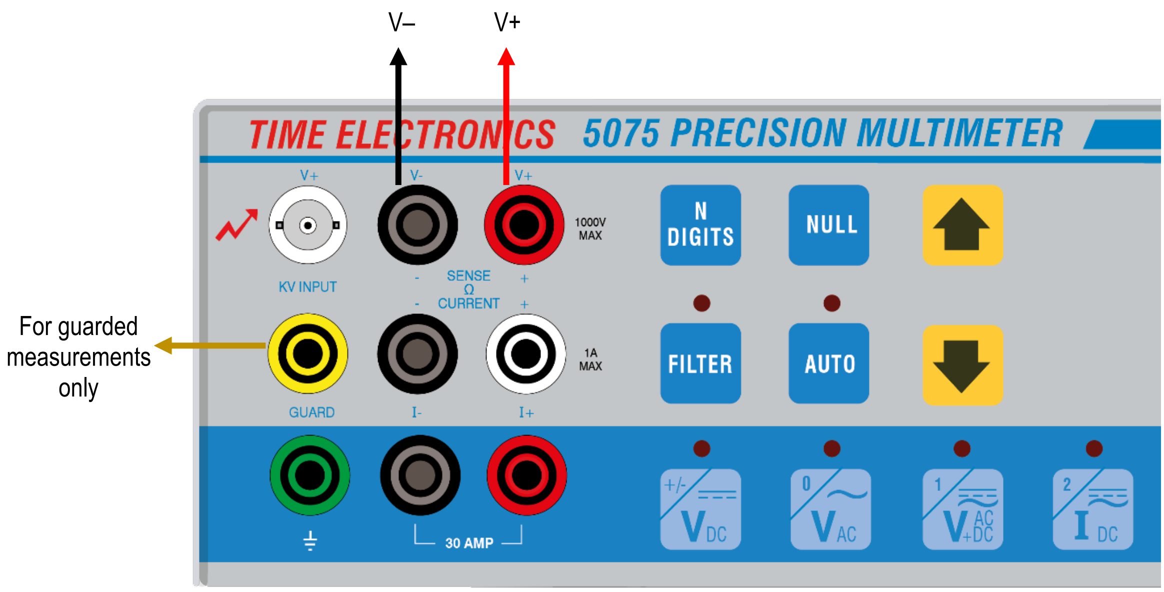
## 4.5 DC Voltage Measurements

Select the DC voltage range and either set auto-range on or manually set the appropriate range.

Select the required resolution and filter time and if required select the Auto Dynamic filter.

Measurements are made over the selected filter period and are averaged to produce the reading.

Most measurements may be made with the simple lead connections shown below.



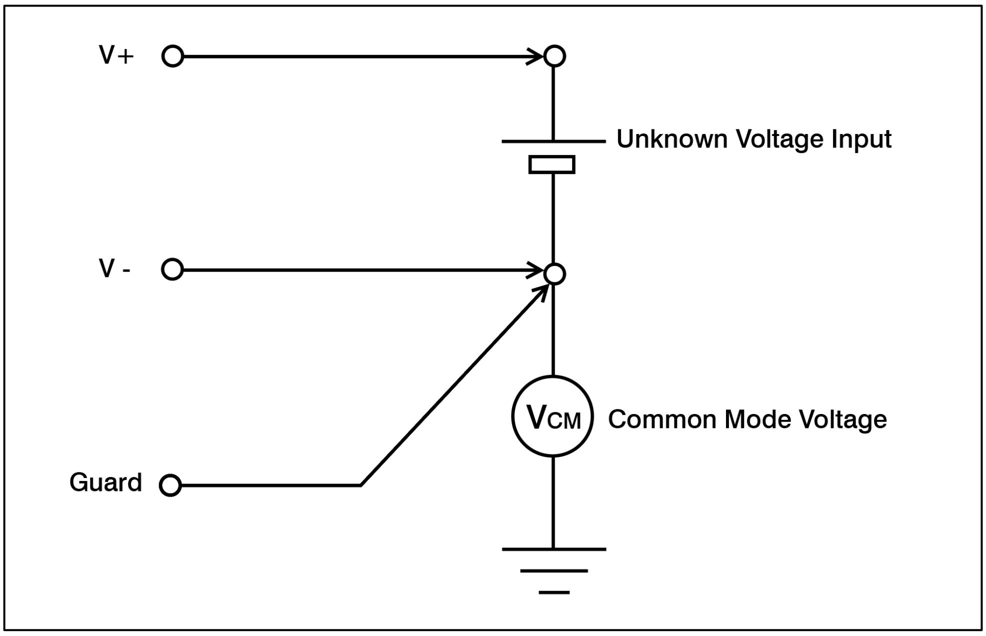

The disadvantage of this connection V+/V- method is that a loop is formed, and stray magnetic ac fields induce small voltages in the loop.

The use of twisted pair cable reduces the loop area and will tend to cancel out the induced voltages. In most cases the guard terminal may be connected to the V- terminal.

Thermal EMF’s may also affect the readings. The shrouded safety sockets of the 5075 are made from hard gold-plated brass to minimise this effect. Nickel plated brass 4mm banana plugs should be avoided since they produce significant thermal EMF’s adding errors to the reading.

Always use low thermal emf leads and connectors when measuring µV or nV signals.

If noisy readings are encountered or when the source to be measured presents an unbalanced impedance to the measuring terminals, screened twisted pair cable should be used with the shield taken to the guard terminal and the guard input taken to the source of the common mode voltage.




The table below shows the full scale, resolution and input impedance for each DC V range.

| RANGE | MAXIMUM RESOLUTION | INPUT IMPEDANCE |
|---|---|---|
| 3 mV | 6 | > 1 GΩ |
| 10 mV | 6 | > 1 GΩ |
| 30 mV | 7 | > 1 GΩ |
| 100 mV | 7 | > 1 GΩ |
| 300 mV | 7 | > 1 GΩ |
| 1 V | 7 | > 1 GΩ |
| 3 V | 7 | > 1 GΩ |
| 10 V | 7 | > 1 GΩ |
| 30 V | 7 | 10 MΩ |
| 100 V | 7 | 10 MΩ |
| 300 V | 7 | 10 MΩ |
| 1 kV | 7 | 10 MΩ |
| 3 kV | 7 | 100 MΩ |
| 10 kV | 7 | 100 MΩ |

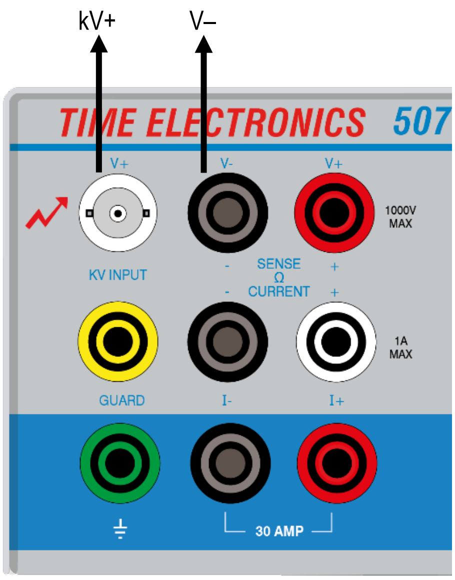
### 4.5.1 Making a High Voltage DC Measurement

To make a high voltage DC measurement up to 1 kV on the 1 kV range, the V-, and V+ 4mm sockets can be used. To record measurements on DC voltages from 1 kV up to 10 kV on the 3 kV and 10 kV ranges the kV BNC socket must be used. It is not possible to auto-range the 3 kV, and 10 kV ranges, see pages 12 and 14 for manual selection of ranges.

We recommend that connection to the KV socket is made using the supplied high voltage lead 8684. Connectors (6204) are available to make your own cables using UR43 or similar high voltage rated cable.

No high voltage should be applied until full connection to the 5075 has been made.

It is most important to connect the 4mm V- terminal to ground before connecting the BNC plug. When using the supplied lead 8684, the short black fly lead is first connected as shown in the picture, followed by connection of the BNC plug. If a non-standard test lead is to be used, then the V- socket must be linked to the green 4mm earth socket before any connection to the BNC socket is made.




Using standard 8684 BNC lead

Using non-standard BNC lead V- Earth connection

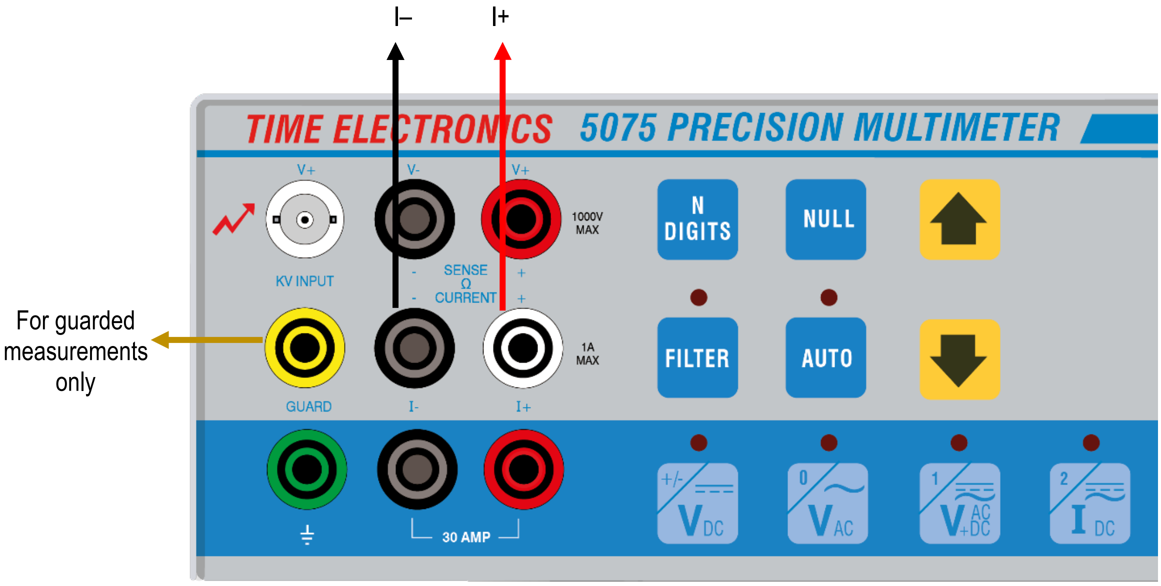
**Extreme caution must be exercised when measuring very high voltages.**
**Do not work alone and do not depend upon the insulation of the cables for protection.**
**High voltages can discharge from point to point or from point to air.**
**Ensure that the test leads are clean, moisture and grease free.**
**Even if equipment has been switched off, capacitors may still retain a high voltage charge.**

## 4.6 DC Current Measurements

Select the DC current range and set to auto-range or manually select the correct range.

Select the required resolution and filter time or set the Auto - Dynamic Filter on.

Connection details:




The same precautions may be applied for current measurement as for voltage measurement. Since the 5075 is capable of measuring very low currents, the use of screened twisted pair cable will help reduce any induced signals if necessary.

At this level care should be taken, especially if the current source is mains powered. Careful earthing and guarding will reduce noise.

Connecting the guard to the source of the common mode voltage will provide a separate current path for it to flow in.

Selecting the analogue filter may also reduce noise since it will filter out the noise before it reaches the A/D converter.

The current ranges (up to 1 Amp) are protected by two F1.25 Amp fast blow fuses, mounted on the rear of the instrument (one for positive and one for negative).

The table below shows the full scale, resolution and shunt resistance for each DC I range.

| RANGE | MAXIMUM RESOLUTION | SHUNT RESISTANCE |
|---|---|---|
| 3 µA | 6 | 10 kΩ |
| 10 µA | 6 | 10 kΩ |
| 30 µA | 6 | 1 kΩ |
| 100 µA | 6 | 1 kΩ |
| 300 µA | 7 | 100 Ω |
| 1 mA | 7 | 100 Ω |
| 3 mA | 7 | 10 Ω |
| 10 mA | 7 | 10 Ω |
| 30 mA | 7 | 1 Ω |
| 100 mA | 7 | 1 Ω |
| 300 mA | 7 | 100 mΩ |
| 1 A | 7 | 100 mΩ |
| 3 A | 6 | 10 mΩ |
| 10 A | 6 | 10 mΩ |
| 30 A | 6 | 10 mΩ |

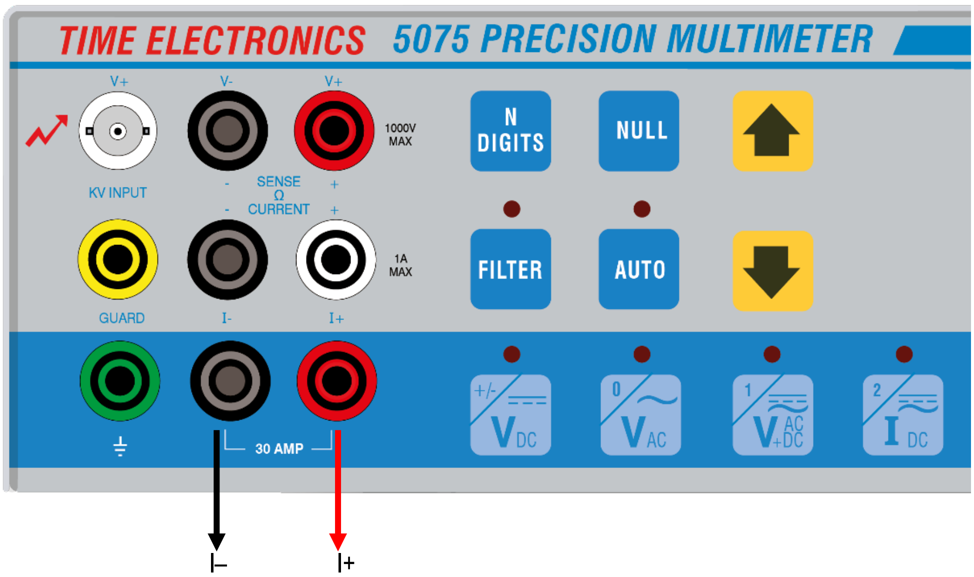
### 4.6.1 Making a High Current Measurement

Currents up to 30 Amps (see tables may be measured using the separate high current terminals.

If a high current has been applied for any length of time it may produce thermal EMF's within the instrument from the current shunt. Therefore, allow the DMM to reach thermal equilibrium before making any precision measurements.

This input is un-fused.

Connection details:




*High current DC*
*3, 10, 30A Ranges*

## 4.7 Resistance Measurements

Two methods may be used to measure an unknown resistance, Two Wire and Four Wire. With the two-wire method the resistance may be measured quickly, to a reasonable accuracy and with a minimum number of connections.

Four wire measurement may be used to eliminate lead and connection resistances. Although this method involves more connections, greater accuracy may be achieved. Four wire measurement may generally be used up 10 kΩ, for values higher than this the lead resistance becomes very small.

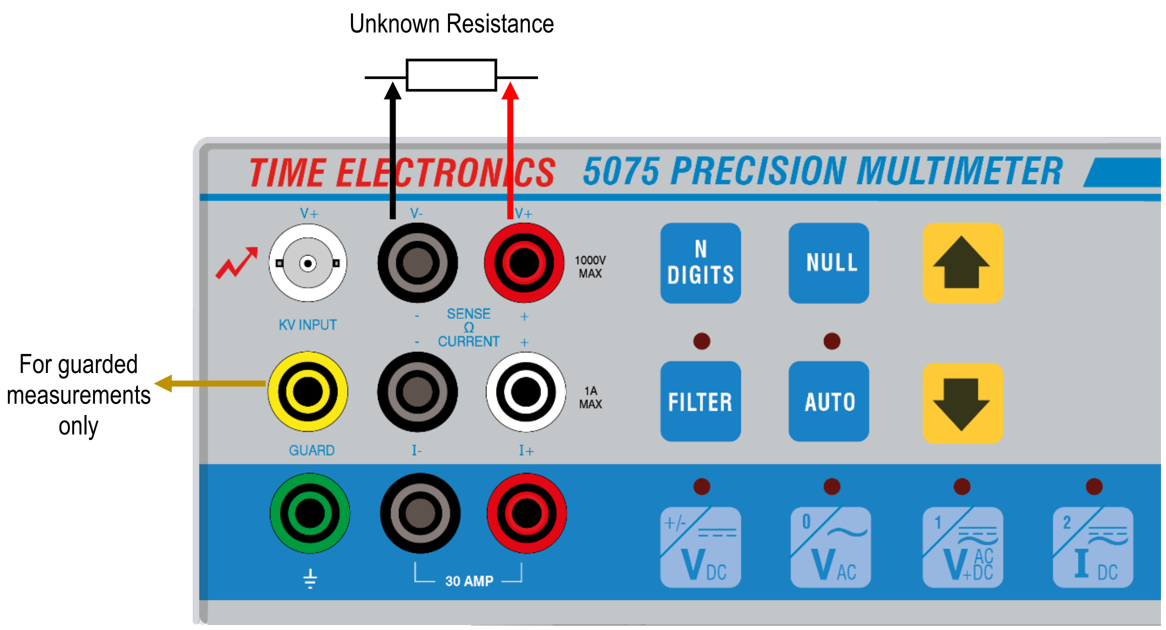
If PRT Temperature has been set to on in the menu options, the 300 Ω four terminal range will display temperature in °C.

For low values, thermals can give problems, so always use good quality leads. Ohms Compensation may be used to compensate for any excessive EMF's within the circuit. See section 4.7.4 for further details on Ohms Compensation.

For high value resistances most of the problems arise from 50/60 Hz line pick-up. The 5075 can be easily saturated by noise at high resistance and low source currents. Careful earthing and guarding will again help. If the resistance being measured is not completely floating as in a calibrator, reversing the connections or selecting the analogue filter may help.

### 4.7.1 Two Wire Method

In a majority of cases, the two-wire configuration shown below is adequate if connection and lead resistance is much less than the resistance being measured. The value displayed will include the lead resistances and the connection resistance.



If the lead resistance is large in comparison to the value being measured, the readings will be inaccurate. Under these circumstances, the four terminal measurement method would give better readings however, the null function may be used to compensate for the lead resistance.

The use of screened twisted pair cable may help to reduce noise on high value resistances.

Range, resolution and measurement current are detailed here:

| RANGE | MAXIMUM RESOLUTION | CURRENT SOURCED | MAX VOLTAGE MEASURED |
|---|---|---|---|
| 30 mΩ* | 6 | 100 mA | 3 mV |
| 100 mΩ* | 6 | 100 mA | 10 mV |
| 300 mΩ | 7 | 100 mA | 30 mV |
| 1 Ω | 7 | 100 mA | 100 mV |
| 3 Ω | 7 | 10 mA | 30 mV |
| 10 Ω | 7 | 10 mA | 100 mV |
| 30 Ω | 7 | 10 mA | 300 mV |
| 100 Ω | 7 | 10 mA | 1 V |
| 300 Ω | 7 | 1 mA | 300 mV |
| 1 kΩ | 7 | 1 mA | 1 V |
| 3 kΩ | 7 | 100 µA | 300 mV |
| 10 kΩ | 7 | 100 µA | 1 V |
| 30 kΩ | 7 | 10 µA | 300 mV |
| 100 kΩ | 7 | 10 µA | 1 V |
| 300 kΩ | 7 | 10 µA | 3 V |
| 1 MΩ | 7 | 10 µA | 10 V |
| 3 MΩ | 7 | 1 µA | 3 V |
| 10 MΩ | 7 | 1 µA | 10 V |
| 30 MΩ | 6 | 100 nA | 3 V |
| 100 MΩ | 6 | 100 nA | 10 V |
| 300 MΩ | 5 | 10 nA | 3 V |
| 1 GΩ | 5 | 10 nA | 10 V |

* 30 mΩ and 100 mΩ only available in four terminal mode.

## 4.7.2 Four Wire Resistance Measurements

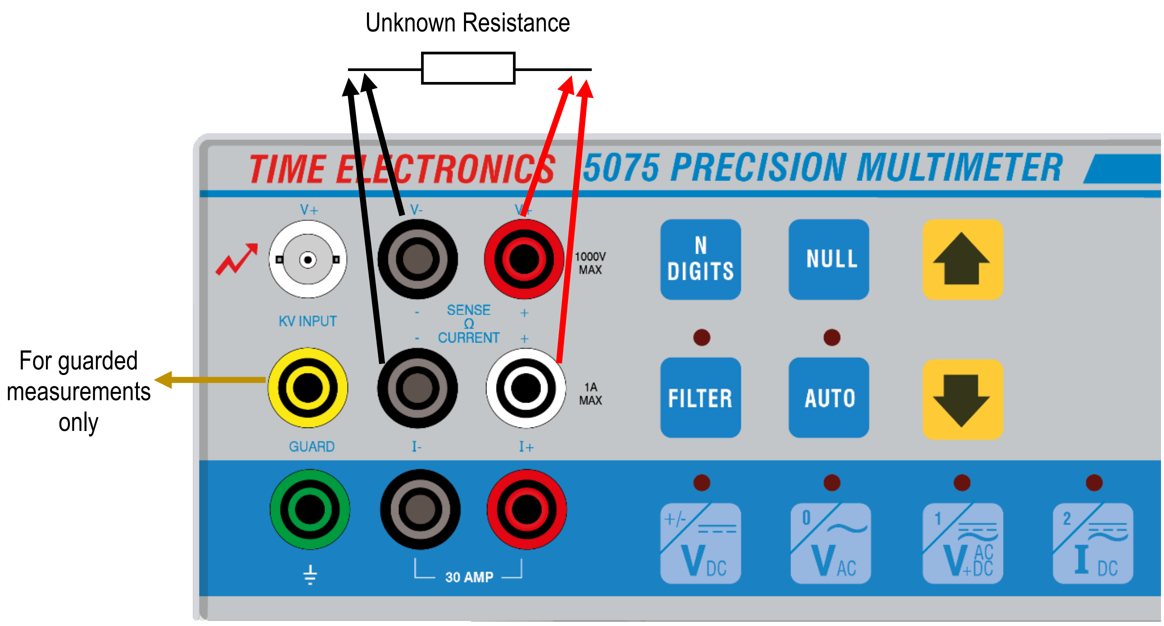
The use of four wire measurements for resistance, effectively eliminates any lead and connection resistances.

Current is passed through the current leads and the voltage developed across the resistance is measured by the voltage terminals. The connection diagram is shown below.

In four wire ohms, the voltage is measured across the unknown resistance only and not across the combined leads.

Screened twisted pair cables are most suitable for high value four wire measurements with long leads, as the effects of leakage and capacitance between the leads is significantly reduced.

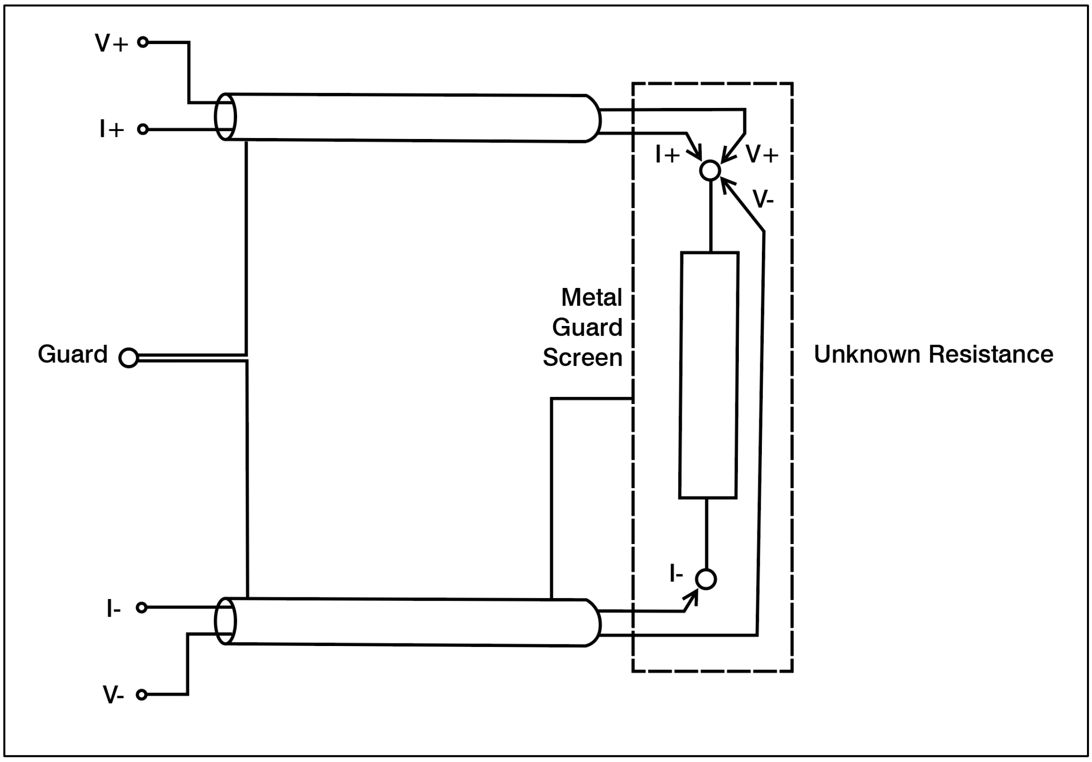
If making high value resistance measurements, a screen surrounding the resistor under test may help in reducing any stray pickup.  This shield should then be connected to the guard terminal, not the earth.  Connection to the earth terminal will probably induce more noise.



### 4.7.3 Nulling with Four Wire Ohms

If accurate measurements are to be made using four wire ohms it is recommended that the following procedure is used to null the lead resistance and any offsets before any measurements are made.

The arrangement shown here ensures that any thermal and induced EMF's are kept to a minimum.




### 4.7.4 Using the Ohms Compensation Mode

Since resistance measurements involve measuring the induced voltage across the resistance, any external voltages present such as excessive thermal EMF's will affect the reading.

The use of Ohms Compensation will cancel the effects of any offset voltages by first measuring the input voltage with the current source on and then measuring the voltage with the current source off. The induced voltage is the difference between the two voltages. This voltage is subtracted from the first voltage therefore giving a more accurate reading.

Ohms compensation may be used on 2 and 4 wire measurements up to 100 KΩ. Ohms compensation will not operate on other ranges.

Pressing this key will toggle between Ohms Compensation On and Ohms Compensation Off. It would be better if the thermals did not exist in the first place, so always use good quality leads, and connectors.

## 4.8 Capacitance Measurements

To measure an unknown capacitor, select capacitance mode and set to auto-range.

For large capacitances, ensure that they have been discharged prior to measurement.

Use the connections shown below, observing polarity. Allow for lead capacitance in the test leads.

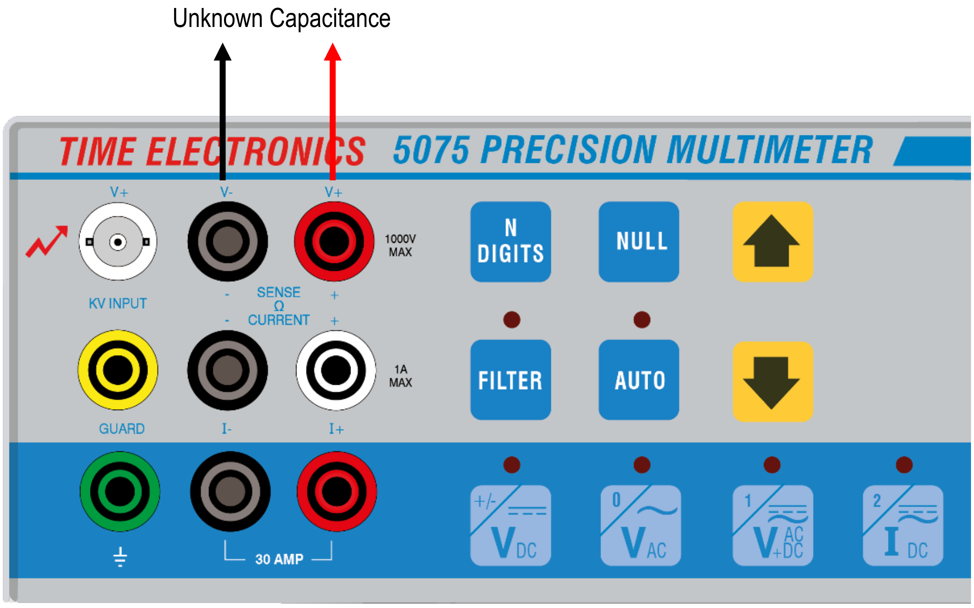



Table below shows the resolution, range and applied voltage.

| RANGE | MAXIMUM RESOLUTION | MAXIMUM APPLIED VOLTAGE |
|---|---|---|
| 30 nF | 5 | 15 V |
| 300 nF | 5 | 15 V |
| 3 µF | 5 | 15 V |
| 30 µF | 5 | 15 V |
| 300 µF | 5 | 15 V |

## 4.9 Using the Diode Tester

The diode test function will pass a current of 1mA through the diode under test and display the diode forward bias voltage drop.

This function is particularly useful for zener diodes up to 10 V. In the case of Zener diodes, it is the reverse breakdown voltage drop (the Zener voltage) being read, if the zener voltage exceeds 10 V, this message will be displayed:


Use the same connections V-, and V+ shown on the previous page, observing the polarity, forward bias for diodes, reverse bias for Zener diodes.

## 4.10 True RMS AC Voltage Measurements

Measurement of AC Voltage is performed in much the same manner as DC measurements.

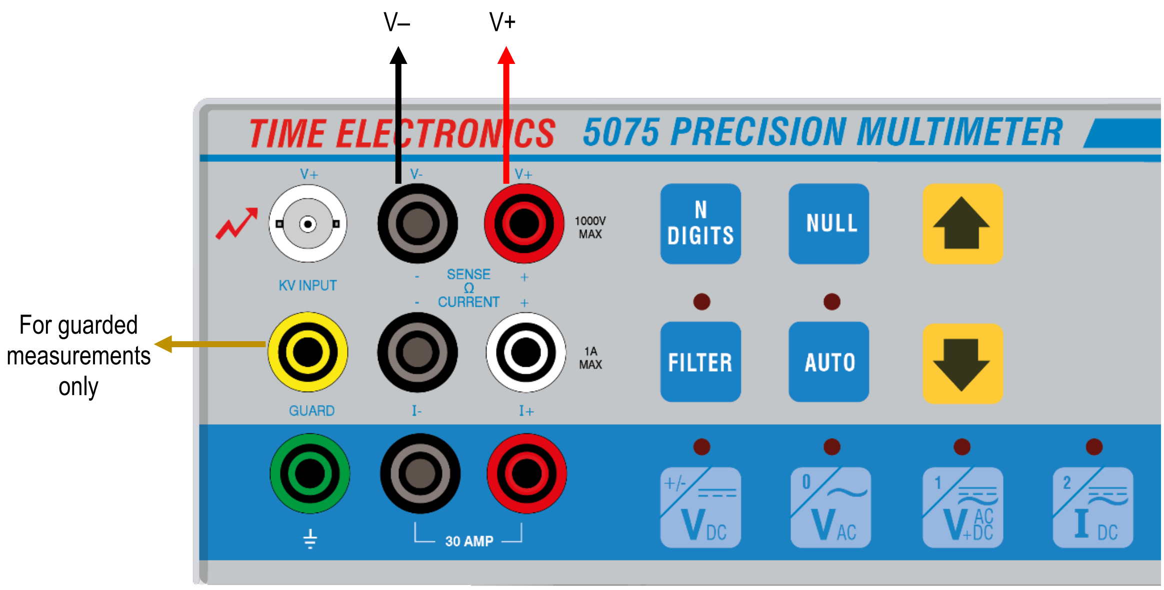
DC voltage measurements can be made with little account taken of the lead resistance, as long as it is small in comparison to the input impedance of the DMM.

With AC voltage measurements, the capacitance of the test leads can load the source and also cause a voltage drop. Normal test leads pairs may have a capacitance of around 150 pF.

The use of separated input leads will have a much lower capacitance, probably about 5 pF, but may introduce stray signals that could affect the reading.

See below for connection details. For best accuracy use the shortest leads possible.

Connecting the guard to the source of the common mode voltage may reduce any input noise.




For resolution, applied frequency and input impedance, see tables on following page.

Table below shows the maximum resolution, maximum applied frequency and input impedance for each range.

| RANGE | FREQUENCY RANGE | MAXIMUM RESOLUTION | INPUT IMPEDANCE |
|---|---|---|---|
| 30 mV | 40 Hz – 20 kHz | 6 | 100 MΩ |
| 300 mV | 40 Hz – 20 kHz | 6 | 100 MΩ |
| 3 V | 40 Hz – 20 kHz | 6 | 100 MΩ |
| 30 V | 40 Hz – 20 kHz | 6 | 1 MΩ |
| 300 V | 40 Hz – 1 kHz | 6 | 1 MΩ |
| 3 kV | 40 Hz – 60 Hz | 6 | 100 MΩ |

Table below shows the various lead capacitances with frequency inputs to give the impedance.

| FREQUENCY | LEAD CAPACITANCE | | |
|---|---|---|---|
| | 5 pF | 60 pF | 150 pF |
| 100 Hz | 320 MΩ | 26 MΩ | 10 MΩ |
| 1 kHz | 32 MΩ | 2.6 MΩ | 1 MΩ |
| 10 kHz | 3.2 MΩ | 260kΩ | 100 kΩ |

## 4.10.1 Making a High Voltage AC Measurement

Voltages up to 3 kV AC may be measured via the kV high voltage BNC connector when the 3 kV range is selected. Auto range selection is not available; this range has to be selected manually.

Follow the connection procedures described in section 4.5.1 DC High Voltage Measurement.

**Extreme caution must be exercised when measuring very high voltages.**
**Do not work alone and do not depend upon the insulation of the cables for protection.**
**High voltages can discharge from point to point or from point to air.**
**Ensure that the test leads are clean, moisture and grease free.**
**Even if equipment has been switched off, capacitors may still retain a high voltage charge.**

## 4.11 True RMS AC Current Measurements

As with AC voltage, AC current is measured using the same procedure as DC current. However, precautions must be taken to ensure that lead capacitance does not affect readings, particularly at high frequencies and low current ranges.

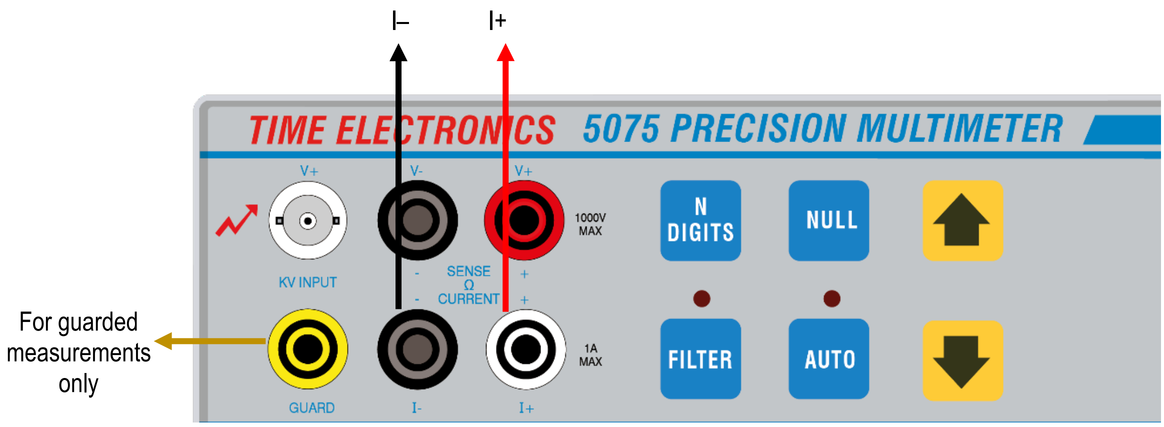
The use of screened twisted pair cables and the correct use of the guard terminal will help reduce induced error signals.

When measuring low value AC currents from a mains powered source, there will be capacitive coupling from the output to earth. Whilst the 5075 input is floating respect to earth, there is still capacitive coupling to earth. This capacitive coupling may short or present a low resistance across the input.

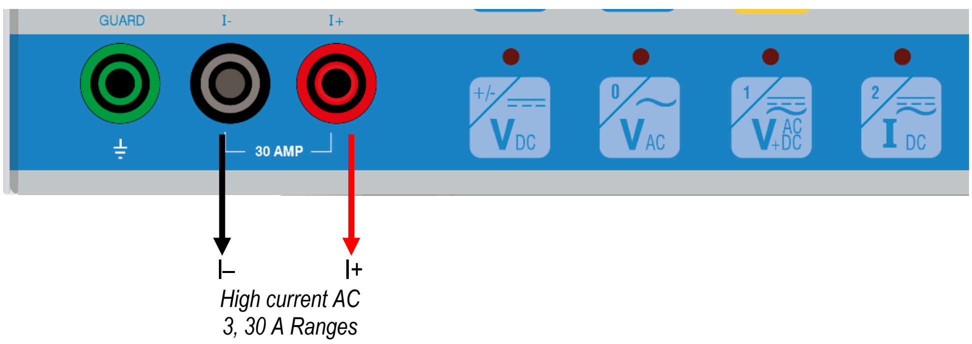
A solution is to use active guarding where a separate battery powered amplifier is used to drive the cable screens and guards of both the generator of measuring instruments.

See the below connections for currents up to 300 mA. Currents over 300 mA must use the high current terminals and the 3 A range or above. Currents up to 30 A, with a frequency of up to 400 Hz may be measured using the high current terminals.

**Connection details (up to 300 mA):**




**Connection details (Currents above 300 mA up to 30 A max frequency 400 Hz):**




See next page for details on maximum frequency, resolution, and shunt resistance.

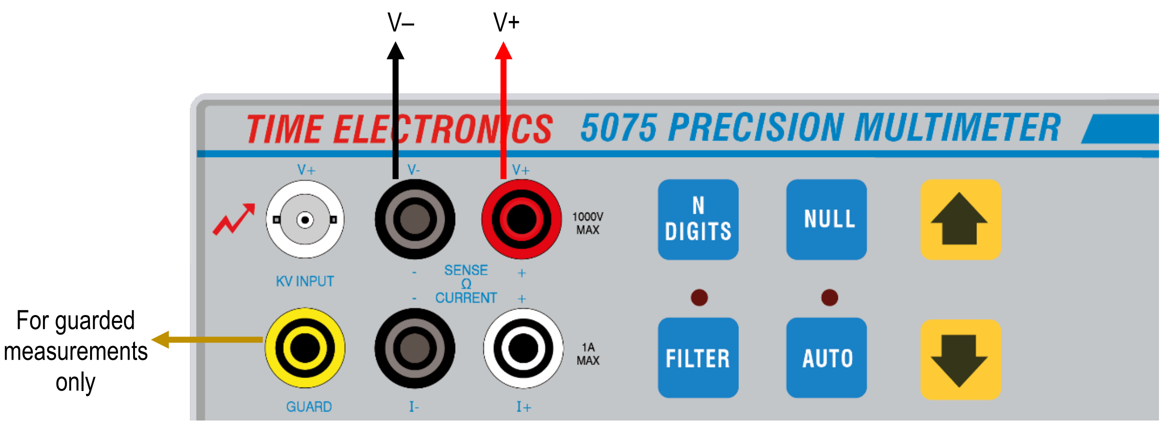
Table below shows the maximum frequency, resolution and shunt resistance for each range.

| RANGE | FREQUENCY RANGE | MAXIMUM RESOLUTION | SHUNT RESISTANCE |
|---|---|---|---|
| 30 µA | 1 kHz | 6 | 10 kΩ |
| 300 µA | 1 kHz | 6 | 1 kΩ |
| 3 mA | 1 kHz | 6 | 100 Ω |
| 30 mA | 1 kHz | 6 | 100 Ω |
| 300 mA | 1 kHz | 6 | 1 Ω |
| 3 A | 400 Hz | 6 | 10 mΩ |
| 30 A | 400 Hz | 5 | 10 mΩ |

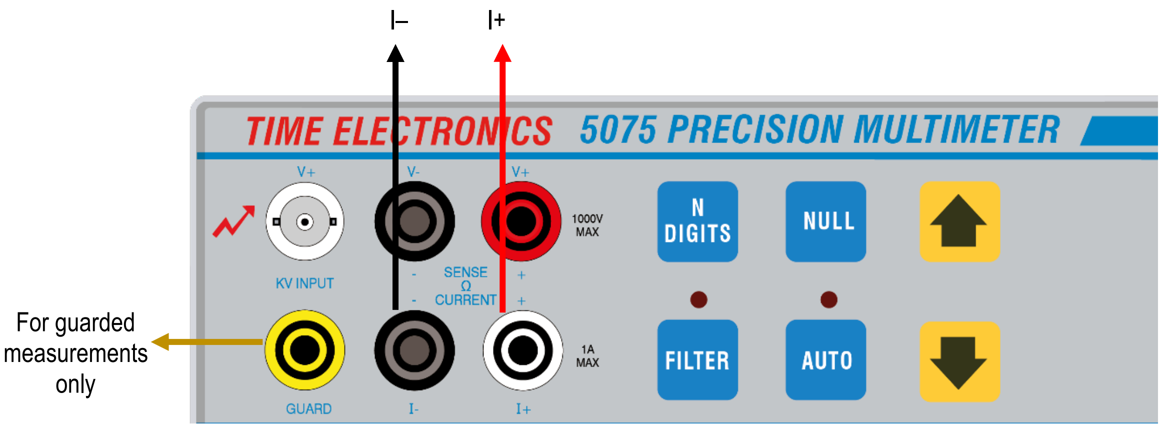
## 4.12 Measuring AC + DC Voltage or Current

In this mode the multimeter will measure the DC component and the RMS. AC component of the input signal, either voltage or current.

**Voltage Connection:**




**Current Connection:**



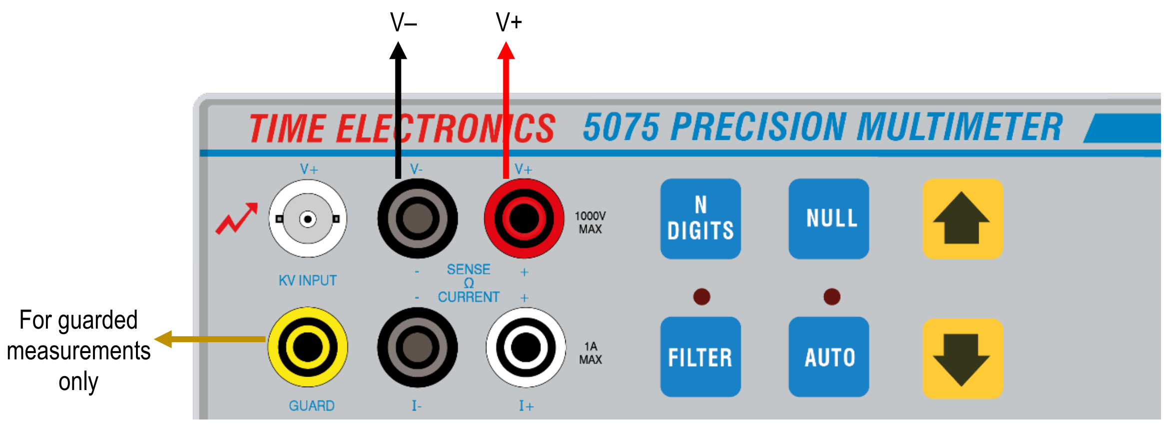
## 4.13 Frequency Measurement Using AC Function

Frequency may be measured on either voltage or current inputs if the AC option has been fitted.

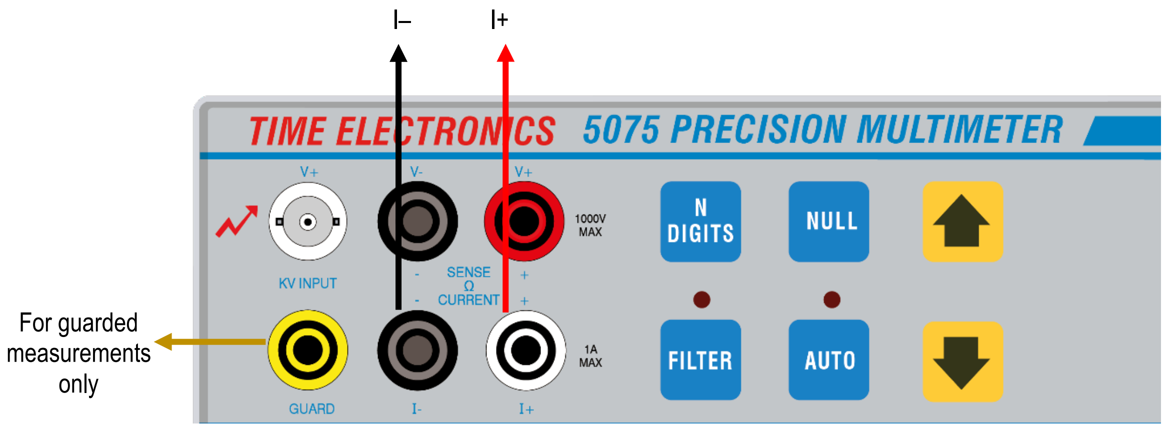
First select the measurement type, AC voltage or current, and then select the correct range. Connections for frequency measurement are shown below.

With the 5075 displaying the correct AC voltage or current, press the 'FREQ' button to display the frequency reading.

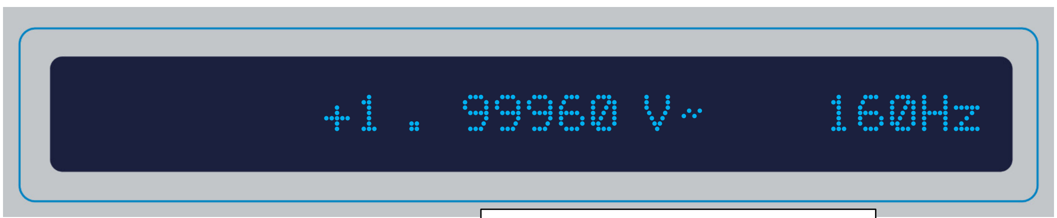
**Frequency Measurement of a Voltage Source:**




**Frequency Measurement of a Current Source:**




If the dual display feature has been selected from the scroll menu, then the frequency and voltage or current of the input may be displayed. See Section 5 Advanced Operation, for further details.




Example of dual display mode

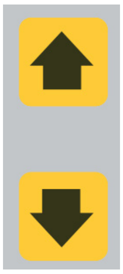
# 5 Advanced Operation Procedure

## 5.1 Menu Options

Options such as key beep, filter types and dual display modes can be altered via the menu.

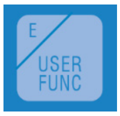
Calibration data and other information can be stored and viewed via this menu.

To select the menu options, press the menu/local key. The display will show:

By using the up and down keys, you may scroll through the menu options.

Once the required option is displayed, pressing the E/User Func key will either toggle between on and off or perform the selected function.




Some options may not be altered unless the calibration mode has been selected, such as the calibration date and interval. These are stored in the non-volatile memory at the time of calibration and may only be altered in the calibration mode.

The operation is performed by pressing the E/User Func key or by entering values using the dual-purpose mode keys.

When in measurement mode, pressing the E/User Func key will bring up the last option selected in the menu.

Menu options follow when set to the calibration address.

Some functions are only available when set to the calibration address and are marked **c**.

## Calibrate to Full Scale c

The range may be recalibrated to its full-scale value with an appropriate input.
See Recalibration section for more details.

## Adjust to Value c

The range may be recalibrated by connecting a known value to the input and adjusting the value displayed until it corresponds with the known input value. See Chapter 8 for more details on recalibration.

## Display Cal Factor c

If this option has been selected the calibration factor will be displayed for each range selected. If the calibration key has been inserted, the calibration factor may be altered by using the up and down keys.

## Clear Cal Factor c

This will clear both the full scale and zero calibration factors for the current range.

## Self Calibration

Selecting this option will recalibrate the internal analogue to digital converter. This should be performed before recalibrating the instrument.

## Internal Temp

This displays the internal temperature of the 5075 and is updated approximately every 5 minutes. The internal temperature is used to perform an internal calibration when the temperature varies by 1 °C, thus ensuring the temperature co-efficient of the unit remains negligible.

If the temperature goes outside the specified limits a warning message is displayed.

## Time

The time may be displayed or entered. This must be in the 24 hour format, e.g. 15:47. Colons are entered using the ./DIODE key. To change and store the time the IEEE address must be set to 16, the calibration address. It is not necessary to plug the calibration key in to alter the time.

## Date

Just as the time option, the date may be displayed or entered using this option. Press the E/User Func key to enter the date. The date must be entered in the DD/MM/YY format. Press the ./DIODE key to enter the / character. To change and store the date the IEEE address must be set to 16, the calibration address. It is not necessary to plug the calibration key in to alter the time.

## Store Options c

User options selected may be stored instead of the default options when in the calibration mode and the calibration key is inserted by pressing this key.

## Cal Due Warning c

A warning message may be displayed if the instrument is out of its calibration date. The message will halt any further readings thus retaining traceability integrity.

## PRT Temperature

PT100 elements may be measured and displayed in °C using this option.

When this has been set on, select the 300Ω four terminal resistance range. The element is read and the temperature displayed.

## Auto Dynamic Filter

The Auto Dynamic filter has been designed to automatically select the most appropriate filter period. The auto dynamic filter will increase or decrease the filter period (up to the maximum set using the filter key) depending upon the stability of the input signal.

If the input is stable over the first filter period the next period is chosen. If again the input is stable over this period, the next period is chosen and continues to do so up to the maximum period set by pressing the Filter key.

If this input was to change for example if the input was disconnected, the filter time would immediately increase to the fastest measurement time.

Once the input has settled again, the filter time will increase automatically to the maximum time previously set by the filter.

## Scanner Display c

Setting the scanner display option on will display the scanner channel being measured on the right of the display.

## Countdown c

For long filter times, (4 seconds and greater), a countdown timer may be displayed in the right of the display to show when the next reading will be updated.

## Analogue Filter

An analogue filter may be switched into the input circuit to remove any high frequency noise that may be present on the input. This may prove useful for removing noise when measuring switch mode power supplies.

## Sample Beep

When this option is set on, the 5075 will beep when a new reading has been taken. This may be used as an indication of an updated reading for very long filter times. This is effective on filter times of 1 second and greater.

## Continuity Beep

Continuity tests can be performed by selecting this option. When used in the resistance mode, any value below 30 % of the full scale will produce the continuity beep.

## Key Beep c

Select on for the keypad to beep when pressed or off for no beep when pressed.

## Cal Period c

This will show the calibration period of the 5075. If the calibration key is plugged in, with the address switch set to the calibration address, a new interval may be stored.

## Cal Temp c

This will show the temperature at the time of calibration. A new temperature may be stored if the calibration key has been plugged in.

## Cal Due c

This will show the date at which calibration is next due.

## Cal Date c

This will show the date of the last calibration. This may be altered if a calibration key has been plugged in.

## Cert No. c

The calibration certificate number may be displayed. This may be altered if a calibration key has been plugged in.

## Serial No. c

Displays the serial number of the instrument.

## IEEE Address

This will display the IEEE address as read from the DIP switch on the rear panel.

## Self-Test & Reset

By selecting this function, the instrument will perform a self-test of all its digital circuits including the IEEE and RAM. The unit will reset after this test.

The IEEE cable must be disconnected when running the test. If an error is displayed, refer to Section 12.

## Scanner Channel

If the scanner board option has been fitted, a scanner channel may be manually selected for monitoring. The mode keys, number 0-9 are used to enter the required input channel. To select a scanner channel, press the E/User Func key.

Enter the required channel number, 1 to 10 for the 10-channel scanner option, then press the E/User Func key to select this scanner channel as the input. Pressing the 0 key will turn the scanner off. To return back to measurement mode press the menu key.

## Dual Display

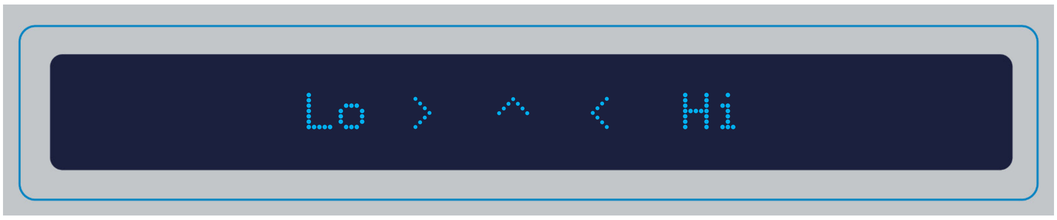
This mode will simultaneously display the voltage and frequency of the input or the current and the frequency (if the A.C. option has been installed), for AC inputs.

## Component Test

The component testing function may be used for component selection.

For example, if you were testing 1kΩ resistors to be within ± 1% of spec.

Select the resistance function and select the 1kΩ range.




It is important that the high limit is entered first (not the low limit).

You must always enter 8 digits - one for each of the *s.

For the example given in the manual you need to enter:

- 10100000 for the first (high limit)
- 09900000 for the second (low limit)

Both are entered by pressing the 'E/USER FUNC' key.

After this it is necessary to press the ‘MENU/LOCAL key to take you into the COMPONENT TEST display.

Please note that the '^' indicator moves in 8 discreet steps between the > and < limit marker indications. These therefore each represents 12.5% of the total limit span.

To exit COMPONENT TEST press MENU/LOCAL key twice.

## Peak Hold

This option will display the peak value measured.

## Max/Min Hold

This option will display the maximum and minimum readings of the input. By using the up and down keys, the maximum, minimum and present values may be displayed. The display will show this at the end of the display to indicate the Max Min option has been selected.



The caption changes between Max / Inp / Min to show which measurement is being displayed.

# 6 Measurement Techniques

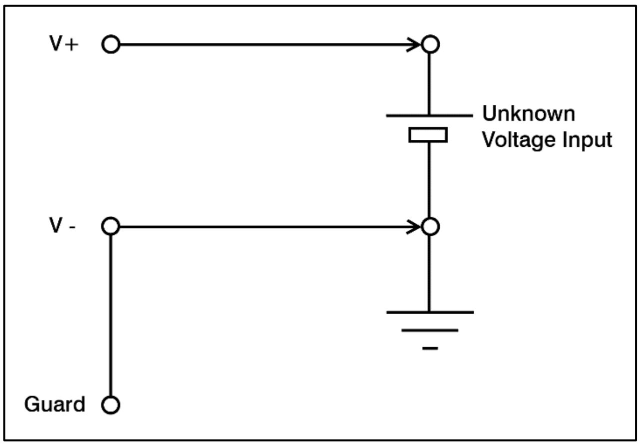
This chapter is an introduction to improving your readings using common measurement techniques and hints on how to get the best performance from your 5075 DMM. It has not been designed to be definitive or fully comprehensive but to be used as a guide only.

## 6.1 Common Mode Noise and Using the Guard Terminal

In most applications, the use of the guard terminal will not be necessary.

It may be connected to the negative terminal as shown here, to give better performance.

However, signals may be induced into the circuit because the input signal leads form a loop.




An illustration of this could be a mains power transformer from a nearby instrument with a strong magnetic field. This would induce a current into the loop as if it was the secondary winding of the transformer and spurious AC signal is superimposed onto the circuit.

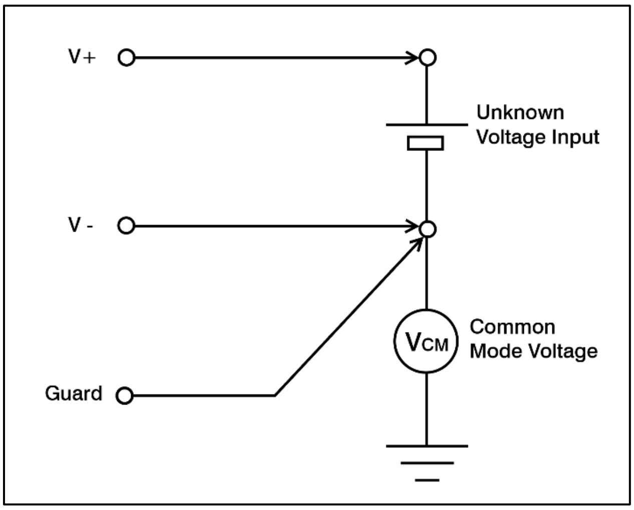
If twisted pair cable is used, the adjacent loops will effectively cancel any induced voltage.

If noise is still encountered, the use of screened twisted pair cable may help. The screen should be connected to either the -VE terminal or to the Guard terminal.

If the source being measured presents an unbalanced impedance to the input terminals or if common mode voltages are present, the screen should be connected to the Guard terminal as shown here.

If this method is used, common mode currents in the measuring circuit have a separate path to flow through, therefore minimizing any errors.

The guard terminal may be used effectively on both voltage and current.

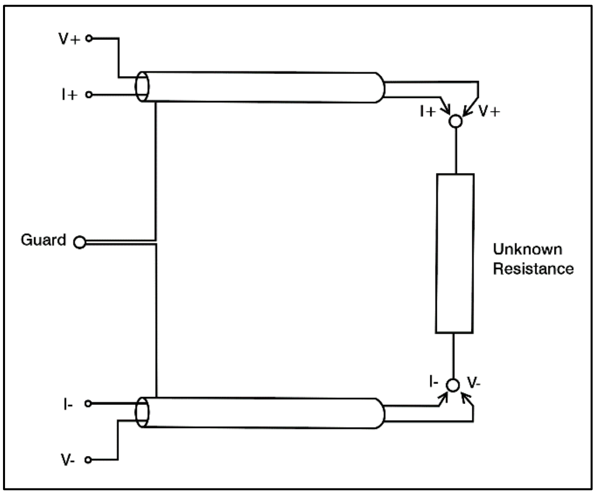



The use of the guard on AC measurements may still be applied as long as the source impedance is low enough not to be shunted by the extra capacitance introduced.

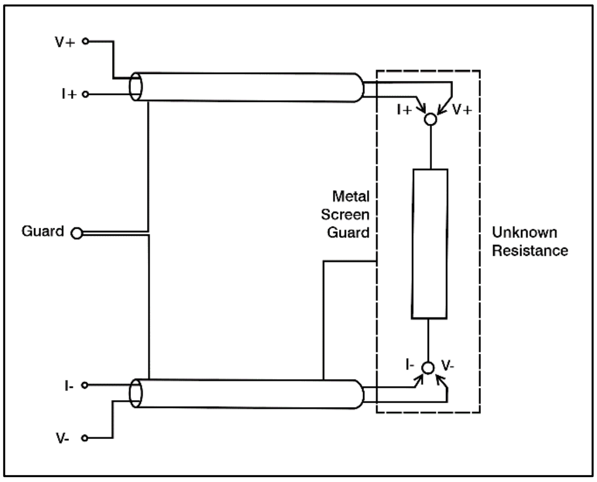
## 6.2 Using the Guard on Resistance

The Guard is equally effective on resistance as it is for voltage and current measurements and may be used in both two wire and four wire mode.

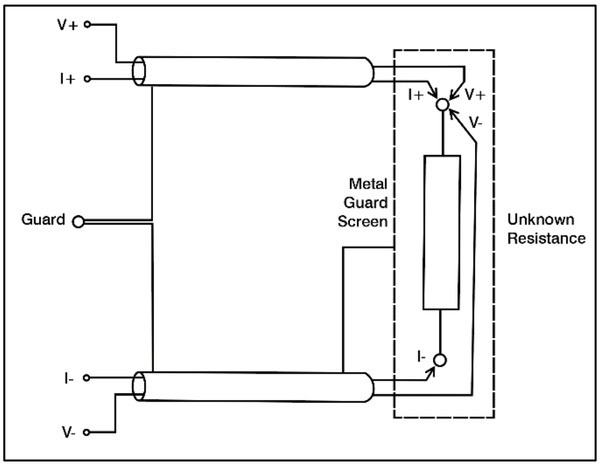
The connection diagram shown here should be followed for most resistance measurements.




If high value resistances are being measured the guard may be taken to the casing of the resistor (if metal), or alternatively connected to a screen encasing the resistor. In most cases, grounding the resistor will make measurements noisier.




When making precision resistance measurements, ensure that the meter has been zeroed correctly. By following the connection diagram shown here, any induced EMF's and thermals are eliminated from the measurement.




If making high value resistance measurements, the use of PTFE insulated cable would be an advantage because of its high insulation resistance.

## 6.3 Input Impedance and Lead Capacitance

Input impedance is the equivalent resistance and capacitance as if you were looking into the DMM's input terminals.

With most DC measurements up to 10 V, input impedance of the DMM and the lead resistance is unimportant if the resistance of the circuit measured is small in comparison to the input impedance of the meter. Care should be taken though when measuring standard cells to ensure that the range selected does not load them.

With AC measurements, capacitance between the leads may cause a number of problems such as source loading and voltage drop in the leads.

If separate leads are used the lead capacitance may be around 5 pF, dependent upon the spacing. Care must be taken with these leads as they may have signals induced upon them, therefore the use of short leads will give better results by reducing the possible loop area and lead capacitance.

## 6.4 Thermal EMF's

Thermal EMF's arise from the use of dissimilar metal junctions in a circuit.  They are often unpredictable and are the most common error in low voltage measurement.

Typical values of thermal EMF's for various types of metals against copper are shown here:

| Material | Thermal EMF |
|---|---|
| Cu - Cu Oxide | 400 µV/°C |
| Cu - Si | 400 µV/°C |
| Cu - Kovar | 40 µV/°C |
| Cu - Pb/Sn Solder | 1.3 µV/°C |
| Cu - Cd/Sn Solder | 0.3 µV/°C |
| Cu - Au | 0.3 µV/°C |
| Cu - Ag | 0.3 µV/°C |
| Cu - Cu | ≤ 0.2 µV/°C |

It can be seen that by using the same materials in a circuit, thermal EMFs will be reduced. Crimping terminals rather than soldering them, gives an even better thermal emfs performance.

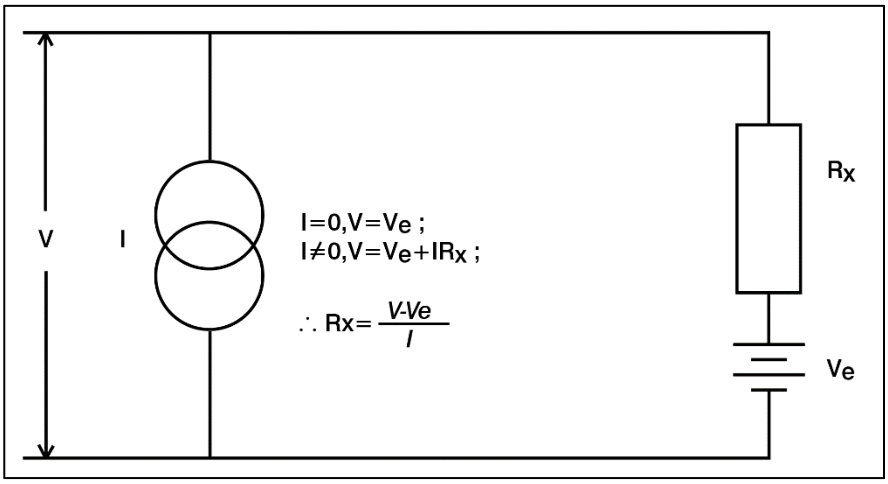
By minimising the temperature gradients within a circuit, thermal emfs are reduced. One method would be to place all junctions in close proximity and provide a good thermal connection to all of them. The thermal conductor must be chosen carefully as most electrical insulators do not conduct heat very well.

To minimise thermals, the same metal should be used throughout the circuit, avoiding wherever possible the use of steel probes, nickel plated terminals and tinned copper wire. If the use of dissimilar metals in the circuits is unavoidable, it should be ensured that they are offset by other junctions at the same temperature.

Allowing the test equipment to warm up in a constant temperature will also reduce thermal emfs. To ensure the ambient temperature is constant, the test equipment should be carefully placed away from hot or cold air draughts, the sun, etc. You may also consider wrapping connections in insulating foam.

Thermal emfs on DC may be seen by taking the reading and then reversing the polarity of the input. The reading should be the same except for the polarity. If there is any difference in the readings, this may be thermal emfs.

If a resistance is being measured, the use of Ohms Compensation may significantly reduce the possibility of thermal emfs affecting the reading (see diagram). When the ohms compensation is on, the DMM will switch off the current source and measure any voltage produced in the circuit. The resultant voltage is then mathematically subtracted from the result with the current source turned on. Therefore, any EMF's produced in the circuit will be eliminated.

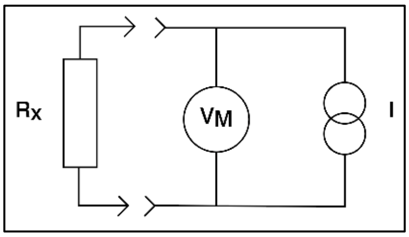



This method is only effective up to about 100 kΩ, but may be used on two or four wire ohms. The most effective solution is to not have thermals present in the first place.

## 6.5 Making High Value Resistance Measurements

Low value, constant current measurement techniques must often be used to determine the value of a high resistance.

This is also the method used in the 5075. This diagram shows the basis of constant current resistance measurement.




According to Ohms law, if resistor $R_x$ was 1Ω and 1A was passed through it, 1V would be developed. If the value of $R_x$ was higher, say 1MΩ and 1A was passed through it by current source 1, 1Million Volts would be developed across $V_m$! (if the current source was capable of that voltage compliance).

This is clearly impractical for a number of reasons. The current source would not have such a high output voltage compliance and the developed voltage is not too easy to work with. The heating effects of such a current would also alter the readings. Therefore, a much lower current is used, with a reasonable voltage compliance, giving a more ideal resultant voltage.

This does however present a few problems which, if precautions are not taken, may lead to false readings.

Firstly, noise may be introduced from a number of sources. Induced EMF from nearby electrical equipment is usually the main source of interference. The use of screened cable and careful guarding will minimise any induced emf effects.

Secondly, Shunt Resistance. This is usually limited by the resistance of the cables and of the connections. The resistance of particular insulators that may contribute to the shunt resistance will depend upon the insulators surface conditions, moisture content and temperature.

Ceramic insulators cleaned with methanol, which have not been touched, may have $10^{14}$Ω to $10^{15}$Ω resistance. If these insulators have a surface film from standing in a dirty environment or if they develop hairline cracks, the insulation resistance may degrade to $10^{11}$Ω to $10^{12}$Ω and affect the readings.

With the use of high insulation resistance cables, clean insulators and correct Guarding / earthing arrangements, any errors will be minimised.
Here are the typical resistances of various commonly used insulating materials.

| Material | Volume Resistivity (ohm/cm) |
|---|---|
| Sapphire | $10^{16}$ to $10^{18}$ Ω |
| Teflon® | $10^{17}$ to $10^{18}$ Ω |
| Polyethylene | $10^{14}$ to $10^{18}$ Ω |
| Polystyrene | $10^{12}$ to $10^{18}$ Ω |
| Kel-F® | $10^{17}$ to $10^{18}$ Ω |
| Nylon | $10^{12}$ to $10^{14}$ Ω |
| Ceramic | $10^{12}$ to $10^{14}$ Ω |
| Glass Epoxy | $10^{10}$ to $10^{17}$ Ω |
| PVC | $10^{10}$ to $10^{15}$ Ω |
| Phenolic | $10^{5}$ to $10^{12}$ Ω |

## 6.6 DC Current Measurement Errors

When measuring current, a small voltage drop will appear across the meter due to the current shunt and protection devices. This voltage drop is called the ‘Burden Voltage’.

With the 5075, the Burden Voltage has been kept to a minimum, generally up to a maximum of 100mV.

The Burden Voltage can present a significant error if the current source is not regulated.

This may be calculated:

$$\%Error = \frac{Vb}{Vs} \times 100$$

Vb is the Burden Voltage and Vs is the source voltage.

Example:

$$\%Error = \frac{0.1V}{12V} \times 100 = 0.833\ \%$$

This could also be worked out as an error in mA:

$$mA\ Error = (Current\ Displayed) \times \frac{Vb}{Vs - Vb}$$

Example:

$$mA\ Error = (870\ mA) \times \frac{0.1V}{12V-0.1V} = 7.311\ mA$$

The error would be added to the current displayed to give the correct reading of 877.311 mA.

## 6.7 AC Measurements

Many factors may be taken into account when measuring precise AC inputs including the RMS to DC. conversion process, bandwidth and the crest factor.

## 6.8 True RMS

True RMS. or Root -Mean - Square is the equivalent value of an AC waveform needed to dissipate the same amount of heat in a load as a DC waveform. An RMS waveform is therefore the DC equivalent of the original waveform and provides a sure fundamental for comparing waveforms.

Many meters use the average conversion method where the scale factor is actually adjusted to display the RMS value for a harmonic free sine wave. If the waveform is irregular this method will not work and will not display RMS readings. The 5075 uses RMS conversion techniques that compute the value of any complex waveform at crest factors up to 6.

For example, if a voltage of 14.1421V (zero - pk) sine wave was measured on the 5075 and an average conversion DMM the same resultant voltage would be displayed. If the voltage was a 20 V (pk - pk) square wave the 5075 would measure the AC component of 10V but the average conversion DMM would display 11.1 V, an error of 11 %.

## 6.9 Bandwidth

Be aware that the accuracy of the 5075 is specified up to 20 kHz or 1 kHz and 60 Hz on the higher ranges.

Particular limitations are applied because of the circuit configuration. Any signal outside of this range will not be an accurate measurement.

## 6.10 Crest Factor

The crest factor of a waveform is the ratio of its peak voltage to its RMS. voltage and are a useful way of expressing the capability of a measuring instrument.

Crest factors start at 1 for a square wave, i.e. where the peak voltage equals the RMS voltage. The 5075 has a maximum crest factor input of 4 or 3 if using the high voltage input.

| WAVEFORM | CREST FACTOR |
|---|---|
| SQUARE WAVE | 1.0 |
| SINE WAVE | 1.414 |
| SAWTOOTH WAVE | 1.732 |
| MIXED | 1.414 to 2.0 |
| SCR OUTPUT 100% - 10% | 1.414 to 3.0 |
| WHITE NOISE | 3.0 to 4.0 |

## 6.11 Zero AC Input Error

A reading other than zero may be displayed when the input is shorted on an AC range. This is due to random noise and the non-linear characteristics of the RMS converter to small inputs.

This however should not be a problem as the 5075 has seven AC voltage ranges with long scale resolution. Also, the non-linearity error is dramatically reduced when an input is applied.

In mathematical terms, when a signal is applied, the result is the square root taken of the sum of the signal and zero squared and not a simple addition of the signal to the zero input error.

For example, with zero input the display shows 0.40 mV on the 30 mV range. When an input signal of 10 mV is applied this becomes:

$\sqrt{10^2 + 0.40^2} = \sqrt{100 + 0.16} = 10.008$ mV

The effect of zero input error reduced from 400 µV to 8 µV.

# 7 IEEE (GPIB) Operation

The IEEE - 488 interface, sometimes called GPIB (General Purpose Interface Bus) or the HPIB (Hewlett Packard Interface Bus) allows remote control of the instrument by a suitable computer or controller.

Repetitive calibration work can be speedily and accurately carried out, giving printed results if required.

The 5075 is compatible with the IEEE - 488 (1978) interface bus.

The IEEE - 488 standard defines a complete interface system for the interconnection of instruments and computers using a bit parallel, byte serial bi-directional bus. Protocols, connections and cables are also defined, enabling computer-controlled systems to be quickly realised.

The main limitations of the IEEE are :

1. A maximum of 15 devices on the bus.
2. The maximum bus length should not be greater than 20m or number of devices x 2, whichever is the shorter.

## 7.1 Data Transfer and Device Addressing

Before a controller can send data it has to identify the recipient.  Each device on the IEEE is given an address to which it will respond when called by the controller, in this way data can be transferred between selected devices in an orderly manner.

The rate at which data is transferred is controlled by handshake signals, the speed being governed by the slowest device active on the bus.

Set baud rates are therefore unnecessary with this system.

## 7.2 IEEE Cables

The IEEE - 488 cable contains 24 wires terminated at both ends with identical plug/sockets which allow for daisy - chaining of additional cables to extend the bus.

Cables used on IEEE systems are available in various lengths to suit different layouts.

## 7.3 IEC Bus Connections

Users requiring to connect the DMM to a European standard bus (IEC - 625), must be aware of the differences in connector pin assignments from the IEEE bus and provide a suitable interface. Table 7.1 compares the pin designations for each standard.

## 7.4 IEEE Connector

The pin connections and dimensions of the IEEE connector are illustrated in Figure 7.1 and in Table 7.1.

Figure 7.2 illustrates the connections.

| PIN NUMBER | IEEE – 488 STANDARD | IEC - 625 |
|---|---|---|
| | FUNCTION | FUNCTION |
| 1 | DIO 1 | DIO 1 |
| 2 | DIO 2 | DIO 2 |
| 3 | DIO 3 | DIO 3 |
| 4 | DIO 4 | DIO 4 |
| 5 | EOI | REN |
| 6 | DAV | EOI |
| 7 | NRFD | DAV |
| 8 | NDAC | NRFD |
| 9 | IFC | NDAC |
| 10 | SRQ | IFC |
| 11 | ATN | SRQ |
| 12 | SHIELD | ATN |
| 13 | DIO 5 | SHIELD |
| 14 | DIO 6 | DIO 5 |
| 15 | DIO 7 | DIO 6 |
| 16 | DIO 8 | DIO 7 |
| 17 | REN | DIO 8 |
| 18 | GND 6 | GND 5 |
| 19 | GND 7 | GND 6 |
| 20 | GND 8 | GND 7 |
| 21 | GND 9 | GND 8 |
| 22 | GND 10 | GND 9 |
| 23 | GND 11 | GND 10 |
| 24 | LOGIC GND | GND 11 |

**Table 7.1**

**Figure 7.1**

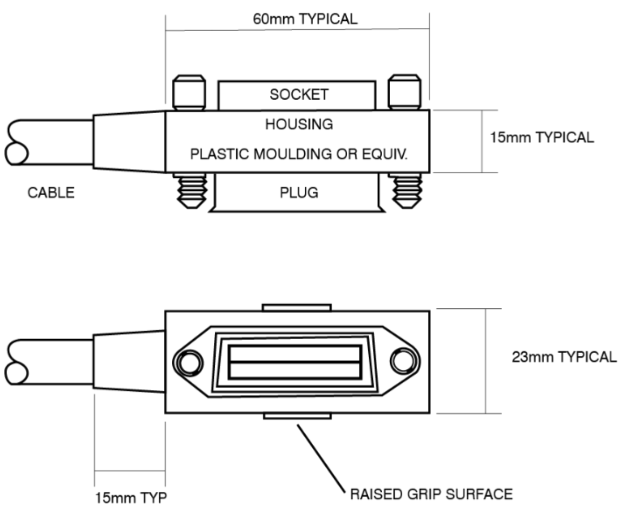
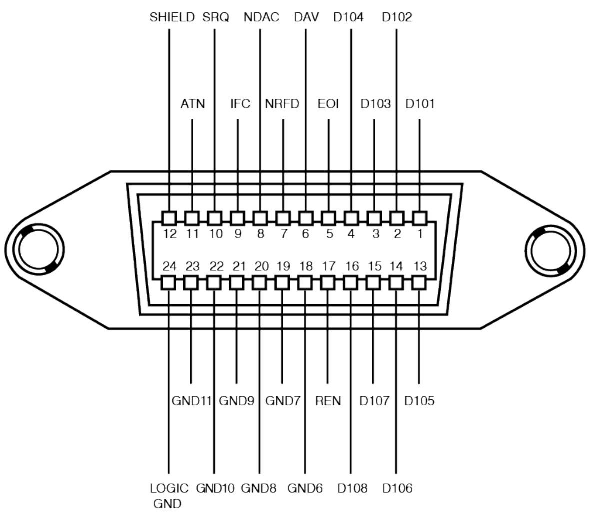



**Figure 7.2**



## 7.5 IEEE Address Selection

Before operating the DMM over the IEEE bus, set the address on the rear of the unit to the required address and operating mode.

Address default setting for normal operation is 17 (green, and brown switches on).

Addresses 0 and 16 are reserved for recalibration and should not be used unless recalibrating the instrument. Address 31 is used to select self-test mode.

The first five switches set the IEEE address and the last three switches are used to select the instruments operation mode. The last three switches are normally set to off but may be used as follows:

Switch 6 - Disable IEEE talk (transmit) mode.

Switch 7 - Disable IEEE listen (receive) mode.

Switch 8 - Dual Primary Addressing mode. In this mode, the unit will respond to two primary addresses differing only in the least significant bit. For example, if the unit address selection switches are set for an address of 8, the unit will also respond to address 9.

NOTE: The instrument only reads the address switch upon power up. Therefore, if the IEEE address is changed it will be necessary to switch the unit off and on again.

## 7.6 Local/Remote Operation

The 5075 is switched into remote operation when a valid command is received on the IEEE bus. The unit will remain in remote control until the MENU/LOCAL key is pressed on the DMM or until the unit is switched off.

## 7.7 Interface Clear Command - IFC

This command initiates a complete reset of the unit, which is then unable to respond to any further IEEE commands for 1 second.

## 7.8 IEEE Command Format

IEEE commands are comprised of characters from the ASCII set. A series of commands can be used to simulate the manual operation of the unit.

The commands must be in one of the following formats:

1) A single upper-case character (A to Z).
2) An upper-case character followed by a number.

Commands may be sent individually or build into a string separated with a slash character (/).

A command string may take the form of:

Terminator Character

IOCTL #2, "FO / R8/ X4" + CHR$ (13)

Controller specific command. 5075 command string.

The controller specific command is an instruction to the IEEE controller to read or write the following string to the device on the bus. This command may vary considerably between controllers and the example shown is a typical QuickBasic language by Microsoft command. Refer to your IEEE controller for specific commands.

The 5075 command string consists of commands from the 5075 Instruction set. These commands will instruct the 5075 to perform measurement functions or other operations.

## 7.9 Terminating Character

All command strings must end with a terminator character for the string to execute. This may be either a line feed or carriage return character as set by the T1 or T2 command.

## 7.10 IEEE Command Execution

Before an IEEE command can be executed the following conditions must be met.

1) The IEEE address and the talk/listen switches set correctly on the rear panel switch.
2) The command must be a valid command (invalid commands are ignored).
3) The command must be followed by a valid terminator character.

# 7.11 IEEE Command List

| RANGE | DC VOLTAGE | AC VOLTAGE | DC CURRENT | AC CURRENT | OHMS | CAPACITANCE | FREQUENCY |
|---|---|---|---|---|---|---|---|
| A0 | AUTORANGE OFF | | | | | | |
| A1 | AUTORANGE ON | | | | | | |
| R1 | 3 mV | 3 mV | 3 uA | 3 uA | 30 mΩ | 30 nF | 100 kHz |
| R2 | 10 mV | | 10 uA | | 100 mΩ | 300 nF | |
| R3 | 30 mV | 30 mV | 30 uA | 30 uA | 300 mΩ | 3 uF | |
| R4 | 100 mV | | 100 uA | | 1 Ω | 30 uF | |
| R5 | 300 mV | 300 mV | 300 uA | 300 uA | 3 Ω | 300 uF | |
| R6 | 1 V | | 1 mA | | 10 Ω | | |
| R7 | 3 V | 3 V | 3 mA | 3 mA | 30 Ω | | |
| R8 | 10 V | | 10 mA | | 100 Ω | | |
| R9 | 30 V | 30 V | 30 mA | 30 mA | 300 Ω | | |
| R10 | 100 V | | 100 mA | | 1 kΩ | | |
| R11 | 300 V | 300 V | 300 mA | 300 mA | 3 kΩ | | |
| R12 | 1 kV | | 1 A | | 10 kΩ | | |
| R13 | 3 kV | 3 kV | 3 A | 3 A | 30 kΩ | | |
| R14 | 10 kV | | 10 A | | 100 kΩ | | |
| R15 | 30 kV | | 30 A | 30 A | 300 kΩ | | |
| R16 | | | | | 1 MΩ | | |
| R17 | | | | | 3 MΩ | | |
| R18 | | | | | 10 MΩ | | |
| R19 | | | | | 30 MΩ | | |
| R20 | | | | | 100 MΩ | | |
| R21 | | | | | 300 MΩ | | |
| R22 | | | | | 1 GΩ | | |
| R23 | | | | | | | |

| MEASUREMENT FUNCTION | |
|---|---|
| F0 | DC VOLTAGE |
| F1 | AC VOLTAGE |
| F2 | AC/DC COUPLED VOLTAGE |
| F3 | DC CURRENT |
| F4 | AC CURRENT |
| F5 | AC/DC COUPLED CURRENT |
| F6 | 2 WIRE RESISTANCE |
| F7 | 4 WIRE RESISTANCE |
| F8 | FREQUENCY |
| F9 | CAPACITANCE |
| F10 | DIODE CHECK |

| RESOLUTION | |
|---|---|
| N4 | 4 DIGITS |
| N5 | 5 DIGITS |
| N6 | 6 DIGITS |
| N7 | 7 DIGITS |

| FILTERS | |
|---|---|
| X0 | FILTER OFF |
| X1 | 150 ms |
| X2 | 250 ms |
| X3 | 500 ms |
| X4 | 1 s |
| X5 | 2 s |
| X6 | 4 s |
| X7 | 8 s |
| X8 | 16 s |
| X9 | 32 s |
| Y0 | ADF OFF |
| Y1 | ADF ON |
| W0 | ANALOGUE FILTER OFF |
| W1 | ANALOGUE FILTER ON |

| SINGLE CHARACTER COMMANDS | |
|---|---|
| Z | NULL |
| T | TAKE READING |
| D | TRANSMIT VALUE TO IEEE |
| * | RESET |

| OUTPUT MODES | |
|---|---|
| E0 | OUTPUT VALUE |
| E1 | OUTPUT VALUE AND FUNCTION |

| TERMINATOR CHARACTERS | |
|---|---|
| V1 | CARRIAGE RETURN - (DEFAULT) |
| V2 | LINE FEED |

| PRT MODE | |
|---|---|
| U0 | PRT MEASUREMENT OFF |
| U1# | PRT MEASUREMENT ON |

| SRQ STATUS | |
|---|---|
| B0 | DISABLE SRQ |
| B1 | ENABLE SRQ |

| SCANNER CHANNEL | |
|---|---|
| S0 | OFF |
| S1 | 1 |
| S2 | 2 |
| S3 | 3 |
| S4 | 4 |
| S5 | 5 |
| S6 | 6 |
| S7 | 7 |
| S8 | 8 |
| S9 | 9 |
| S10 | 10 |

| MENU FUNCTIONS | |
|---|---|
| J1 | SERIAL No. |
| J2 | CERTIFICATE No. |
| J3 | CALIBRATION DATE |
| J4 | CALIBRATION DUE DATE |
| J5 | CALIBRATION TEMPERATURE |
| J6 | CALIBRATION PERIOD |
| J7 | DATE |
| J8 | TIME |
| J9 | INTERNAL TEMPERATURE |
| J10 | IEEE ADDRESS |
| **OHMS COMPENSATION MODE** | |
| O0 | COMPENSATION OFF |
| O1 | COMPENSATION ON |

## 7.12 Transmitted Value Format

When the ‘D’ command has been sent to the instrument via the IEEE bus, the present value will be sent back.

This may take the format of an 8 digit reading either with the function or without depending upon the output mode (E0 or E1).

i.e. ± 1. 2345678± 03 Or with the function - ± 1. 2345678± 03DCV

## 7.13 Programming Example

The following simple demonstration program written in Basic takes one reading from the DMM. The IEEE interface card in your computer may be different from the one used in this example program.

The following program will allow the operator to send a valid IEEE command to the DMM, to set a range or filter and then display the result.

```
100   REM *** IEEE CONTROL DEMO PROGRAM
101   OPEN "IEEECTRL" FOR RANDOM AS #1              `Open Control File
102   OPEN "IEEEDATA" FOR RANDOM AS #2              `Open Data File
220   T$ = CHR$ (13) + CHR$ (10)                    `Set the terminator character
230   CLS
231   INPUT "Enter IEEE Address of DMM" ; IE$        `Select IEEE address
232   IOCTL #1, IE$                                  `Send IEEE address
233   INPUT "ENTER COMMAND (X TO EXIT, Q TO TAKE READING" ; C$
234   IF C$ = "X" THEN END
235   IF C$ = "Q" THEN GOSUB 400 : GOTO 300
236   IOCTL #2, C$ + T$                             `Send command to IEEE
237   GOTO 300
238   REM *** TAKE READING FROM DMM
239   IOCTL #2, "T" + T$                            `Instruct DMM to take reading
240   FOR I = 1 TO 1000 : NEXT I
241   IOCTL #2, "D" + T$                            `Transmit reading from DMM
242   R$ = IOCTL$ (2)                               `Readback from IEEE Bus
243   PRINT R$                                      `Print reading
460   RETURN
```

# 8 Re-Calibration

Re-calibration will be required to take into account the long-term drifts inherent in instrumentation and also to restore the accuracy.

Calibration periods may be chosen by the customer depending upon the accuracy required from the instrument.

The 5075 may be calibrated at any time and any individual range may be calibrated.

The 5075 will require recalibration when the below message appears on the display:


You may calibrate a range to a specific input value or to its full scale value.

## 8.1 Calibration Source

For a reliable measurement, a calibration source with a least four times the accuracy should be used to calibrate this instrument.

Always ensure that the source is suitable for the measurement function.

## 8.2 Warm Up Time

Adequate time must be allowed for both the 5075, the calibration sources and the connections to reach thermal equilibrium. In general, allow two hours in a stable environment and at a room temperature of 23 °C.

Guard the instruments' from temperature gradients but allow adequate ventilation.

## 8.3 Front Panel Re-calibration

To set the instrument into calibration mode, switch the IEEE address to either 0 or 16. Turn the instrument on and allow two hours to warm up. Insert the calibration key into the rear panel of the 5075. A small ‘c’ will appear in the display.

It is recommended that you select the ‘Self Calibration’ option from the menu before calibrating any ranges. This will setup the A/D converter.

The calibration factors may be displayed for each range by selecting the ‘Display Cal Factor’ option in the menu.

Select the range you wish to calibrate (ranges may be calibrated in any order but see note 1), and apply a zero signal to the input. Press the null key. This has set the zero for this range.

If applying a full scale value to calibrate to, select the ‘Cal to Full Scale’ option from the menu. This will calibrate the full scale. A different menu is displayed when in the calibration mode.

You can calibrate the full scale of a range by applying an input that is close to the value. The reading displayed can be adjusted to correspond with the known input value.

Select the range to calibrate and select the ‘Adjust to Value’ function in the menu, press the ‘E’ key. The small ‘c’ that indicates the calibration mode changes to a large ‘C’ and the measured input is displayed. The LED above the ‘E’ key remains lit to indicate calibration mode.

Using a combination of keys, the measured value may be adjusted in 1 ppm, 10 ppm, or 100 ppm steps to indicate the known input value.

The ' ↑ ' key will increase the displayed value by 1 ppm.

The ‘Null’ key will increase the displayed value by 10 ppm.

The ‘N Digits' key will increase the displayed value by 100 ppm.

The ‘ ↓ ’ key will decrease the display value by 1 ppm.

The ‘Auto’ key will decrease the displayed value by 10 ppm

The ‘Filter’ key will decrease the displayed value by 100 ppm.

Using these keys, the desired value may be displayed.

Once the range has been adjusted, press the ‘E’ key once more to store the adjusted range.

Also in the menu options, the calibration details should be updated, i.e. Cal Period, Cal Due, Cal Date, Cert Number.

To avoid calibration errors, the 5075 will only alter its calibration factors in small steps. Therefore, large changes in value will require more than one attempt.

**Note 1:** When calibrating the 10 scale DC ranges, the lower 3 range is set automatically to be exactly 30% of the upper 10 range and should not need adjustment. The - 10 and - 3 ranges are also setup automatically.

# 9 Specifications

## 9.1 Technical/General Specifications

For technical and general specifications, please see the **5075 Extended Specifications** document that accompanies this user manual.
It can also be downloaded at www.timeelectronics.com.

## 9.2 Operating Information/Features

### 9.2.1 N Digits

This changes the reading resolution, which can be changed from 4 up to 7 digits (depending on the scale selected).

### 9.2.2 Null

The null facility is available on all D.C. ranges, Ohms and Capacitance. Null is not available on A.C. or frequency. When this key is pressed, the DMM will accept the measured present value as the zero value for the range selected.  If auto-range is on, the unit will null each range. This is useful for cancelling an offset voltage or for zeroing the value of the test leads on resistance.

### 9.2.3 Auto Ranging

Auto-range (AUTO) will select the optimum range for the measurement. This will introduce very little delay for the operator. The indicator above the keypad will show when the DMM is in auto-range mode.

### 9.2.4 Filter

The filter alters the integration time of the reading.  Filter times are 150 ms, 250 ms, 500 ms, 1 s, 2 s, 4 s, 8 s, 16 s, 32 s and off.

### 9.2.5 Internal Temperature

Internal Temperature controlled at 35 ºC ± 2 ºC with an ambient temperature of 20 to 28 ºC.

### 9.2.6 Ohm’s Compensation

Cancels the effects of any offset voltages by first measuring the input voltage with the current source on and the measuring the voltage with the current source off. The induced voltage is the difference between the two voltages, thus giving a more accurate reading. Can be used in 2 and 4 wire mode for measurements up to 100 KΩ. Ohms compensation is not available on ranges above 100 KΩ.

### 9.2.7 Diode / Zener Diode Test

The diode test function will pass a current of 1 mA through the diode under test and displays the diode forward voltage. May be used for Zener diodes up to 10 V measuring the reverse breakdown voltage.

### 9.2.8 Self-Test Reset

The instrument can perform a self-test of all its digital circuits including the IEEE and RAM.

### 9.2.9 Max – Min

This function displays the maximum and minimum readings of the input. By using the up and down keys the Maximum, Minimum or Present value input may be displayed.

### 9.2.10 Peak Hold

This function will display the peak value measured. By using the up and down keys the Peak value or Present input may be displayed.

### 9.2.11 Component Test

Used for component selection. If a component to be tested must fall between a high and low value, the component test can be used to make the selection process quicker. It provides a visual display which moves a pointer between the high and low values input, and also indicates whether the component is higher or lower in value than the high and low points if it doesn't fall between them.

### 9.2.12 PRT Temp

Pt100 elements can be measured and displayed in ˚C using this function.

### 9.2.13 Dual Display

Display Voltage and frequency of the input or the current and frequency (if the AC module has been installed), for AC inputs.

### 9.2.14 Analogue Filter

The analogue filter can be switched into the input circuit to remove any high frequency noise that may be present on the input.

### 9.2.15 Auto dynamic filter

The Auto Dynamic filter automatically selects the most appropriate filter period. The auto dynamic filter will increase or decrease the filter period (up to the maximum set using the filter key) depending upon the stability of the input signal.

### 9.2.16 Continuity / Sample bleep

Continuity tests can be performed by selecting this option when in resistance mode. Any value below 30% of the full range will produce the continuity beep.

Sample beep alerts the operator to a new reading being displayed.

### 9.2.17 Internal Date / Time

The Date and Time can be displayed or entered using this option.

### 9.2.18 Internal Temp

The internal temperature of the 5075 can be displayed and is updated approximately every 5 minutes. The internal temperature is used to perform an internal calibration when the temperature varies by 1 °C, thus ensuring the temperature co-efficient of the unit remains negligible.

### 9.2.19 Remote control

The 5075 implements the requirements of the IEEE - 488/1978 standard.

The IEEE - 488 interface, sometimes called GPIB (General Purpose Interface Bus) or the HPIB (Hewlett Packard Interface Bus) allows remote control of the instrument by a suitable computer or controller.

Repetitive calibration work can be speedily and accurately carried out, giving printed results if required.

The main limitations of the IEEE are: -

1) A maximum of 15 devices on the bus.

2) The maximum bus length should not be greater than 20m or number of devices x 2, whichever is the shorter.

# 10 Scanner Option 9726

The 9726 scanner option can be factory fitted at time of order or as a retrospective option. Below lists fitting and operational information.

**WARNING: Operations involve removal of the top cover. Before proceeding, ensure that the mains supply and any inputs have been disconnected. Failure to do so may expose live terminals and present an electrical shock hazard.**

## 10.1 Fitting the Scanner (Option 9726)

The scanner option for the 5075 DMM consists of an internally fitted relay board. This board contains 10 low thermal emf, multiple plated moving armature relays and its driver circuitry. Up to two boards may be fitted giving up to 20 channels.

To fit the scanner board first remove the top cover by locating four screws under the handle covers.

If necessary, using a sharp knife cut out the label from around the scanner connector hole. Locate the scanner board in the two 'D' connector holes.

Locate the two male connectors on the side PCB and connect the four colour fly lead from the scanner board to one of the connectors.

Locate the scanner mounting points. Mount the angle bracket to the side panel using the two countersunk head screws. Fix the board to the rear panel using the four D connector screws provided.

Locate the microprocessor bus connector on the processor / power supply board. Fit the bus cable from the processor board (connector 1) to the scanner board (connector 2).

The installation is now complete. Replace the top cover and handles.

## 10.2 Connections

Connections are made via two 25-way female 'D' connectors as shown in Figure 10.1. Channels 1 to 5 are on the left connector and 6 to 10 are on the right connector.

Best performance may be gained by using good quality connectors with shielded shells and gold-plated copper contacts.

Pin 13 on both connectors are earth/screen connections.

## 10.3 Operating the Scanner

The relays switch all 4 input terminals: V+, V-, I+, I– to one of 10/20 inputs via the 25 way 'D' connectors.

It is important to observe the maximum ratings of the scanner option, which are detailed in the specifications section.

The scanner card may be used for voltage, current, resistance, capacitance, frequency, and Pt100.

Refer to Chapter 4 for manual operation or Chapter 7 for remote IEEE operation.

## 10.4 Scanner Specifications

Maximum voltage: 200 V DC / 150V AC

Maximum current: 1 A DC / 1A AC

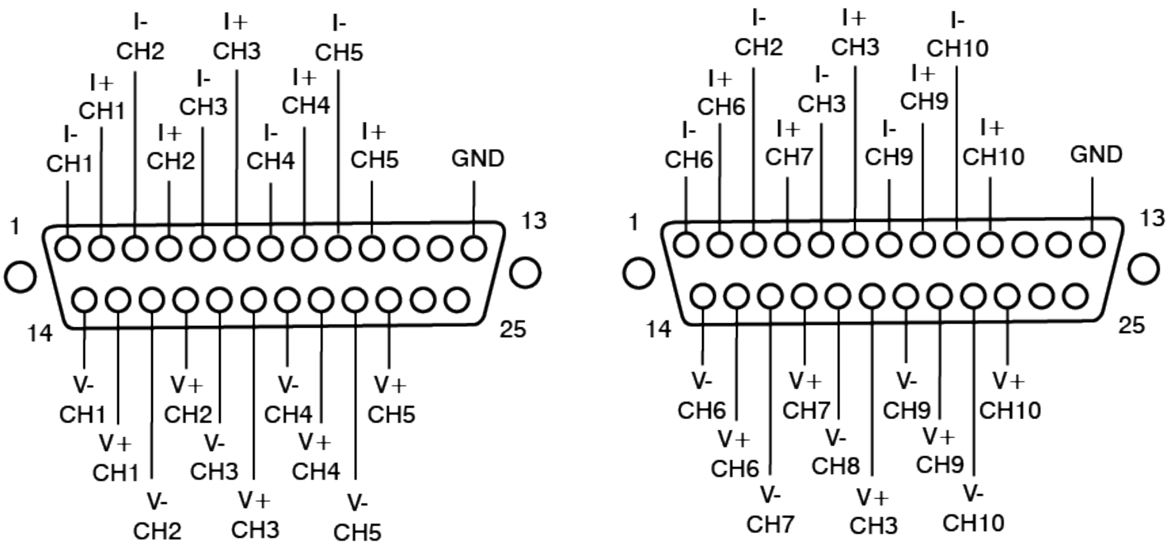
Thermal EMF: Less than 2 uV per contact

Contact resistance : Less than 150 mΩ

Operating life: Up to 200 million operations

Operating time: 20 ms

**Figure 10.1**



# 11 5075 Internal Componentry Information

This chapter is a brief introduction to the technical details of the 5075 internal parts.

The 5075 consists of two main boards with plug in modules.

1) The PSU and Processor board.
2) The Analogue Board containing - the A/D and Reference Module & the AC Module

## 11.1 Digital Board

This board can be examined in three sections.

### 11.1.1 PSU Section

The transformer has three primary tappings on one winding and three secondary windings, of which one is centre tapped. One side of the 11 V and 9 V windings are taken to a common reference point and then to mains earth and the chassis of the instrument. The 22V - 0V - 22V winding has its centre tap taken to earth via a neon and capacitor. This will ensure that the 0V line does not drift above approximately 90V but still remains isolated from the other supplies.

The power supply section supplies five outputs. It has two unregulated supplies; +10V and an unregulated +5V supply which may be pulsed up to +12V for latching relays. A regulated +5V supply is derived for the TTL circuits.

A regulated +15V/0V/-15V output is also supplied from the separate 22V-0V-22V winding to give an isolated supply for the analogue circuits.

Both the +5V and +15V/-15V supplies have zener protection in case of over voltage.

### 11.1.2 Processor Section

The heart of the unit is the 6802 processor with its support I.C.'s. The main ROM is a 128k device, the 27128. A secondary ROM is also used and is a 64k device (the 2764).

The board has 64k of on board RAM, (the 6264) for processor use, and also has 64k of non-volatile RAM. This is used to store calibration factors and other information, (the X2864). 32 lines of I/O provided by two 68A21 Peripheral Interface Adaptors connected to the uP bus. These lines are used to control range and function selection. 5 lines are used to obtain serial information from the A/D converter.

A stall circuit will reset the board if the processor hangs and stops the PIA giving a low frequency pulse from its CA2 output.

Additional address decoding is used to select IEEE chips, display drivers, LED drivers etc.

The display is driven directly from the data bus and contains its own on board drivers and support I.C.'s. Also, this board has its own customised character set stored in ROM.

The membrane keyboard is read by a keyboard encoder, I.C.19, a 74LS923 addressed by IC8.

The LED's on the front panel are driven by two 8 bit data latches, I.C. 21 and I.C. 22, both 74LS273.

An additional PIA is used to drive the parallel printer port and also to provide the processor with information of installed options.

Capacitance and frequency is measured by a 6840 counter, I.C. 25.

The frequency input is taken from a buffered output of the A.C. module via an opto-coupler to the C2 input of the 6840.

Capacitance is taken from a ramped voltage level and gated with a timing pulse generated by I.C.5 (4040). This pulse is then measured by the 6840. The 6840 is read directly on the data bus by the processor.

The Real Time Clock is a self-contained clock I.C. addressed by I.C.31 and read by the data bus. A lithium back up battery runs the clock during power off.

### 11.1.3 The IEEE Interface

The IEEE interface section is built around the Motorola 68488 General Purpose Interface Adapter (GPIA). The I/O lines of the 68488 are driven through MC3448 drivers. IEEE address selection is by an 8 digit switch whose condition is gated to the uP bus via a 74LS244 tri-state buffer, I.C. 17.

## 11.2 Analogue Board

All the inputs are scaled between 0V and 2.5V from their associated configuration/conversion circuits. This is then taken to the A/D converter and reference circuits located in the main module. This signal is converted to digital output using the Delta-Sigma conversion method.

### 11.2.1 DC Voltage

All ranges are scaled up or down to the input of the A/D converter.

Measurements are made over the selected filter period and averaged to produce the reading.

### 11.2.2 DC Current

Current is measured by placing an internal shunt resistor across the input and measuring the voltage developed voltage. Ohms law is then used to give the current.

The voltage measured across the current shunt resistor should be no more than 100mV.

This is measured by the DC voltage circuits.

### 11.2.3 Resistance Measurements

Resistance is measured by passing a known current through the unknown resistance being measured. The voltage developed across this is then measured by the DC voltage circuit. Ohms law is then used to give the resistance.

When Ohms Compensation is turned on, the current source is turned off between readings and the voltage measured again. This voltage is then subtracted from the reading taken with the source turned on. This will compensate for any thermal emfs produced in the circuit.

## 11.3 True RMS AC Voltage Measurements

AC Voltage is measured by using the implicit RMS computation technique, employing an absolute value V/I converter, a squarer divider, low pass filter and a precision current mirror.

These components are all contained in the AC module.

The output from the AC module is fed to the DC voltage circuits.

## 11.4 True RMS Current Measurement

True RMS current is measured by placing an internal shunt resistor across the input and measuring the AC voltage produced across it.

This voltage is measured by the AC voltage circuits then fed to the DC voltage circuits for conversion to digital signals.

# 12 Fault Diagnosis

**WARNING: Operations involve removal of the top cover. Before proceeding, ensure that the mains supply and any inputs have been disconnected. Failure to do so may expose live terminals and present an electrical shock hazard.**

This section gives details of some possible problems and how to correct them. If spares are needed, part numbers are listed in Section 13.

If the fault is not listed or if parts required are not listed, please enquire quoting instrument type and serial number.

## 12.1 Fault Check List

**If the unit is completely dead with no front panel lights, check the following :**

1) Mains supply.
2) Mains fuse blown in plug.
3) Mains fuses blown in appliance inlet.
4) Internal fuses have blown (See fuse replacement).

**The unit responds to manual controls but not to IEEE operation.**

1) Defective IEEE cable.
2) Incorrect IEEE address.
3) Incorrect terminator characters.
4) Incorrect IEEE commands.

**The unit powers up but operates incorrectly.**

Run the self-test.

**The unit displays 'Cal Factor Error'.**

The unit has a corrupted calibration factor and will need recalibrating.

**The 5075 occasionally resets to power on state.**

Excessive mains interference is causing the uP to stop. The watchdog circuit is causing the reset. Add additional mains filtering.

**Current ranges below 1A do not work.**

A current range fuse has blown. (See fuse replacement)

**Capacitance ranges do not work.**

Capacitance range fuse has blown. (See fuse replacement)

**Time and Date have been lost.**

Backup battery needs replacing. (See battery replacement)

## 12.2 Fuse Replacement

The 5075 has three types of fuse fitted. The mains fuse must be of the 20 mm, HBC, Sand filled and ceramic body type.

The internal DC supplies have two 1A, 20 mm anti-surge for the +15V and –15V rails and two 2A, 20 mm semi-delay (type T) fuses for the 5V and 5/12V rail.

### 12.2.1 Replacement of the Mains Fuse

The mains fuses are located in the mains inlet socket. To replace these fuses, first remove the power lead from the instrument.

Remove the fuse holder / voltage setting cartridge from the power connector, then locate and remove the fuse holder.

Install the correct fuse and replace the cartridge (800 mA for 220 V / 240 V AC or 1.6 A for 110 V AC).

### 12.2.2 Replacement of the DC Fuses

The D.C. fuses are located inside the instrument, on the processor / PSU circuit board, by the mains transformer.

Removal of the top cover is only recommended by qualified personnel as live parts are exposed. Ensure that the mains supply cable and any input leads have been disconnected before attempting the replacement of any fuses.

They are marked on the board as FS1 to FS4 with their appropriate rail voltages.

See Figure 12.1 for fuse locations.

When replacing the fuses always replace with the same type and rating of fuse.

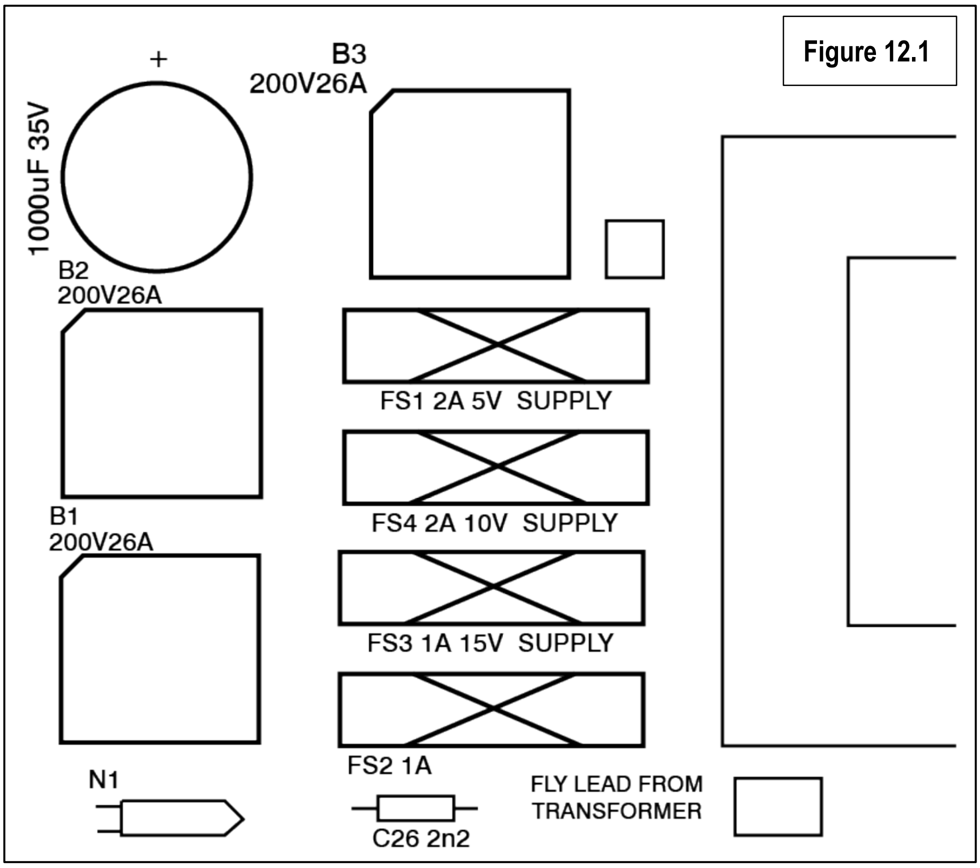



Figure 12.1

## 12.2.3 Replacing the Current Range Fuses

The current range fuses may be found on the rear panel. There is a separate fuse for positive and negative current both fuses rated at 1.25 A, 20 mm quick-blow.

Replacing a current fuse is simply by unscrewing the fuse holder, checking and fitting the new fuse.

## 12.2.4 Replacing the Capacitance Range Fuse

The capacitance range fuse may be found on the rear panel of the 5075, in between the current fuse holders and the rear input terminals.

The fuse rating is 50 mA, Quick blow, 15 mm glass.

Replacing a current fuse is simply by unscrewing the fuse holder, checking and fitting the new fuse.

## 12.3 Replacement of Analog or Digital Boards

Only qualified personnel should attempt replacement of the analogue or digital circuit boards.

Recalibration will be required if the analogue board has been replaced or if the calibration RAM (I.C. 7) has been replaced. You may replace the processor board and fit the original calibration RAM into the new board. This will not affect the calibration.

***Important: Disconnect the mains supply cable before removing the top cover.***

### 12.3.1 Analogue Board

The analogue board may be removed by unscrewing the six mounting nuts. The connectors must be removed first noting their polarity. If modules have been fitted these may only be removed once the board has been released.

The input lead assemblies may now be removed, again noting the locations they have been removed from.

Any modules may now be removed and transferred to the new analogue board.

The new Analog board may now be fitted using the reverse procedure.

Recalibration may now be performed as described in Chapter 8.

### 12.3.2 Digital Board

The digital board may be replaced by first removing the mains power connector fitted to the back panel. Unplug the mains power switch. The earth lead (yellow/green) must also be removed from the front panel.

Remove all the ribbon cables and other connectors, noting their polarity.

The 3 regulators may now be unscrewed from the side panels, put the ceramic washers to one side. The 2 transit bolts, if still fitted, may now be removed from the underside of the chassis.

After removal of the seven 6BA screws, the board may be removed.

Fitment of the new board is in the reverse order. The 5 V regulator (REG3) does not need an insulation washer and must have the earth lead connected to the mounting bolt. Heatsink compound must be applied between the regulators' surfaces.

Care must be made with storage or disposal of the digital board. This board contains a Lithium battery. Do not attempt to charge or fast discharge this cell. Do not open, puncture, crush or tamper with the cell. If the battery is accidentally shorted or starts to heat up, remove to a well-ventilated area to cool down, taking care to protect personnel and surroundings. Suitable protective clothing should be worn when handling suspect cells and if the skin has come into contact with the electrolyte, it should be washed thoroughly with water. Dispose of this cell in a secured approved battery recycle facility, **DO NOT DISPOSE OF IN A FIRE or in landfill.**

If only the digital board has been replaced, the calibration RAM (I.C.7) may be swapped, otherwise recalibration is necessary.

## 12.4 Replacing the Clock Backup Battery

The replacement battery must be as specified by Time Electronics (Time Electronics part number 7638).

Replacing the real time clock backup battery is best done with the digital board removed from the case as described in the previous section. Also read the important safety notes about Lithium batteries.

Once removed, locate the battery and remove the cable tie securing the device.

Carefully de-solder the battery as quickly as possible Do no overheat the battery as it may explode.

Form the replacement batteries legs.

Locate the new battery, observing the polarity and secure with a new cable tie. Solder in place, again without overheating the battery.

Be aware that this battery contains Lithium and must be disposed of in an environmentally friendly approved battery recycle facility.

# 13 Spare Parts List

5075 spare parts listed below. Contact Time Electronics for availability and pricing.

**Main Parts**

2593..............Rear Panel Label
2594..............Front Panel Label
2750..............Technical Manual
6151..............F50mA Fuse x 1
6172..............F1.25A Fuse x 2
6204..............High Voltage B.N.C.
6251..............Mains IEC Socket
6356..............Mains Rocker Switch
6430..............Autocal Key
7224..............Fluorescent Display
7511..............Mains Transformer
9039..............Front Feet
9035..............Top Cover
9550..............A/D Module
9551..............Digital Board
9579..............Analog Board
9582..............A.C. Module

**Analogue Board Parts**

2053..............10MΩ 0.1% Resistor (UP500/C)
2054..............1M111Ω 0.05% Resistor (UP400/C)
2076..............1Ω 0.5% Resistor (PBV)
2077..............0.1Ω 0.5% Resistor (PBV)
2078..............10kV Range Resistor (100MΩ)
2080..............30Amp Range Resistor (10mΩ)
4102..............1N5401 3A 100V Diode
4105..............1N4148 Signal Diode
4108..............EPAD50 Low Leakage Diode
4205..............2N3704 Transistor
4236..............VN10KM VMOS FET
4314..............79L05A Regulator
4317..............78L05A Regulator
4418..............TL081ACP Op-Amp
4434..............OP97FP Op-Amp
4436..............HCPL2630 Opto-Isolator
4437..............MAX430CPA Chopper Amp
4553..............DG442DJ Analog Switch
4554..............ILD74 Opto-Isolator
4575..............MC1413 Octal Driver
6307..............S4-L-6V Latching Relay
6308..............S3-L-6V Latching Relay
6310..............S2-L-6V Latching Relay
6312..............S4-12V Relay
6313..............IC-12V Relay Driver I.C.

**Digital Board Parts**

1243..............100MΩ Resistor
1865..............220Ω Resistor Network
3502..............1000µF 63V Capacitor
3519..............2200µF 63V Capacitor
3523..............4700µF 35V Capacitor
4050..............6V8 5W Zener Diode
4051..............16V 5W Zener Diode
4103..............1N4005 1A 50V Diode
4111..............200V 3A Bridge Rectifier
4200..............BC184L Transistor
4323..............78T05CT 5V 3A Regulator
4324..............LM7815CT +15V 1A Regulator
4325..............LM7915CT –15V 1A Regulator
4532..............74LS244 Octal Buffer
4555..............MC3448 Bus Transceiver
4556..............MC68488 IEEE 488 Adapter
4559..............3.2768MHz uP Crystal
4578..............X2864BD-18 Non-Volatile RAM
4579..............UM6264-12L RAM
4583..............6802 Processor
4585..............68A21 PIA I.C.
4595..............74C923 Keyboard Encoder I.C.
4647..............Bridge Rectifier Heatsink
6111..............2A 20mm Fast Blow Fuse
6132..............1A 20mm Semi Delay Fuse
6203..............IEEE Connector
7526..............Peizo Buzzer

# 14 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.

## 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.

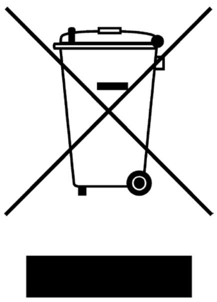
Send the instrument, shipping charges paid to:

**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.