Ezecal MK3

User Manual

EZECAL MK3 USER MANUAL
Contents

1 General.

1.1 Battery installation/replacement and recharging.

The EZECAL is supplied with 4 off "AA" size nickel cadmium batteries. These batteries may be recharged as required using the optional EZECAL recharging unit. If necessary the batteries may be replaced with alkaline or zinc/carbon batteries, however these must be thrown away when they run out and, under no circumstances should any attempt be made to recharge them.

Cell size	**AA**
	R6
	MN1500
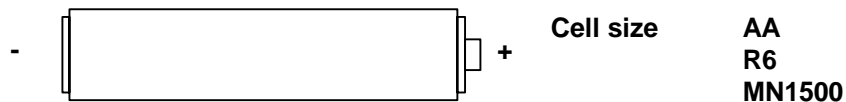
To install new batteries, first ensure the EZECAL is switched off and remove the lid of the battery compartment by lightly pressing the region marked "OPEN" and sliding the lid towards the terminals. Remove the old batteries and dispose of them carefully. Fit the new batteries observing the polarity markings printed inside the compartment and on the battery and refit the lid. The EZECAL is now ready for use.

Recharging Nickel Cadmium batteries.
The EZECAL may be recharged either from the optional mains adapter or car cigar lighter adapter. To recharge, first switch off the EZECAL and then plug the charging lead into the side of the unit. Leave the unit for 16 hours to fully charge the batteries. The EZECAL will provide approximately 20 hours of continuous use with freshly charged batteries.

If necessary the EZECAL may be used whilst charging is in progress, in this case recharging will take slightly longer to complete.

WARNING. DO NOT USE THE CHARGER UNIT TO POWER THE EZECAL EXCEPT WHEN RECHARGEABLE BATTERIES ARE FITTED.

Black Common Terminal

Yellow Input Terminal

Red Output Terminal

```
FGH Controls Ltd
   EZECAL MK3
```

LCD Display

Charging Socket

LRN	B 7	N 8	9
RCL	K 4	T 5	E 6
▶	S 1	R 2	J 3
+/-	CLR	L 0	ENT

Keypads

ON OFF   **EZECAL**

On/Off Switch

B 7	N 8	9
K 4	T 5	E 6
S 1	R 2	J 3
	L 0	

Numeric Keypad/Sensor Type Selection keys

LRN — Learn/Log mode select button

RCL — Recall/Replay mode select button

▶ — Function select/Scroll button

+/- — Sign change/Toggle button

CLR — Clear/Backward step button

ENT — Enter/Forward step button
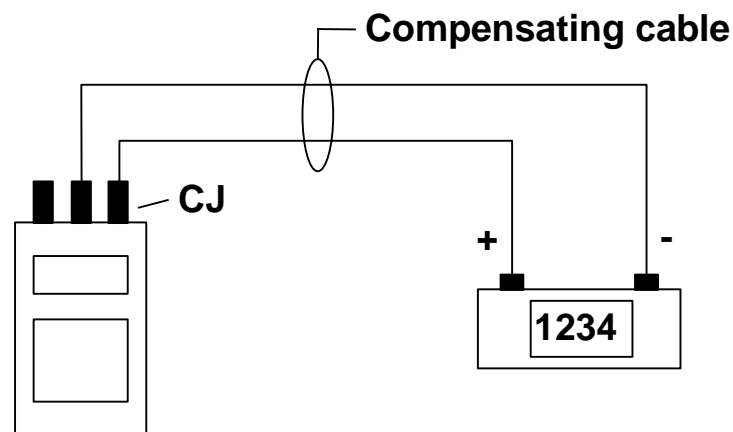
1.2   Nomenclature.

1.3   Connecting the EZECAL in simulation mode.

The EZECAL unit is intended for the calibration and checking of temperature measurement or control instruments using any of the BS 4937 standard thermocouples. The simulator eliminates the need for thermocouple emf look up tables, tedious cold junction calculations and temperature unit conversions. It also provides a rapid means of checking the actual thermocouple.

For thermocouple simulation purposes the EZECAL unit can be connected to the instrument under test in three different ways.

AUTOMATIC COLD JUNCTION METHOD.

The EZECAL is wired to the instrument under test in the appropriate compensation cable. The EZECAL should be set to its AUTO cold junction mode (see section 2.3). In this mode the EZECAL will automatically measure the temperature of its own terminals and adjust the output emf to compensate.

Compensating cable

CJ

+   **-**

1234

MANUAL COLD JUNCTION METHOD 1

The EZECAL is wired in copper cable to a reference junction and hence in the appropriate compensating cable to the instrument under test. For this method of connection the EZECAL should be set to its MANUAL compensation mode and the temperature of the reference junction entered. (see sections 2.3 and 2.4). The reference junction point can be any stable or temperature controlled environment between -10 and +55 °C. (melting ice is commonly used as a reference environment of 0 °C).

Copper cable   **Compensating cable**

CJ

+   **-**

1234

Reference Junction

MANUAL COLD JUNCTION METHOD 2

The EZECAL is wired in copper cable to the instrument under test. For this method the simulator should be put into its MANUAL compensation mode and the temperature at the terminals of the instrument under test entered. (see sections 2.3 and 2.4) This method of connection is the least reliable of the three described and should only be used for rough checking, as changes in ambient temperature will affect the readings on the instrument under test.

Copper cable

+   **-**

CJ

1234

1.4   Connecting the EZECAL in measure mode.

In order to use the Ezecal to measure temperature via a thermocouple the EZECAL should be connected in one of the three following ways.
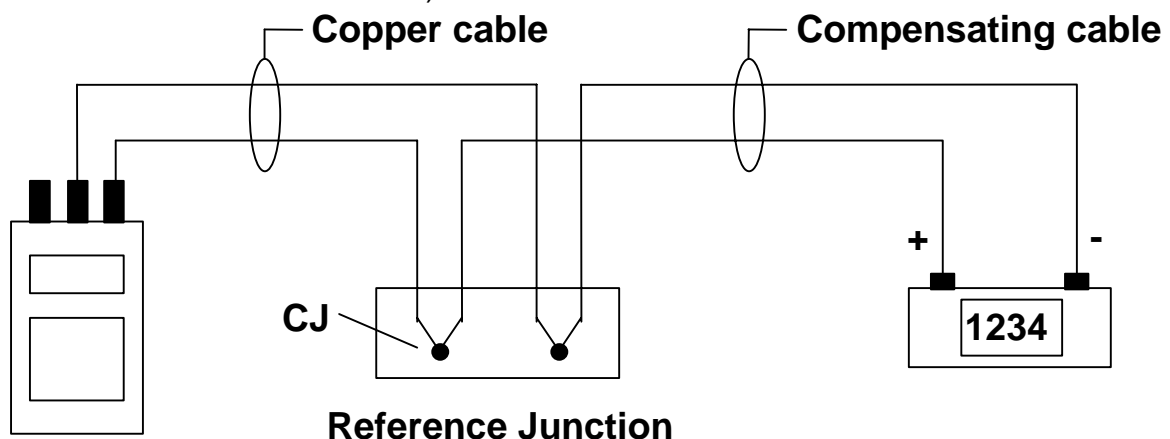
AUTOMATIC COLD JUNCTION METHOD.

The EZECAL is wired to the instrument under test in the appropriate compensation cable. The EZECAL should be set to its AUTO cold junction mode (see section 2.3). In this mode the EZECAL will automatically measure the temperature of its own terminals and adjust the output emf to compensate.

Compensating cable
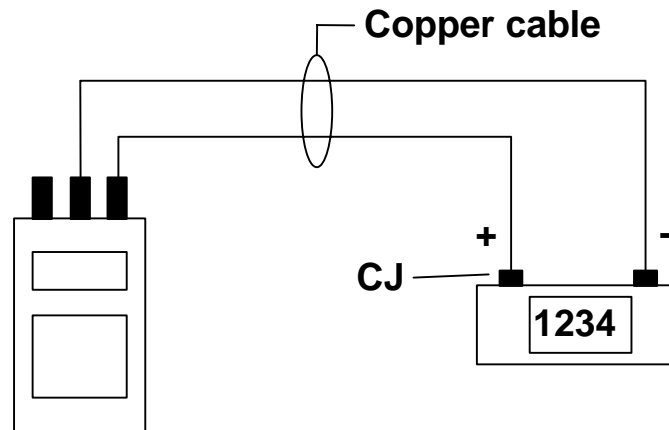
CJ

-   **+**

Thermocouple

MANUAL COLD JUNCTION METHOD 1

The EZECAL is wired in copper cable to a reference junction and hence in the appropriate compensating cable to the instrument under test. For this method of connection the EZECAL should be set to its MANUAL compensation mode and the temperature of the reference junction entered. (see sections 2.3 and 2.4). The reference junction point can be any stable or temperature controlled environment between -10 and +55 °C

Copper cable   **Compensating cable**

CJ

Reference Junction   **Thermocouple**

- +

MANUAL COLD JUNCTION METHOD 2

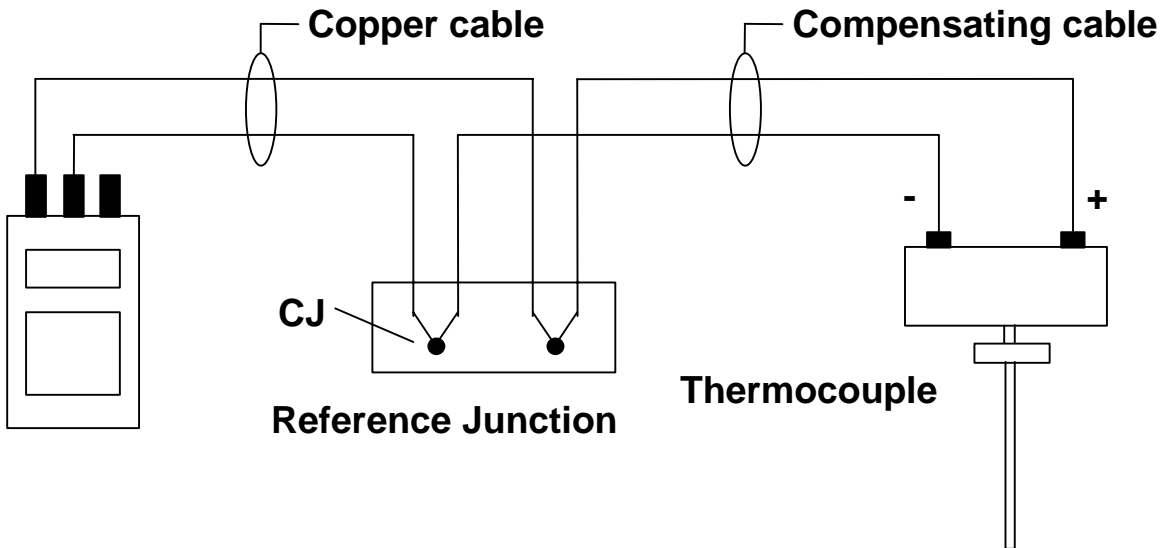The EZECAL is wired in copper cable to the instrument under test. For this method the simulator should be put into its MANUAL compensation mode and the temperature at the terminals of the instrument under test entered. (see sections 2.3 and 2.4) This method of connection is the least reliable of the three described and should only be used for very rough temperature measurements.

Copper cable

CJ

- +
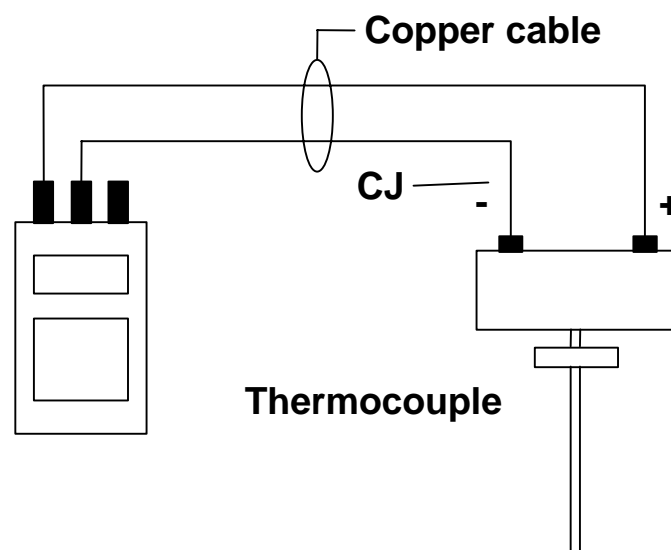
Thermocouple

NOTE: For measurements with type B thermocouples or linear transducers the EZECAL should be connected as shown above. The set mode of compensation does not matter in this case.

1.5   Using the keyboard.

The numeric keypad on the EZECAL is used just like a calculator. To enter a number simply press the numeric keys in the usual order. On the first key press the existing number will be cleared and a flashing cursor and question mark will appear. The cursor indicates where the next number pressed will be displayed. Digits already entered will be shifted one space to the left. The ENT key must be used at all times to enter the number, at which point the cursor and question mark will disappear. Negative numbers are entered by using the +/- key to negate the number entered at any time.

Mistakes can be corrected by pressing the CLR key at any time during input and re-entering the correct number. Alternatively the incorrect number may be overwritten by the correct one after pressing the ENT key.

Examples.

Entering a positive number

existing display +1000°C

Key	Display
s 1	+ 1?
R 2	+ 12?
J 3	+ 123?
ENT	+ 123°C
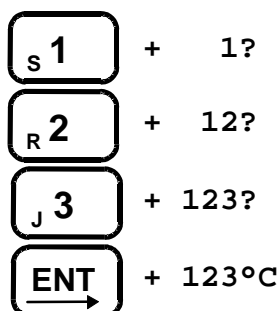
Entering a negative number

existing display +1000°C

Key	Display
s 1	+ 1?
L 0	+ 10?
L 0	+ 100?
+/-	- 100?
ENT	- 100°C
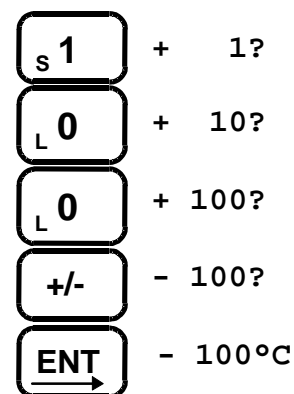
Correcting a mistake

existing display +1000°C

Key	Display
s 1	+ 1?
R 2	+ 12?
CLR	+ ?
s 1	+ 1?
J 3	+ 13?
ENT	+ 13°C
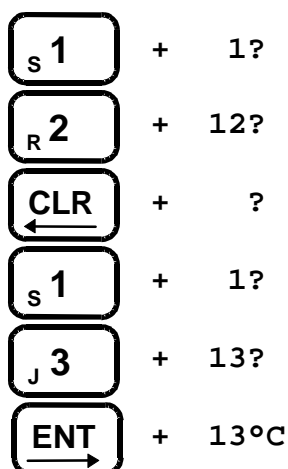
Entering a number out of limits

existing display +0°C

Key	Display
s 1	+ 1?
B 7	+ 17?
ENT	Error
s 1	+ 1?
E 6	+ 16?
ENT	+ 16°C
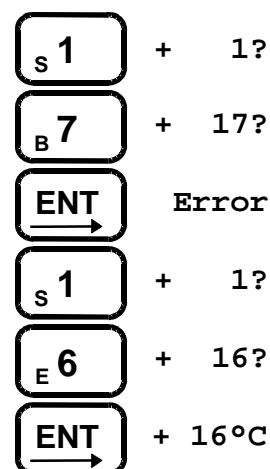
2   Setting up the EZECAL.

This section describes how to set up the EZECAL to simulate or measure the particular thermocouple of interest, the temperature units and the cold junction compensation mode.

2.1 Setting the thermocouple type.

The EZECAL can simulate or measure any of the eight standard thermocouple types specified under BS 4937, these are :-

Pt10%Rh/Pt	type S	-50 to 1767 °C
Pt13%Rh/Pt	type R	-50 to 1767 °C
Fe/Cu	type J	-210 to 1200 °C
NiCr/NiAl	type K	-270 to 1372 °C
Cu/CuNi	type T	-270 to 400 °C
NiCr/CuNi	type E	-270 to 1000 °C
Pt30%Rh/Pt6%Rh	type B	-0 to 1820 °C
NiCrSi/NiSi	type N	-270 to 1300 °C
also Linear millivolts		-99.99 to +99.99 mV
		and equivalents in °F.

One custom thermocouple range may also be included to special order.

W5%Re/W26%Re	type W5	-0 to 2320 °C
Fe/CuNi	type L (DIN 43710)	-200 to 900 °C
		and equivalents in °F.

The sensor type is set by using the scroll key until the thermocouple type is displayed and then pressing a numeric key to set the required type. Custom ranges are always invoked using key 9.

For example.

``` OUTPUT +1760°C Type:S CJC:Man ```	▶ ▶	``` Thermocouple S Select using 0-9 ```	**Display shows current type**
	ₖ4	``` Thermocouple K Select using 0-9 ```	**to set type K**
	ₖ9	``` Thermocouple W5 Select using 0-9 ```	**to set type W5 (custom range)**
	∟0	``` Thermocouple Lin Select using 0-9 ```	**to set linear**
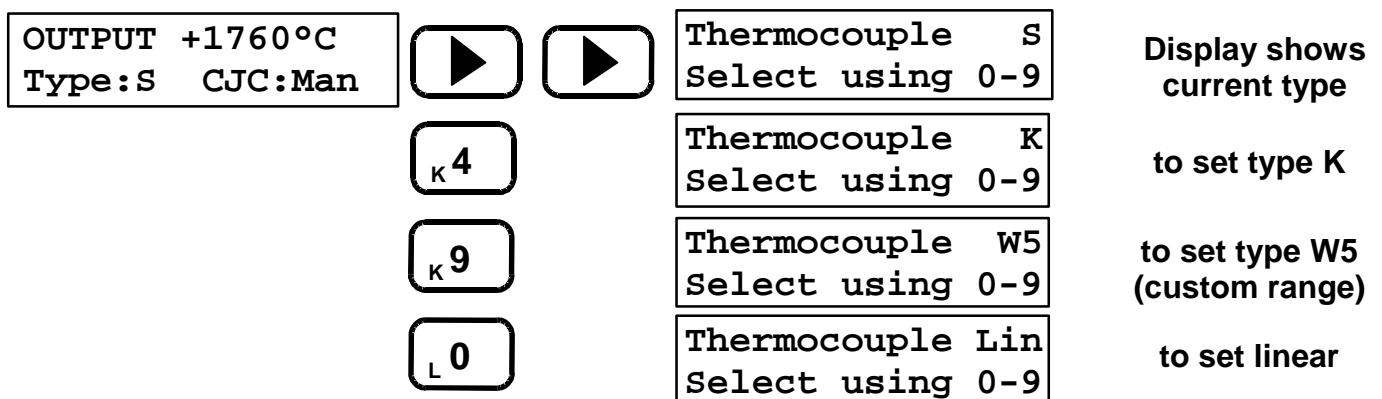
2.2 Selecting the temperature units.

The EZECAL can work in either °C or °F. To change the temperature units press the SCROLL key until the temp units message is displayed, and then use the +/- key to toggle between °C and °F.

For example.

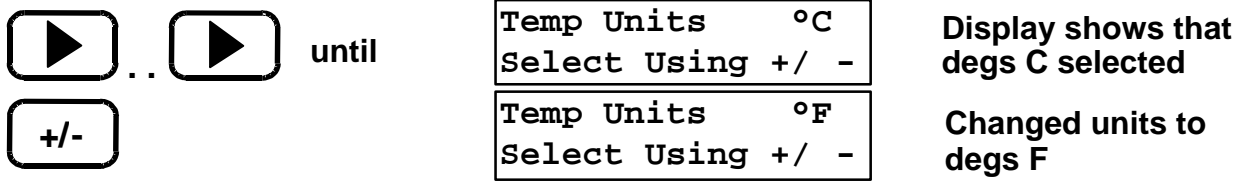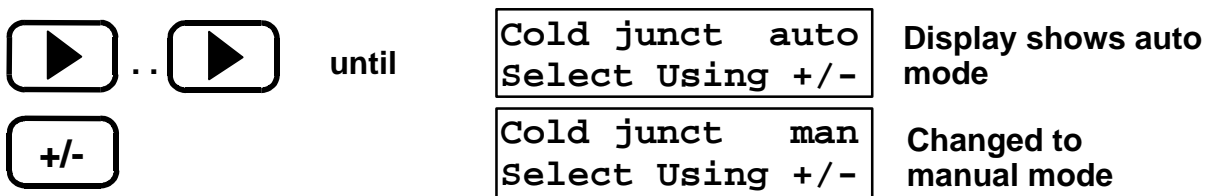|	
▶ .. ▶ **until**	```Temp Units °C``` ```Select Using +/ -```	**Display shows that degs C selected**
+/-	```Temp Units °F``` ```Select Using +/ -```	**Changed units to degs F**

2.3 Selecting Cold junction Compensation mode.

The EZECAL is capable of measuring the temperature of its terminals and adjusting the simulated output or measured input accordingly. This automatic adjustment can be switched on or off as required depending on the way the unit is connected (see section 1.4). If compensation cable is used to connect the EZECAL to the thermocouple or instrument then the automatic mode should be used. If, however an external reference junction is used then the manual mode should be selected and the reference temperature should be entered.

To switch between automatic or manual compensation, press the SCROLL key until the compensation message is displayed. Then use the +/- key to toggle between AUTO and MANUAL.

For example

▶ .. ▶ **until**	```Cold junct auto``` ```Select Using +/-```	**Display shows auto mode**
+/-	```Cold junct man``` ```Select Using +/-```	**Changed to manual mode**

2.4 Cold junction compensation temperature.

For operation in manual cold junction mode, it is up to the user to enter in the actual cold junction temperature. The location of the cold junction depends on how the EZECAL is wired (see sections 1.3 and 1.4). The valid range for this temperature is -10 to +55 °C or 14 to 131 °F. The lower line of the display indicates the valid range. In Automatic compensation mode there is no need to enter this temperature, the EZECAL will measure the temperature automatically and its value will be shown on the display. If this measured temperature is outside the specified limits of -10 to +40 °C (or equivalent) and error message will be displayed.

For example in MANUAL CJC mode.

▶ .. ▶ **until**	`CJ Temp + 24.0°C` `From -10 to 55°C` **Existing CJ temp is displayed**
₂ **2**	`CJ Temp +   .2?` `From -10 to 55°C`
₈ **8**	`CJ Temp +  2.8?` `From -10 to 55°C`
₅ **5**	`CJ Temp + 28.5?` `From -10 to 55°C`
ENT	`CJ Temp + 28.5°C` `From -10 to 55°C`

A new cold junction temperature of 28.5 degs C has now been entered.

In AUTOMATIC CJC mode.
Display shows internally measured CJ temperature.

`CJ Temp + 24.2°C`

Display indicates measured CJ temperature is out of range.

`CJ Temp + Error`
`*CJ RANGE ERROR*`

3.0 Simulation Mode.

Simulation mode is used to simulate the set thermocouple type. The required temperature is entered on the keypad and the equivalent emf with compensation if required will be output to the simulate terminals directly after the ENT key is pressed.
First of all the EZECAL must be set to SIMULATE mode.

▶ .. ▶ **until**	`Mode    Measure` `Select Using +/-`	**Existing mode is displayed**
+/-	`Mode    Simulate` `Select Using +/-`	**Mode changed to Simulate**

3.1.1 Simulation mode display indications.

Simulation mode is recognised by the word "OUTPUT" appearing on the top line of the display. The current set-up and actual temperature being simulated is also displayed along with any error conditions that may arise.

```
Indicates Simulate                    Simulated temperature
      Mode                      Temp              °C
                                units             °F

                        ┌──────────────────┐
                        │OUTPUT    +1000°C │
                        │Type:K  CJC:Auto  │
                        └──────────────────┘

                Sensor        S         Cold Junction Mode
                Type          R               Auto
                              J                Man
                              K       (not shown in linear mode)
                              T
                              E
                              B
                              N
                            Linear
```
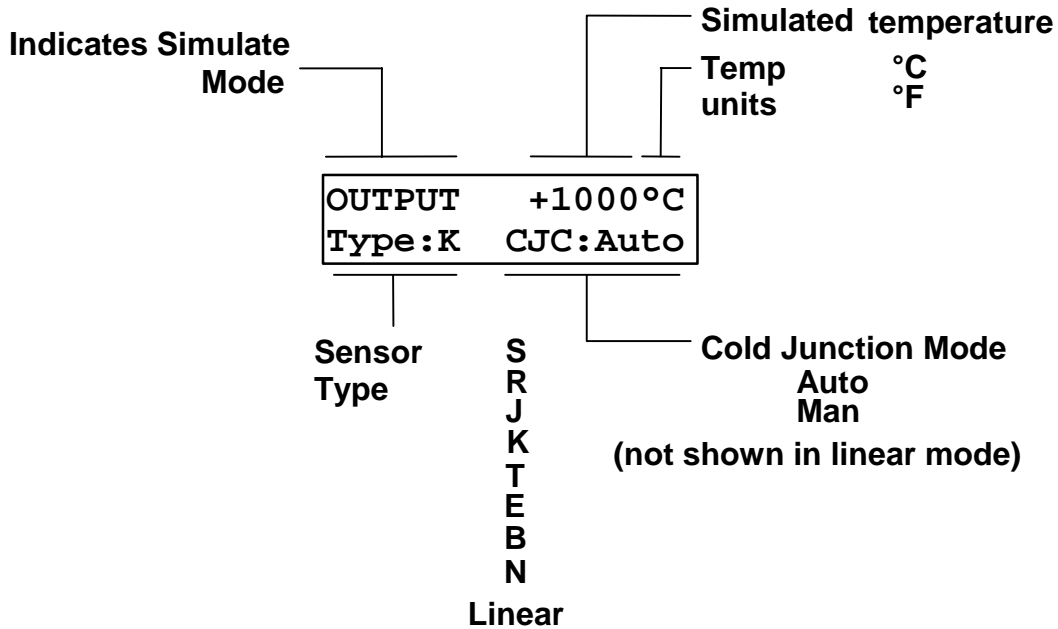
3.1.2 Manual temperature simulation.

In simulation mode the required temperature is simply entered on the keypad and, if valid, will appear at the output terminals upon depression of the ENT key. If the entered temperature is outside the valid range for the sensor selected then an error screen will appear:-

```
┌──────────────────┐
│OUTPUT     Error │
│* OUT OF RANGE * │
└──────────────────┘
```

This error is quickly cleared by simply pressing CLR or re-entering a valid temperature:-

```
┌──────────────────┐
│OUTPUT     Error │
│* OUT OF RANGE * │
└──────────────────┘
        ┌─────┐   ┌──────────────────┐
        │ CLR │   │OUTPUT         ? │
        │ ←   │   │* OUT OF RANGE * │
        └─────┘   └──────────────────┘
```
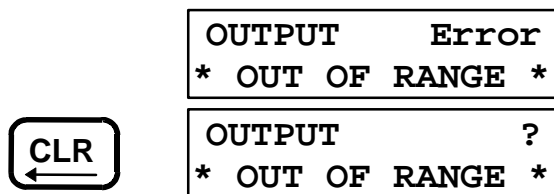
To enter a temperature for simulation. For example 1000 °C:-

```
┌────┐ ┌────┐ ┌────┐ ┌────┐ ┌─────┐ ┌──────────────────┐
│ s1 │ │ L0 │ │ L0 │ │ L0 │ │ ENT │ │OUTPUT  +1000°C  │
└────┘ └────┘ └────┘ └────┘ │  →  │ │Type:K  CJC:Auto │
                             └─────┘ └──────────────────┘
```

Negative temperatures are also easily entered:-

```
┌──────┐ ┌────┐ ┌────┐ ┌────┐ ┌─────┐ ┌──────────────────┐
│ +/-  │ │ R2 │ │ L0 │ │ L0 │ │ ENT │ │OUTPUT   -200°C  │
└──────┘ └────┘ └────┘ └────┘ │  →  │ │Type:K  CJC:Auto │
                               └─────┘ └──────────────────┘
```

3.2   Learn Mode.

The LEARN mode is used to program the simulator to produce a series of temperatures. This is useful if, for instance the user wishes to check the calibration of several instruments at various positions in their range. In this case the user could use learn mode to teach the simulator the required list of temperatures. Then using the RECALL mode each instrument could be checked very quickly and easily by recalling each test temperature with a single keystroke. Alternatively the time base facility could be used to automatically step through the sequence of temperatures without user intervention.

3.2.1 Programming a series of temperatures.

In order to teach the simulator a series of temperatures, The EZECAL must be in SIMULATE MODE (see section 3.0). LEARN mode is activated simply by pressing the LRN keypad.
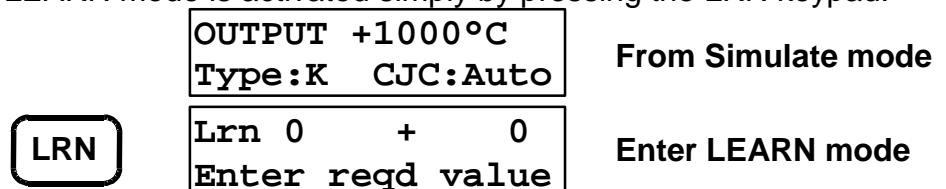
```
OUTPUT +1000°C
Type:K   CJC:Auto
```
From Simulate mode

LRN

```
Lrn 0     +      0
Enter reqd value
```
Enter LEARN mode

The LEARN mode display.

Step number 0-9 ─────┐

Indicates LEARN mode ─────┐

Value programmed For current step ─────┐

```
Lrn 0      +1234
Enter reqd value
```
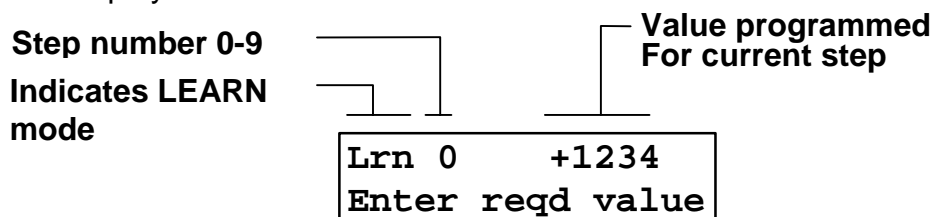
Learn mode can store up to 10 step values. Each step is assigned a number 0 to 9 and this is shown on the display at all times.
To teach the EZECAL a new step value the SCROLL key should be used to select the required step number:-

```
OUTPUT    +1234
Enter reqd value
```

▶ . . . ▶ **Until**

```
Lrn 6     +    0
Enter reqd value
```
Select step required

_E6 _L0 _L0

```
Lrn 6      + 600?
Enter reqd value
```
Enter step value

ENT

```
Lrn 6      + 600
Enter reqd value
```
Use ENT to store value
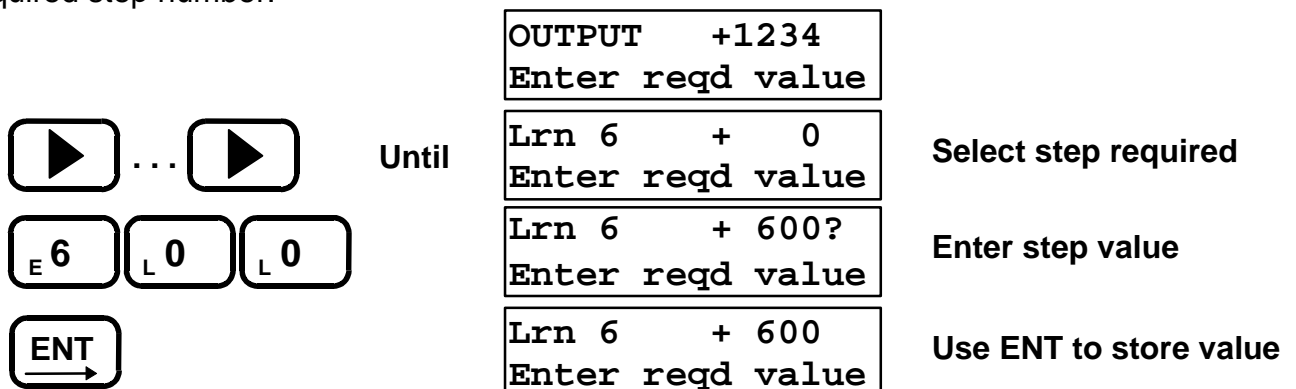
The step values shown in learn mode are unit less and could be °C, °F or millivolts. This allows the user the flexibility of recalling the programmed steps with any sensor type or temperature units required.

To exit from learn mode:-

```
Lrn 6      + 600
Enter reqd value
```
In LEARN mode

LRN
```
OUTPUT +1000°C
Type:K  CJC:Auto
```
Press LRN again to exit
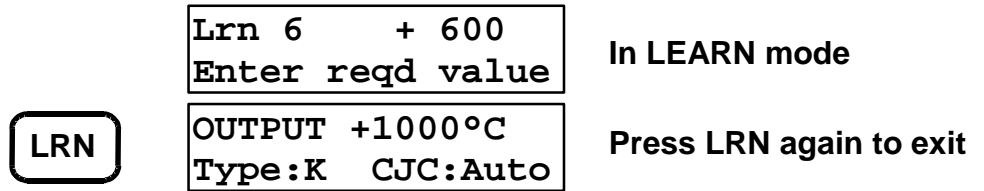
3.3 Recall mode.

Recall mode is used to recall one or more preset temperatures previously stored in the learn mode. These temperatures may be recalled manually or in sequence using the time base facility. The EZECAL can also be set to ramp between the preset temperatures if required. To enter RECALL mode:-

```
OUTPUT     +1000°C
Type:K   CJC:Auto
```

RCL
```
Timebase     Off
Enable using +/-
```
First activate the time base if required

+/-
```
Timebase     0.2m
Enter value reqd
```
Timebase activated

E 6 **L 0** **L 0** **ENT →**
```
Timebase     60.0m
Enter value reqd
```
Enter timebase value up to 999.9 mins

▶
```
Rcl 0 t   +100°C
Type: K CJC:Auto
```
Press scroll to enter recall mode
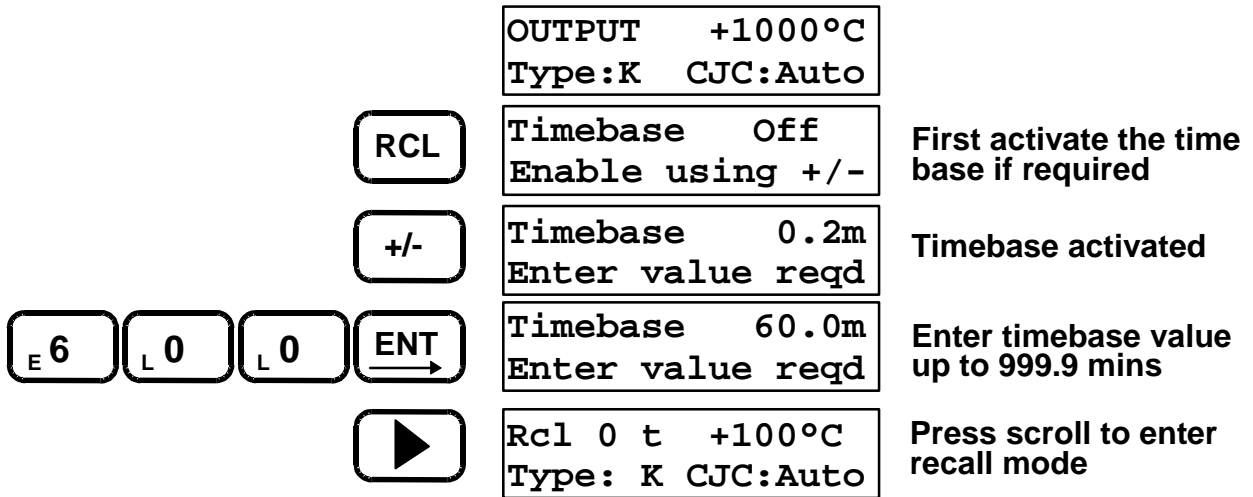
Recall mode display indications.

t indicates time base is active

Current step number
Indicates RECALL mode

Simulated temperature

Temp units **°C**
°F

```
RCL 0 t   +100 °C
Type:K   CJC:Auto
```

Sensor Type **S**
R
J
K
T
E
B
N
Linear

Cold Junction mode
Auto
Man
(Not shown in linear mode)
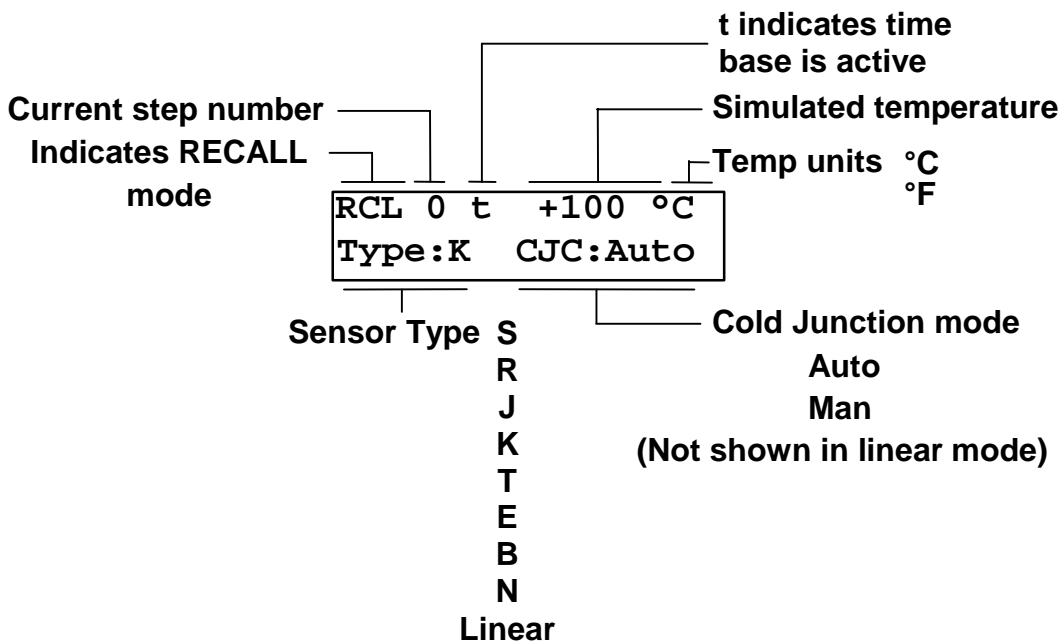
In recall mode it is not possible to manually enter temperatures.

3.3.1 Recalling a series of temperatures.

When first entering recall mode initially the recalled step number will be zero, however any of the 10 available steps can be recalled simply by pressing the relevant numeric key.

```
Rcl 0  + 100°C
Type:K  CJC:Auto
```
Initially step 0 is invoked

```
 E 6
```
```
Rcl 6  + 600°C
Type:K  CJC:Auto
```
Step 6 called up directly

```
 9
```
```
Rcl 9  + 900°C
Type:K  CJC:Auto
```
or step 9

If the programmed values were intended to be used as a sequence, then the user may manually step through this sequence by use of the ENT key (forwards) and the CLR key (backwards).

```
Rcl 0  + 100°C
Type:K  CJC:Auto
```

```
ENT →
```
```
Rcl 1  + 200°C
Type:K  CJC:Auto
```
Steps forwards

```
CLR ←
```
```
Rcl 0  + 100°C
Type:K  CJC:Auto
```
or backwards

If the time base facility was enabled and a non zero time was entered then the EZECAL will automatically step through the sequence, one step every time base period. When the step number reaches 9 or a step value is found to be zero the step number will wrap around to step zero again. The steps may still be recalled manually as in the above two examples. In this case the time base will be restarted after every manual step.
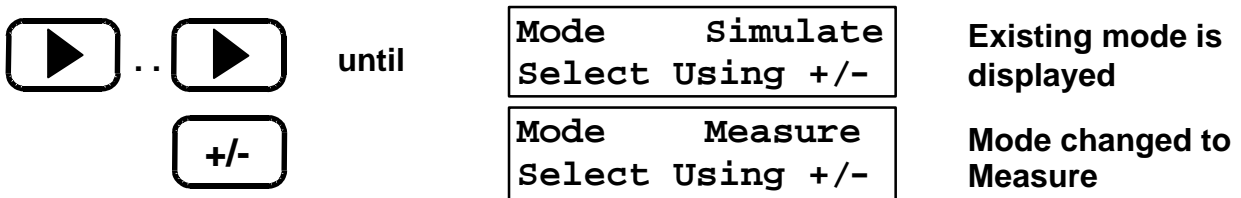
If a long time base period is used it may be useful to know how much time is left until the next step. This can be displayed if the +/- key is pressed and will appear on the bottom display line as long as the key is held down.

```
Rcl 0 t +100°C
Type:K  CJC:Auto
```

```
+/-
```
```
Rcl 1 t +100°C
Next step   2.0m
```
Time to next step shown
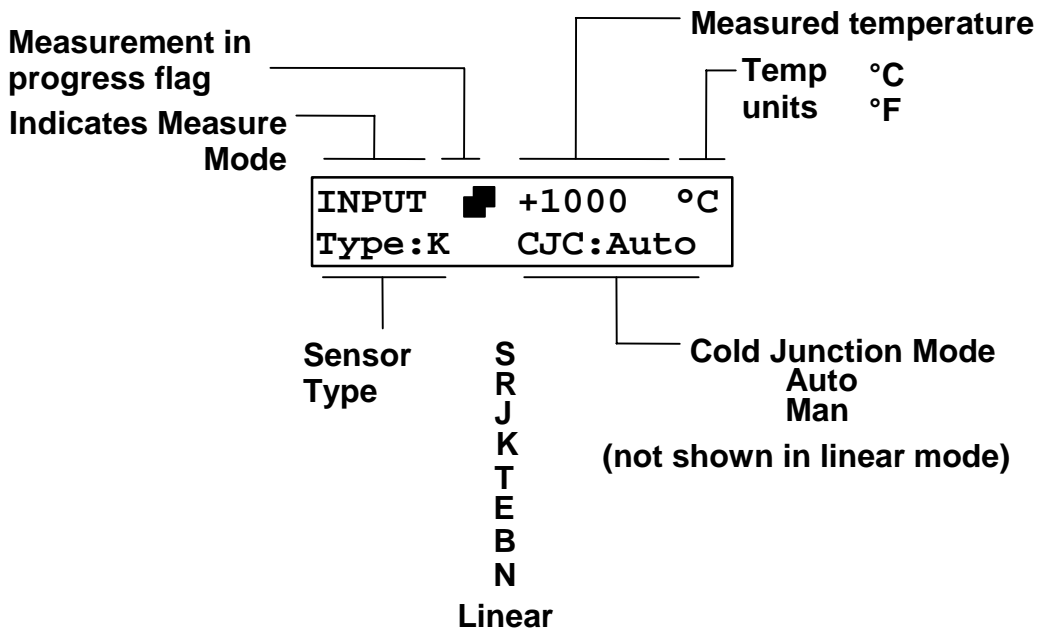
4.0 Measure Mode.

Measure mode is used to measure the e.m.f. signals from the set type of thermocouple. The actual temperature is shown on the correctly compensated dependant upon the compensation mode set (see section 2.3).

To set the EZECAL to MEASURE MODE:-

▶ .. ▶ **until**

+/-

```
Mode      Simulate
Select Using +/-
```
Existing mode is displayed

```
Mode       Measure
Select Using +/-
```
Mode changed to Measure

4.1 Measure mode display indications.

Measure mode is recognised by the word "INPUT" appearing on the top line of the display. The current sensor type cold junction compensation mode is also displayed along with any error conditions that may arise.

Measurement in progress flag

Measured temperature

Indicates Measure Mode

Temp units °C °F

```
INPUT  ▟  +1000   °C
Type:K    CJC:Auto
```

Sensor Type

S
R
J
K
T
E
B
N
Linear

Cold Junction Mode
  Auto
  Man

(not shown in linear mode)

If the measured temperature is outside the valid range for the type of sensor selected the display will indicate a range error.

```
INPUT  ▟   Error
* OUT OF RANGE *
```
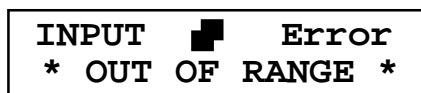
If the cold junction temperature is outside the allowed limits the display will indicate a cold junction error.

```
INPUT  ▟   Error
*CJ RANGE ERROR *
```

4.2 Log Mode.

Log mode may be used by the user to log or monitor a thermocouple over a period of time. The EZECAL will store up to 50 temperatures whilst logging. If the unit is left for a long time such that more than 50 readings are taken, then the last 50 will be remembered. T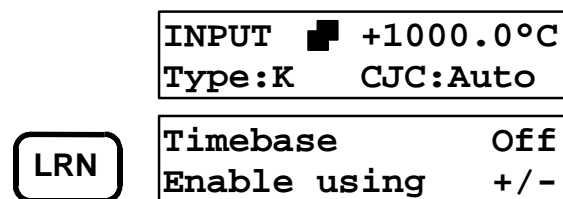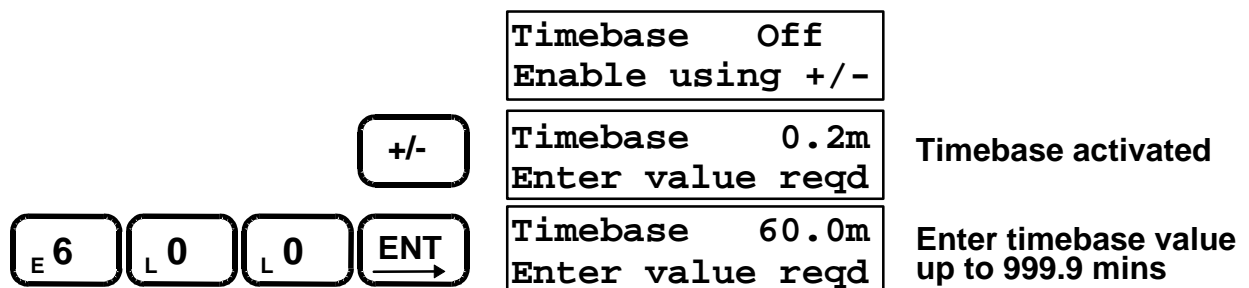he logged values may be replayed at a later stage (speeded up or slowed down) into a chart recorder or any desired instrument. Whilst logging the EZECAL will keep a separate note of the maximum and minimum temperatures encountered along with the average temperature and the period of any oscillation encountered.

Log mode may only be invoked from measure mode by pressing the LRN key:-

```
INPUT  ◪  +1000.0°C
Type:K    CJC:Auto
```

```
┌─────┐   ┌──────────────────────┐
│ LRN │   │Timebase          Off │
└─────┘   │Enable using      +/- │
          └──────────────────────┘
```

4.2.1 Setting the log timebase.

As log mode is invoked the log timebase is displayed. This is the desired time interval between each log. For log mode, the time base must be enabled and have a value set between 0.1 and 999.9 minutes.

```
Timebase    Off
Enable using +/-
```

```
┌──────┐   ┌──────────────────┐
│ +/-  │   │Timebase     0.2m │   **Timebase activated**
└──────┘   │Enter value reqd  │
           └──────────────────┘
```

```
┌─────┐┌─────┐┌─────┐┌─────┐   ┌──────────────────┐
│ E 6 ││ L 0 ││ L 0 ││ ENT→│   │Timebase    60.0m │   **Enter timebase value**
└─────┘└─────┘└─────┘└─────┘   │Enter value reqd  │   **up to 999.9 mins**
                               └──────────────────┘
```

4.2.2 Starting and stopping the log.

The log is started simply by pressing the scroll key, and will continue logging until manually stopped.

```
Timebase     60.0m
 Enter value reqd
```

```
┌──────┐   ┌──────────────────┐
│  ▶   │   │Log 01 ◪   +100°C │   **Press scroll to start**
└──────┘   │Type:K    CJC:Auto│   **logging**
           └──────────────────┘
```
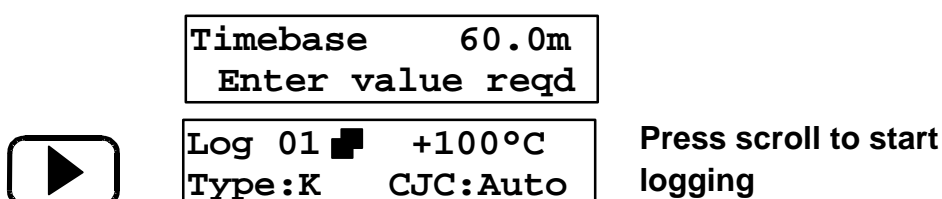
The following screen will be displayed throughout the log:-
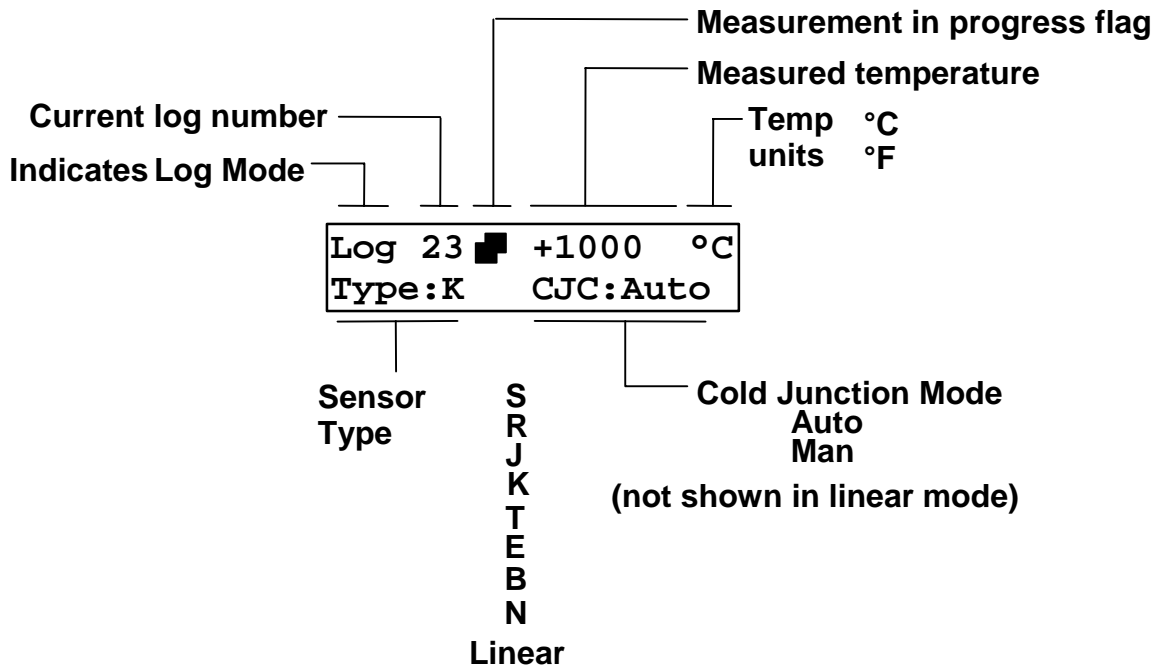
Measurement in progress flag

Measured temperature

Current log number

Indicates Log Mode

Temp **°C**
units **°F**

```
Log 23 ◼ +1000   °C
Type:K   CJC:Auto
```

Sensor
Type

S
R
J
K
T
E
B
N
Linear

Cold Junction Mode
       Auto
       Man
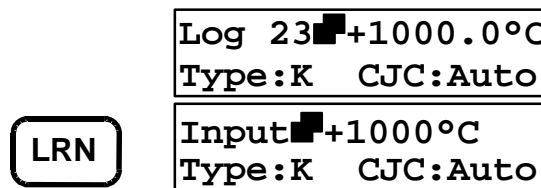**(not shown in linear mode)**

At any time during the log the time remaining to the next log may be displayed by pressing the +/- key.
This display will remain for as long as the +/- key is held down.

```
Log 23◼+1000°C
Type:K  CJC:Auto
```

+/-

```
Log 23◼+1000°C
Next log     3.5m
```
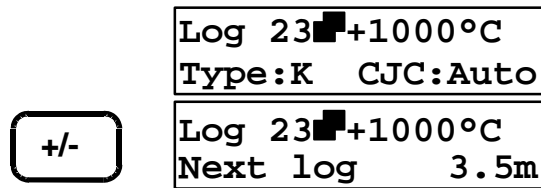
To stop the log and exit log modes simply press the LRN key:-

```
Log 23◼+1000.0°C
Type:K   CJC:Auto
```

LRN

```
Input◼+1000°C
Type:K   CJC:Auto
```

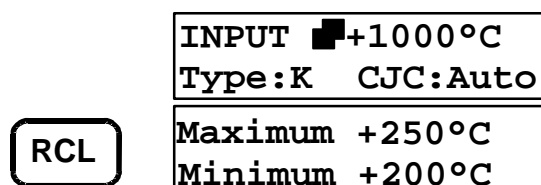The log values stored may now be examined or replayed in REPLAY mode (see following section).

4.3 Replay Mode.

Replay mode is used to examine and replay the logged values obtained in log mode. Associated data such as maximum and minimum, average and period can also be examined in this mode.
To invoke REPLAY mode:-

```
INPUT ◼+1000°C
Type:K   CJC:Auto
```

RCL

```
Maximum +250°C
Minimum +200°C
```

4.3.1 Maximum and minimum logged values.

Whilst logging was in progress the EZECAL kept a record of the maximum and minimum of the logged values. These values are shown as the first display in replay mode.

```
Maximum +250°C
Minimum +200°C
```

If there were no logged values and hence no maximum or minimum then an error message will be displayed.

```
Maximum      None
Minimum      None
```

4.3.2 Average and oscillation period of logged values.

The average and period values are displayed immediately after the maximum and minimum values by pressing the SCROLL key.

```
Maximum    +250°C
Maximum    +250°C
```
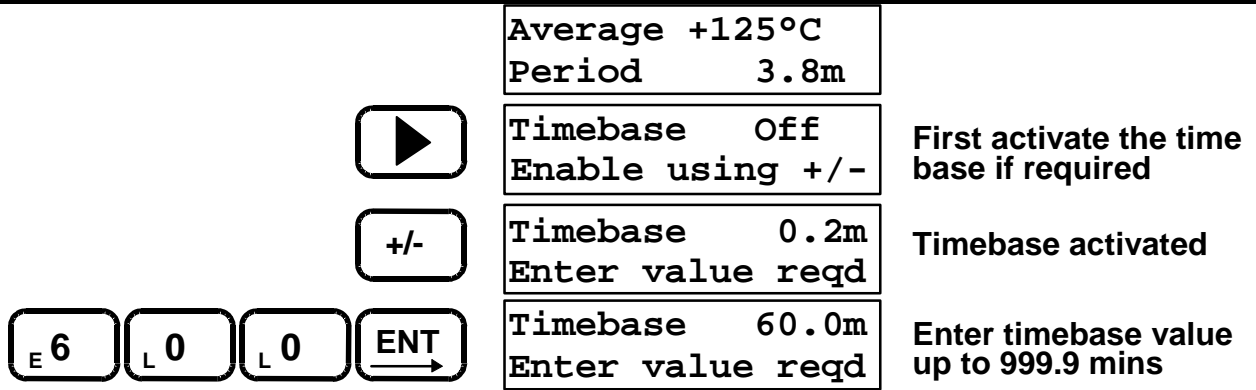
▶

```
Average    +225°C
Period      3.8m
```

The displayed average is the average of all of the logged values taken.
The oscillation period is the time between the last 2 successive peaks during the logging period, provided at least 2 peaks were detected. If no peaks were detected during the log then the period value is displayed as "none".

```
Average +125°C
Period     None
```

4.3.3 Setting the replay time base.

The logged values may be replayed at any speed regardless of the time base used at the time they were recorded. This enables the values to be replayed rapidly into a chart recorder for instance. The replay time base can be either "off" (manual replay) or a value between 0.1 and 999.9 minutes, and is set exactly as the log and recall time bases.

```
Average +125°C
Period     3.8m
```

▶

```
Timebase    Off
Enable using +/-
```

First activate the time base if required

+/-

```
Timebase   0.2m
Enter value reqd
```

Timebase activated

E6   L0   L0   ENT

```
Timebase   60.0m
Enter value reqd
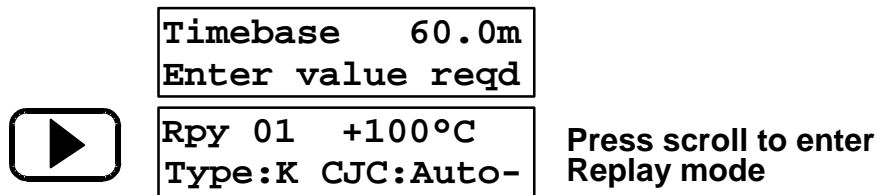```

**Enter timebase value up to 999.9 mins**
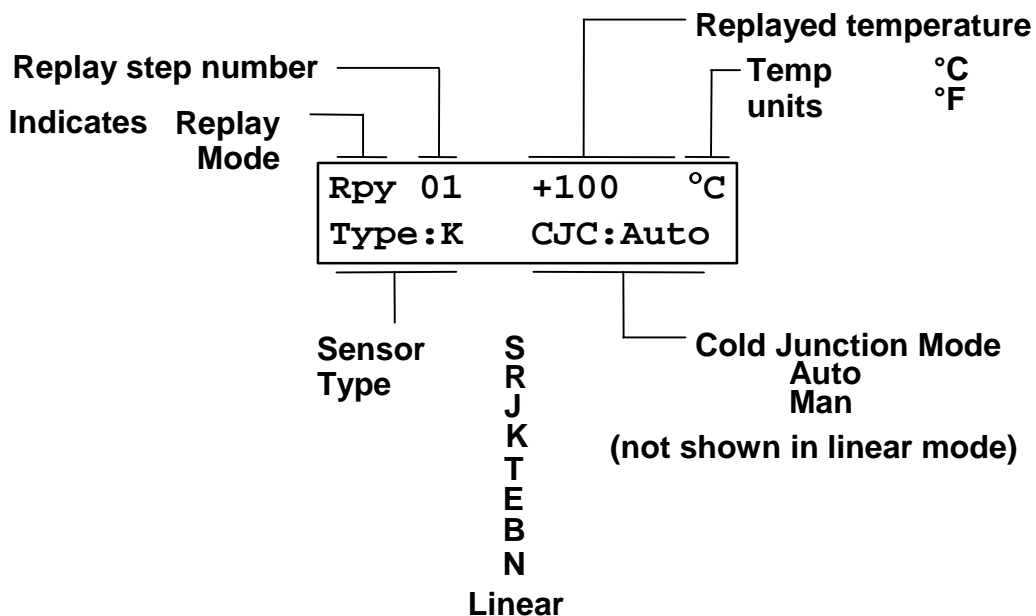
### 4.3.4  Replaying the logged values.

The values recorded during the log may be replayed in sequence using the time base, or may be manually replayed by means of the keypad. In either case the values must be replayed in the same sensor type and temperature units in which they were logged. The EZECAL will force the sensor type and units automatically.
As each value is replayed, the EZECAL will simulate the replayed temperature and this emf will appear (with relevant compensation) on the output terminals.
To start the replay:-

```
Timebase   60.0m
Enter value reqd
```

▶

```
Rpy 01   +100°C
Type:K CJC:Auto-
```

Press scroll to enter Replay mode

Display indications during REPLAY mode.

Replayed temperature

Replay step number

Temp units   °C
°F

Indicates   Replay Mode

```
Rpy 01    +100   °C
Type:K    CJC:Auto
```

Sensor Type

S
R
J
K
T
E
B
N
Linear

Cold Junction Mode
Auto
Man

**(not shown in linear mode)**

When first entering replay mode initially the replayed step number will be one, the user may manually step through the values by use of the ENT key (forwards) and the CLR key (backwards).
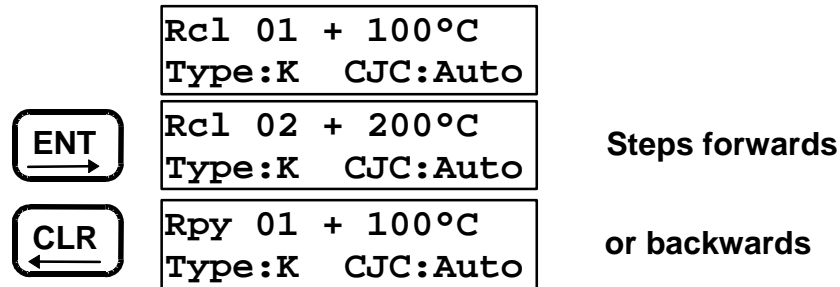
```
Rcl 01 + 100°C
Type:K  CJC:Auto
```

ENT
```
Rcl 02 + 200°C
Type:K  CJC:Auto
```
Steps forwards

CLR
```
Rpy 01 + 100°C
Type:K  CJC:Auto
```
**or backwards**

If the time base facility was enabled and a non zero time was entered then the EZECAL will automatically step through the logged values, one step every time base. When the step number reaches 50 or the number of logged values, the step number will wrap around to step one again. The steps may still be recalled manually as in the above example. In this case the time base will be restarted after every manual step.

If a long time base period is used it may be useful to know how much time is left until the next step. This can be displayed if the +/- key is pressed and will appear on the bottom display line as long as the key is held down.

```
Rpy 04 + 100°C
Type:K  CJC:Auto
```

+/-
```
Rpy 24 + 100°C
Next step    2.0m
```
Time to next step shown
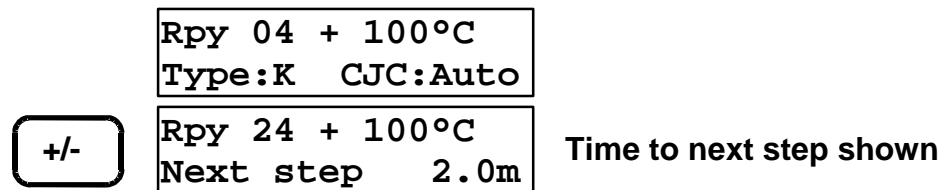
To terminate the replay at any time and return to measure mode simply press the RCL key again:-

```
Rpy 24 + 100°C
Type:K  CJC:Auto
```

RCL
```
INPUT �█ +123°C
Type:K  CJC:Auto
```
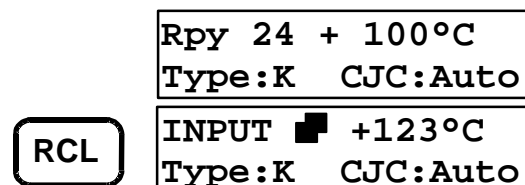
5. Specifications.

5.1 Physical.

Size uncased	: 200 x 100 x 45mm
Weight	: 450g
Power source	: 4 x AA NiCd rechargeable batteries
Battery life	: approx. 20 hours continuous use
Ambient temp	: -10 to +40 °C
Humidity	: 0 to 95%RH non condensing
Case material	: Black A.B.S

5.2 Electrical.

Simulation and Measuring.

Basic resolution	: 5µV 1 in 40000
Basic linear accuracy	: better than 0.05% of span
	(at ref. conditions 20 °C, 50% RH)

Setting resolution

Thermocouple ranges	: 0.1 °C or 0.1 °F
Linear range	: 10µV

Input noise rejection	: better than 70dB
Sampling frequency	: 20 samples per second
Display update time	: 0.8 seconds

Cold junction.

Accuracy	: +/- 0.25 °C
Resolution	: 0.1 °C or °F
Range (auto mode)	: -10.0 to +40.0 °C
(manual mode)	: -10.0 to +55.0 °C
CJ rejection	: Better than 20:1

Ranges to BS4937

Type S	-50 to 1767 °C
Type R	-50 to 1767 °C
Type J	-210 to 1200 °C
Type K	-270 to 1372 °C
Type T	-270 to 400 °C
Type E	-270 to 1000 °C
Type B	-0 to 1820 °C
Type N	-270 to 1300 °C

and equivalents in °F

Linear	-99.99 to + 99.99 mV

Output impedance	: Less than 0.1 Ohms
Max. output current	: +/- 1 milliamp
Warm up time	: Less than 1 minute
Output settle time	: 2 seconds to 99%

Battery low detection	: 4.5 Volts
Recharge time	: approx. 16 hours from low bat using approved charger
Power consumption	: 100mW max.

5.3 Conformity Table.

TYPE	RANGE	MAX ERROR(°C)
S	-50 to 0	1.1
	0 to 1767	1.2
R	-50 to -20	1.8
	-20 to 0	0.2
	0 to 1767	1.2
J	-210 to -150	0.15
	-150 to 0	0.12
	0 to 50	0.29
	50 to 1200	0.24
K	-270 to -220	2.0
	-220 to 0	0.21
	0 to 1372	0.32
T	-270 to -110	7.6
	-110 to 400	0.16
E	-270 to -170	2.0
	-170 to 0	0.12
	0 to 200	0.44
	200 to 1000	0.21
B	50 to 250	7.0
	250 to 750	1.5
	750 to 1820	0.64
N	-270 to -230	3.0
	-230 to 0	0.4
	0 to 1300	0.42

The above table shows the worse case error (due to the internal lineariser) which may be expected on the given thermocouple over the specified temperature range. The absolute error on any given range is this error plus the error due the basic linear accuracy of +/- 0.05%.