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# **Thermocouple Calibrator Type DP6**

## Operating Instructions

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**Limited Warranty & Limitation of Liability**

CROPICO guarantees this product for a period of 1 year. The period of warranty will be effective at the day of delivery.

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## Disposal of Old Product



This product has been designed and manufactured with high quality materials and components that can be recycled and reused.

When the crossed out wheeled bin symbol is attached to a product it means the product is covered by the European Directive 2002/96/EC.

Please familiarise yourself with the appropriate local separate collection system for electrical and electronic products.

Please dispose of this product according to local regulations. Do not dispose of this product along with normal waste material. The correct disposal of this product will help prevent potential negative consequences for the environment and human health.

### **User Note:**

These Operating Instructions are intended for the use of Competent Personnel.

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## GENERAL

The DP6 is delivered complete with battery charger and comes fully charged ready for use. Before operating, read these instructions carefully. They will guide you through the operation and help you to get the best possible results.

After unpacking, inspect for physical damage and immediately report any defects in writing, retaining packaging materials for inspection.

The DP6 is a highly accurate portable calibrator designed for the measurement of the outputs from thermocouples and all mV transducers as well as the simulation of thermocouples and mV signals.

The right hand two-line alphanumeric display shows the instrument status and programming options. The left hand display is a 4-½ digit LCD which indicates the measured or sourced value. The sealed switch membrane which forms the front panel, incorporates all the function keys necessary for configuration.

The plug top charger supplied with the instrument is a two-stage charger and can therefore be used for bulk and float charging. Safety circuits built into the DP6 ensure that the lead acid battery cannot be discharged below a pre-set value. This ensures that the maximum battery life will be achieved.



**WARNING:** Before starting any maintenance, repair or exchange of parts, the instrument should be disconnected from the charger and any mains power source.

## BATTERY CHARGING

The DP6 has a built-in sealed lead-acid battery which is fully charged when delivered. This type of battery has advantages over other types of rechargeable batteries; it is more tolerant of erratic charging cycles thus giving better service life.

When the battery reaches a low charge state "**LO BATT**" appears in the top left hand corner of the value display, indicating that approximately one hour's further continuous use is possible. Before the battery reaches a deep discharge state which could be detrimental to its long-term performance, a protection circuit is automatically activated, shutting down the DP6. The displays will blank and no further operation will be possible until the charger is plugged in and charging current provided.

The charger supplied with the DP6 is of a plug-top style and models are available for most countries. It is a two-stage charger providing bulk charge for fully discharged batteries, automatically switching to trickle charge state to maintain the battery at full charge level. The DP6 may be used with the charger permanently connected.



**WARNING** The charger is a non-serviceable part and should not be opened except by a competent, authorised technician. We again emphasise that under no circumstances should any repair work be attempted until the unit is fully disconnected from any mains supply.

**CASE DESIGN**

The DP6 is housed in a high impact plastic case with a sealed switch membrane for the front panel. The rear of the instrument incorporates two low thermal emf copper terminals for connection; a five-pin DIN socket for the RS232 connection, and a 2.5 mm. power inlet socket for the battery charger. The case is held together by 4 screws located beneath the rubber feet.

**MAINTENANCE**

Normally no maintenance is required other than recharging the battery. Use only the charger provided, or one approved by **CROPICO**. To clean the DP6, wipe it carefully with a moist cloth and avoid aggressive detergents or solvents.

Servicing and calibration must only be performed by expert trained staff. Always ensure that repairs will not alter any of the design characteristics to the detriment of safety and performance. Spare parts to be installed must correspond to the original parts and be properly fitted to the factory state.

**TECHNICAL SPECIFICATION**

Limits of error apply for 1 year at 20 degrees centigrade ± 1 deg. C

RANGE	MAX. DISPLAY	UNCERTAINTY	RESOLUTION
10mV	±15.000 millivolts	±0.02% of reading ±0.015% FS)	1µV
100mV	±150.00 millivolts	±0.01% of reading ±0.01% FS )	10µV
1V	±1.5000 Volts	±0.01% of reading ±0.01% FS )	100µV

Temperature coefficient : typically 17 ppm/Deg C +0.2µV/Deg.C

REFERENCE JUNCTION: Referenced to 0 Deg. C and with three operating modes. Automatic with internal sensor, Off (= to 0 Degrees C), and Manual entry via keyboard). UNCERTAINTY:

Better than ±0.1 Deg. C at +20 Deg. C

DEVIATION: 0.01 Deg.C/Deg.C over the range 0 to +50 Deg.C

MANUAL INPUT RANGE: The reference junction reference value may also be set via the keyboard over the range 0 ...+100 Deg. C.

**GENERAL**

Digital Displays:	1. 4½ Digit high contrast LCD 10.2 mm. Display range 19999 digits, automatic decimal point & polarity. 2. Two line alphanumeric LCD for programming and display of configuration.
Working Temperature:	0 ... +40 Deg. C rel. humidity 80% max. non-condensing. Nominal Temperature: -20 ... +50 Deg. C
Battery Type:	6 Volt 1.2 Ah sealed lead acid, replaceable
Operating Time:	15 hours typical continuous use.
Charger Type:	External charger operating from mains supply.
Terminals:	Two 4 mm. low thermal emf copper terminals for measurement and injection.
Case:	Shockproof thermoplastic with polycarbonate sealed membrane keyboard
Size:	150 x 130 x 60 mm. approx.
Mass:	1.4 kg. approx.



**USE AND APPLICATIONS**

The DP6 is an accurate and portable thermocouple simulator/calibrator which will both measure and inject millivolts and includes the provision for linearising the output for 10 different thermocouple types. The values may be displayed in °C, F, °K, mV or V with the correct units and decimal point. The readings are displayed on a 4½ digit LC display, with the set-up status and programming information displayed on a separate two line alphanumeric LC display.

Full cold junction compensation is incorporated with the flexibility of switching on or off or entering a numerical value. The DP6 provides for variable rate ramping via the up/down keypad of the simulated values, or set values may be entered directly from the keyboard. A memory function enables the storage and recall of 10 different set-up configurations for each thermocouple type and mV range (a total of 130 memories), and full digital calibration ensures that the very best performance is maintained.

CODE	THERMOCOUPLE TYPE		RANGE	UNCERTAINTY	RESOLUTION
	MATERIAL	STANDARD	Degrees C	Measure & Source	All Ranges
B	PtRh30- PtRh6	BS4937 DIN IEC 584	+500 to +1820 +200 to +500 +60 to +200	±0.5 Deg. C ±1.5 Deg. C ±6.0 Deg. C	
E	NiCr-CuNi	BS4937 DIN IEC 584	-200 to +1000 -250 to -200 -270 to -250	±0.2 Deg. C ±0.6 Deg. C ±6.0 Deg. C	
J	Fe-CuNi	BS4937 DIN IEC 584	+800 to +1200 +200 to +800 0 to +200 -210 to 0	±0.3 Deg. C ±0.2 Deg. C ±0.1 Deg. C ±0.3 Deg. C	
K	NiCr-NiAl	BS4937 DIN IEC 584	+1000 to +1370 +100 to +1000 -50 to +100 -150 to -50 -225 to -150 -270 to -225	±0.4 Deg. C ±0.3 Deg. C ±0.1 Deg. C ±0.2 Deg. C ±0.5 Deg. C ±3.0 Deg. C	0.1 Degree C
L	Fe-CuNi	DIN 43710	+300 to +900 -100 to +300 -200 to -100	±0.2 Deg. C ±0.1 Deg. C ±0.15 Deg. C	0.1 Degree K
N	NiCrSi-NiSi	ASTM E230	+1100 to +1300 +400 to +1100 +150 to +400 0 to +150	±0.4 Deg. C ±0.3 Deg. C ±0.15 Deg. C ±0.1 Deg. C	1.0 Degree F
R	PtRh13-Pt	BS4937 DIN IEC 584	+1200 to +1760 +100 to +1200 0 to +100 -50 to 0	±0.8 Deg. C ±0.4 Deg. C ±0.5 Deg. C ±0.8 Deg. C	
S	PtRh10-Pt	BS4937 DIN IEC 584	+1400 to +1760 +1200 to +1400 +50 to +1200 -50 to +50	±0.95 Deg. C ±0.5 Deg. C ±0.4 Deg. C ±0.6 Deg. C	
T	Cu-CuNi	BS4937 DIN IEC 584	-100 to +400 -230 to -100 -250 to -230 -270 to -250	±0.2 Deg. C ±0.5 Deg. C ±1.0 Deg. C ±2.5 Deg. C	
U	Cu-CuNi	DIN 43710	+300 to +400 0 to +300 -150 to 0 -200 to -150	±0.2 Deg. C ±0.1 Deg. C ±0.15 Deg. C ±0.2 Deg. C	

## DESCRIPTION OF CONTROLS



- |   |                  |
|---|------------------|
| 1. Value Display                                      | 4. Function Keys |
| 2. Configure display                                  | 5. ON/OFF Keys   |
| 3. Increment/Deferment<br>Keys & Keyboard Value entry |                  |

## RIGHT HAND CONFIGURATION DISPLAY

### FUNCTION KEYS

The right-hand function keys are used to change the status and configuration of the DP6.

When the instrument is switched on the configuration last used is restored and displayed.

To change the existing configuration, press **SEL** the first changeable parameter will flash. To change this flashing parameter press **CHG** the display will then show a second menu giving the next selection alternatives to choose from. To select one of these options, press the button below the function required  $\square$  the symbol guides you down to the correct key. Once the choice has been made and entered, the display will return to the initial format and the next parameter to be changed will flash. Follow the same procedure to change this parameter (press **CHG** and select next option from the new menu). Each time the **SEL** button is pressed, the cursor moves on to the next changeable parameter, scrolling right throughout the selection. After you have made the final parameter selection, press **SEL** to remove the flashing cursor and return to the fixed display which will now show the chosen set-up.

**The following may be changed :**

1. The units °F °C °K mV V
2. Source or Sense
3. Thermocouple Type or Voltage
4. Cold Junction - automatic/manual/off

**RIGHT HAND MENU DISPLAY**

°C	Source	K - 90
CJ=+000.0°C		OFF

To change the current configuration, press the **SEL** (Select) Key. The first changeable parameter will flash. To change this, press the **CHG** (Change) key and another menu will appear.

If you do not wish to change the flashing parameter, press **SEL** again and the next variable will flash. Repeated pressing of the **SEL** key will scroll through the possible changeable characters.

Once the **CHG** key is pressed and the second menu appears, a number of choices will be possible. The options will be directly above the white arrows. Choose the option you require and follow the arrow down, pressing the key directly below it. In some cases, a third option menu will appear giving more choice of configuration.

**EXAMPLE:**

To configure the DP6 in SOURCE mode for a type K thermocouple with cold junction OFF, proceed as follows:

mV	Measure	DCV
----	---------	-----

Press **SEL** - measure/source flashes

Press **CHG** - second menu appears

	Make Choice	
Meas		Source

Press the key below SOURCE (**KYB**) DP6 switches to source mode and next changeable parameter (thermocouple type/DCV) flashes

mV	Source	DCV
----	--------	-----

Press **CHG** - next menu appears

	Make Choice	
T/C		DCV

Press key below T/C (**SEL**) thermocouple choice menu appears

B	E	J	K	L	N	R	S
T	U	<<	>>				OK

Select thermocouple type with flashing cursor using the keys below « » symbols. Once the cursor is placed on the required thermocouple type, press OK key.

°C	Source	K
CJ=+000.0°C		OFF

The next screen shows the selected configuration with the cold junction configuration OFF flashing. Press SEL to remove flashing cursor.

The DP6 is now configured to SOURCE Deg. C for a type K thermocouple with a cold junction switched OFF.

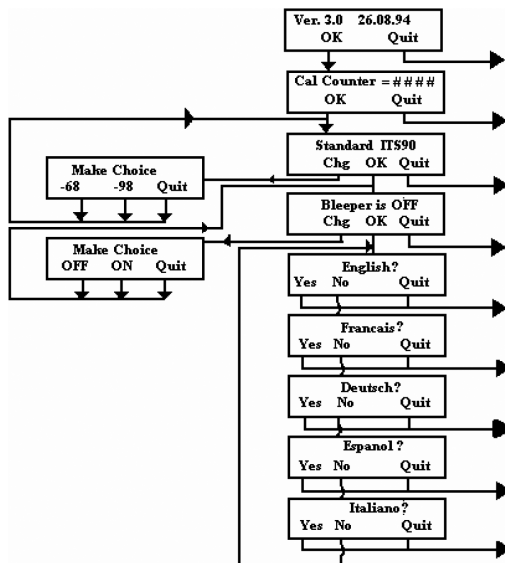
Follow the above principle to change any parameters. Press **SEL** to highlight the function you wish to change. Press **CHG** to change that variable.

**OPTION MENUS**

The DP6 has many advanced features making it extremely versatile, for example, you can switch between IPTS68 and ITS90 calibration. The language used for displaying the set-up configuration can be selected. English, French, German, Italian and Spanish are available.

To give an audible feedback when the keys are pressed a beeper is used. This may be turned on or off from the option menu.

To select the option menu press the key marked **MEM**. From the menu select **OPT** by pressing the key directly below it marked **CHG**. The display will then indicate the software version installed. The **OK** key brings up the calibration counter number. Press **OK** again and the Calibration Standard is displayed. This can be changed between IPTS68 and ITS90. With the desired standard selected pressing **OK** brings up the next menu, and the beeper may be switched ON or OFF. Select **OK** again and the language options are offered. Press **QUIT** at any time to return to the main menu.



## APPLICATIONS

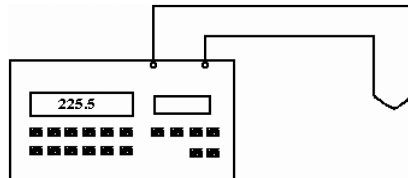
### THERMOCOUPLES

A thermocouple consists of two conductors of dissimilar material which have a common junction at which the conductors are in good thermal and electrical contact. This point of connection is known as the measuring or hot junction. The other ends of the conductors are connected to an instrument which will measure electromotive force and the point of connection is known as the reference or cold junction. If heat is applied to the measuring junction, an emf will be generated which can be measured. The magnitude of this emf is dependent upon the difference in temperature between the measuring and the reference junction. Consequently, when using thermocouples or calibrating thermocouple measuring instruments, it is necessary to determine the temperature of the reference junction and then add or subtract its value to or from the temperature difference according to whether positive or negative temperatures are being measured or simulated. The concept seems very complicated, but when using the DP6 to measure or simulate temperature, all the above is automatically taken into account and the user can proceed with confidence.

### MEASUREMENT OF TEMPERATURE

The DP6 is an accurate and versatile instrument for the measuring of temperature using thermocouples as the sensing element.

It can display the temperature in degrees Centigrade, Fahrenheit or absolute Kelvin.



Connect the thermocouple to the terminals at the rear of the DP6 (ensure the correct polarity). The red-based terminal is the positive and all-black terminal is the negative connection. For those thermocouples terminated with a miniature thermocouple plug, an all-copper connection socket is provided as an accessory. This plugs straight into the DP6 terminals and may be used with any thermocouple type.

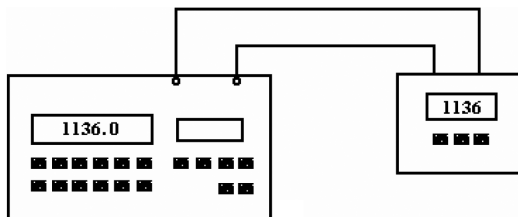
The thermocouple type and measure mode must be now configured using the right hand display, and the value measured will be shown in the left hand display. The resolution will be 0.1 degrees for Centigrade, Kelvin and Fahrenheit. The cold junction compensation is automatic and the temperature displayed is the true temperature at the thermocouple hot end. It should be remembered that whilst the DP6 is an extremely accurate measuring instrument, when assessing the overall accuracy of the measurement the uncertainty of the thermocouple used should be included.

## MEASUREMENT OF MILLIVOLTS AND VOLTS

The DP6 has 3 voltage measuring ranges, 10mV; 100mV and 1V. The resolution on the 10mV range is 1 microvolt, and each range has a full scale value of 15mV, 150mV and 1.5 Volts respectively. Care must be taken when measuring in the lower range to ensure that connections are clean and that no thermal emfs are introduced by the connecting circuits. Settling time should also be allowed between connecting to the DP6 terminals and measurement thus allowing any warming of the terminals and connecting wires to stabilise.

## THERMOCOUPLE SIMULATION

The DP6 is capable of simulating 10 different thermocouple types and is extremely versatile in the manner in which it can be used. The right display is used to configure the thermocouple type; the units and cold junction.



The purpose of simulating thermocouple outputs is to calibrate temperature sensing devices such as indicators, recorders, controllers and data loggers.

The DP6 will simulate temperature in degrees C, F or K. The simulated value can be switched between these units and the displayed value changes to show the same output value scaled in the new units.

The value to be simulated may be selected in three different ways, and will be displayed in the left hand 4½ digit display as follows:

## KEYBOARD ENTRY

In this mode values may be entered calculator-style from the numerical keyboard. Press the key marked KYB and then type the value required. The value will be displayed as entered and is confirmed by pressing the OK key. Should a wrong value be entered pressing the CLE key clears that value. If a value outside the range is entered, then the display will blank eg. ---. Once the value is confirmed the polarity can be switched automatically from + to - and zero can be selected immediately by pressing the key marked ZER.

## RAMPING KEYS

The value may be increased and decreased using UP/DOWN keys directly below each digit. Follow the runway below the digit that requires changing, and press the  $\bar{U}$  key to increase and the  $\bar{D}$  key to decrease the value. In this mode, it is possible to ramp the output value up or down in steps of 0.1 - 1 - 10 - 100 and 1,000 steps with the value flowing to the next digit when 9 or 0 is reached. This makes for a very quick and flexible mode of operation.

## MEMORY RECALL

The third method of value selection is via the memory recall facility. Once the configuration is stored in the memory it may be recalled by pressing MEM and the memory store number, the full configuration stored will be recalled.

## COLD JUNCTION

The cold junction compensation has three possible operating modes as follows:

- a) Fully automatic - in this mode instruments with their own built-in cold junction compensation can be calibrated. In this case, the instrument under test should be connected to the DP6 terminals using thermocouple wire or thermocouple compensating cable. In this configuration any difference in temperature between the test instrument and the DP6 will be compensated for by the emf generated by the difference in temperature between the two end of the connecting wire.

**IMPORTANT** It should be noted that different grades of thermocouple cable and thermocouple compensating wire are available. To achieve the best possible results, cable of the best grade should be used. Please consult your cable supplier to ensure this is achieved.

- b) Cold Junction Off -In this mode the cold junction is set to the equivalent of 0 degrees Centigrade. This mode would be used if, for example, an external cold junction compensation was used, eg. the CROPICO electronic reference junctions type RJ or an ice point reference. In some instances this would achieve a greater accuracy.
  
- c) Numerical Cold Junction Value - This numerical cold junction value can be entered from the DP6 keyboard and would be used in instances where thermocouple instruments were referenced to an external cold junction unit operated at perhaps, 50 degrees C.



## MEMORY

The DP6 has 10 memories for each thermocouple type and mV range, making a total of 130 memories in total. To store a configuration, first set the DP6 to the complete configuration that you wish to store, including measure/source mode, cold junction configuration, units and value if in source mode. Press the **MEM** key followed by the key directly below the **STO**. The right hand display then asks for a number - 0 ... 9 - this is the memory store number. Key in the number that you wish to store the configuration under, using the left hand key pad. To recall a memory configuration press **MEM** and then the key below the **RCL**. Again the display will ask for the memory number that you wish to recall. Key in the number and the DP6 will immediately be reconfigured to that memory store.

## CALIBRATION

The calibration of the DP6 can be simply and easily carried out from the front panel. All the calibration constants are stored digitally and no mechanical adjustments are necessary. It is only necessary to calibrate the Mv and V ranges, the conversion to temperature is carried out by the micro-processor. The equipment required is a precision digital voltmeter with at least 1 microvolt resolution and a dc voltage calibrator with 1 microvolt steps or better and a maximum value of at least 1.5 volts.

To enter the calibration routine press the MEM key, the menu will then give you the choice of selecting the CAL option. Press the CAL key and the option of CAL or PRINT will be given, pressing CAL again takes you into the calibration mode. The display will ask for a passcode to be entered; the factory-set passcode is 9252, but this can be changed by the user. Enter the factory passcode via the numerical keypad. The display will then ask if you require to change the passcode.

**CAUTION:** If the passcode is changed, make a careful note of the new one. However, should you forget, it will be necessary to contact the CROPICO Sales Office or your local service distribution centre who will supply a master code number. If this should be needed, you will be required to have the calibration counter number available. The calibration counter will increase by 1 each time the user enters the correct passcode.

Once the correct code is entered, the option to calibrate the MEASURE, SOURCE or COLD JUNCTION is given. Press the key below the option required and proceed with the calibration as described below.

**MEASURE:** After selecting the calibrate measure mode, connect a dc voltage source to the terminals. The voltage source must have at least 1 microvolt resolution and be capable of generating up to 1.5 volts with uncertainty of at least 5 ppm.

Follow the prompts from the right hand display which will ask you to first inject 0 Volts. With 0 Volts injected, press the CAL key and the display will ask you to WAIT WHILE CALIBRATING. Upon completion of the calibration, the display will require the next value +10mV; follow the same procedure, inject +10mV from the precision source and press CAL. Repeat this procedure for all values requested. On

completion of the measure calibration, you will be given the choice of ending the calibration routine or selecting the next option.

**SOURCE:** To calibrate the source mode, press the SRCE key and with a precision digital voltmeter connected to the DP6 terminals, note the reading on the DVM. The right hand display will indicate the value that the DP6 should be injecting. If the DVM value is within the required tolerance, then press OK. If the value is outside the tolerance, then press CAL. The display will ask you to enter the value as measured on the DVM. Press OK and the DP6 will digitally correct its output and the DVM should now measure the corrected output value. If you are satisfied with this calibration point, then pressing OK moves on to the next calibration point. Repeat this procedure for all the calibration points. After the last calibration the display will return to the main calibration menu. At any time during the calibration procedure it is possible to escape back to the main calibration menu by pressing the QUIT key.

**RJ REFERENCE JUNCTION:** This function is carefully set up during the final factory calibration prior to dispatch and it is not normally recommended that this calibration is readjusted unless the calibration laboratory is capable of sensing and measuring temperature to an absolute uncertainty of better than 0.01 degrees Centigrade.

Should you consider it necessary to calibrate the Reference Junction then proceed as follows. Press the RJ key and the right hand display will indicate the Reference Junction temperature as measured by the internal sensor which is buried in a large copper block mounted directly behind the input terminals. The option is then given to accept this value or enter a new value.

To determine the temperature of the Reference Junction it is necessary to open the DP6 case and insert a calibrated Pt100 sensor in the copper block behind the terminals. The option is then given to accept this value or enter a new value.

To determine the temperature of the Reference Junction it is necessary to open the DP6 case and insert a calibrated Pt100 sensor in the copper block behind the terminals. A ¼-inch hole is provided for this purpose. A few precautions are necessary to achieve the best possible measurement performance. A contact grease should be used to give good thermal contact; the instrument should be left for at least 30 minutes after inserting the sensor and before measurement; the measuring current to the standard sensor should be kept to a minimum and applied only whilst a measurement is made and not left continuously powered. These measures will avoid any errors due to self-heating of the sensor.

Measure and note the temperature of the copper reference block and press CAL. The display now asks you to enter the Reference Junction temperature; pressing the OK key accepts this value and the corrected RJ value is then indicated in the DP6 display. OK returns you to the main calibration menu.

## **PRINT**

It is possible, using the RS232 interface, to print out the calibration constants. Connect to a serial printer which must have a buffer memory and accept data at 1200 baud. When connected, simply press the PRINT command from the calibration menu and the constants will be listed together with the software version and the calibration counter number.

## **THE ENVIRONMENT**

We expect the DP6 to give long and trouble-free service but, as with everything, there will come a time when you will want to replace it. **CROPICO** will continue to develop new instruments and to update the design of existing models, and therefore will be able to offer an instrument suitable for your needs.

When disposing of the DP6 batteries care should be taken to comply with any regulations that may exist. The DP6 has two batteries that should be disposed of safely; the sealed lead-acid battery which is fitted to the bottom PCB and which supplies the power for running the instrument and a Lithium memory back-up battery (circuit reference B1), which is mounted on digital board DP6-A.

Care should be taken in disposing of these batteries and they may be returned, all carriage and charges paid, to **CROPICO** for safe disposal.

Any regulations and directives applying to the disposal of such material must be applied.

Do not dispose of batteries in fire.

Do not short circuit.

Do not crush, puncture, open, dismantle or otherwise mechanically interfere with batteries.

## **STORAGE**

The DP6 should be stored in a dry, clean environment. To avoid deterioration of the battery, the DP6 should be charged periodically (at least every 6 months) and only stored in a charged state.

The storage temperature should not exceed 60 degrees Centigrade.

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