UniCal Tc+

Multifunction Indicator-simulator

Instruction Manual ed. 05

INTRODUCTORY NOTE

***ATTENTION*: THIS MANUAL MUST BE REFERRED TO INSTRUMENTS WITH SERIAL NUMBER 18784, VER. 2.000 ONWARDS.**

This publication contains operating instructions, as well as a description of the principles of operation, of the **UniCal Tc+** portable indicator-simulator.
The information covers all models of the instrument, including the basic equipment and its options and accessories.
The manual is a complete "USER GUIDE", providing step-by-step instructions for operating the **UniCal Tc+** in each of its designed functions.

The information contained in this publication is derived in part from proprietary and patent data of **E Instruments**. This information has been prepared for the sole purpose of assisting operating personnel in the efficient use of the instrument.
Publication of this information does not convey any rights to use or reproduce it for any purpose other than in connection with the installation, operation, and maintenance of the equipment described herein.

The instrument uses sophisticated analog and digital technologies.
Repair and service requires highly qualified personnel.
E Instruments will supply, on request, all pertinent instructions and procedures for service and calibration.
E Instruments specialists will be glad to give any technical support you may require.

The instrument is powered by an internal group of alkaline or Ni-Cd rechargeable batteries.
An external battery charger module, with power voltage at 110 or 220 V ac, is supplied as a standard accessory with rechargeable batteries.
Always check battery charger data; to modify power supply or to replace mains plug, see paragraph 8.2, and correct data written on the battery charger label.

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INDEX

1 GENERAL PERFORMANCE

A complete system for testing, measuring and calibrating built in a single, compact portable instrument.
The portable calibrator **UniCal Tc +** is a multifunction instrument designed to meet, in a modern and practical way, the needs of instrumentation engineers, both in laboratory and field work.
Accurate, compact, rugged, easy to use; the ideal solution for measurement and simulation of :

- **millivolts**
- **thermocouples**

The **UniCal Tc +** has been developed using the most advanced microprocessor technology to provide high accuracy on extended ranges and a powerful operative flexibility.
Linearization algorithms of the characteristic curves of thermocouples are held in the microprocessor memory in accordance with IEC / ANSI and DIN standards (thermocouples type T, K, J, S, R, E, B, N, C, U, L, F).
An unique automatic Rj compensation system allows the **UniCal Tc +** to provide accurate input and output readings over wide (-5°C to +50°C) operating conditions. Further, for external RJ joints, an external compensation can be selected with temperature adjustable from -50°C to +100°C.
The selection of the operative mode is made on the polycarbonate membrane keyboard with a working life up to one million operations per key.
Both measured and simulated values are indicated on a high quality LCD dot matrix display which assures good contrast even in poor light conditions.
A menu-driven procedure allows the generation of memory stored values, or a continuous or step ramp output.
The instrument carries out mathematical functions for measuring the average values of unstable signals and, in combination with scale factor mode, square root calculation.
The case, made of shock-resistant and self-extinguishing ABS, is ergonomically designed for easy practical use.
The instrument is powered by four alkaline or Ni-Cd rechargeable batteries (1.2 V nominal) : an external battery charger supplied as a standard accessory with rechargeable batteries.

1.1 Instrument codes

UniCal Tc 3908 - A - B

The basic configuration of the instrument includes a soft vinyl case and an instruction manual.

Table	**A**	**Battery charger power supply pre-set for:**
	0	alkaline Batteries
	1	110V 50/60 Hz - USA plug
	2	230V 50/60 Hz - SCHUKO plug
	3	240V 50/60 Hz - UK plug
	4	230V 50/60 Hz - EUROPEAN plug
	5	100V 50/60 Hz - Japan plug
	9	Special

Table	**B**	**Options on request**
	1	Calibration Certification

1.2 Specifications

- **IN / OUT parameters:**
  mV
  thermocouples type J, K, T, R, S, B, N, C, E, U, L, F
- **Reference junction compensation:**
  automatic with Pt100 sensor.
- **External with manual setting:**
  from -50°C to +100°C
- **Rj compensation drift:**
  ± 0.025°C/°C
- **In / Out ranges:**
  see table
- **Resolution:**
  see table
- **Limits of error:**
  see table
- **Common mode rejection:**
  > 130 dB at 50/60 Hz
- **Normal mode rejection:**
  > 60 dB at 50/60 Hz
- **Temperature stability:**
  span: ±0.005% of the reading/°C
  zero : ±0.2 µV /°C
- **Output impedance (emf output and Tc):**
  less than 0.5 ohm with maximum current of 0.5 mA
- **Input impedance**
  > 5 MΩ
- Maximum input dc over voltage :
  ± 5V
- **Source resistance:**
  1 µV error for 100 Ω source resistance
- **Display:**
  high contrast dot matrix LCD
  (7x5 dots per character - 16 characters)
- **Technical unit indication:**
  Up to 4 characters directly on the display
- **Scale factor:**
  Zero and span adjustable within -10000 and +10000
- **Square root:**
  in combination with scale factor (display limits 0 and +2500)
- **Calibration:**
  automatic procedure
- **Power supply:**
  n.4 rechargeable Ni-Cd batteries 1,25V 0,7 Ah or n.4 alkaline batteries
- **Battery life:**
  8 hours
- **Recharge time:**
  8 hours with instrument switched -OFF-
- **Battery voltage:**
  display indicated value
- **Program release identification:**
  version number indicated on the display
- **Operating temperature range:**
  from -5°C to +50°C
- **Storage temperature range:**
  from -30°C to +60°C

- **Case:**
  ABS
- **Dimensions:**
  215 x 96 x 35 mm
- **Weights:**
  net 1 Kg
  gross with packing 1.5 Kg

1.2.1 Table of ranges and accuracies

IN-OUT ranges

Tc	Total in-out ranges 1°C res.	Total in-out ranges 0.1°C res.	High accuracy range	Accuracy (% of reading)
J	-346 to 2192 °F -210 to 1200 °C	-346 to 2192 °F -210 to 1200 °C	-202 to 2192 °F -130 to 1200 °C	± (0.04%+0.54 °F or 0.3 °C)
K	-445 to 2498 °F -270 to 1370 °C	-382 to 2498 °F -245 to 1370 °C	-76 to 2372 °F -60 to 1300 °C	± (0.04%+0.54 °F or 0.3 °C)
T	-454 to 752 °F -270 to 400 °C	-391 to 752 °F -255 to 400 °C	-58 to 752 °F -50 to 400 °C	± (0.04%+0.54 °F or 0.3 °C)
R	-58 to 3200 °F -50 to 1760 °C	428 to 3200 °F -50 to 1760 °C	1472 to 3092 °F 800 to 1700 °C	± (0.04%+1.26 °F or 0.7 °C)
S	-58 to 3200 °F -50 to 1760 °C	536 to 3200 °F -50 to 1760 °C	1472 to 3200 °F 800 to 1760 °C	± (0.04%+1.44 °F or 0.8 °C)
B	212 to 3308 °F 100 to 1820 °C	1805 to 3200 °F 500 to 1820 °C	2192 to 3308 °F 1200 to 1820 °C	± (0.04%+1.26 °F or 0.7 °C)
C	32 to 4172 °F 0 to 2300 °C	32 to 3200 °F 0 to 2300 °C	32 to 4172 °F 0 to 2300 °C	± (0.04%+1.8 °F or 1 °C)
U	-328 to 752 °F -200 to 400 °C	-328 to 752 °F -200 to 400 °C	-58 to 752 °F -50 to 400 °C	± (0.04%+0.54 °F or 0.3 °C)
L	-328 to 1400 °F -200 to 760 °C	-328 to 1400 °F -200 to 760 °C	-202 to 1400 °F -130 to 760 °C	± (0.04%+0.54 °F or 0.3 °C)
N	32 to 2372 °F 0 to 1300 °C	32 to 2372 °F 0 to 1300 °C	176 to 2372 °F 80 to 1300 °C	± (0.04%+0.72 °F or 0.4 °C)
E	-454 to 1832 °F -270 to 1000 °C	-418 to 1832 °F -260 to 1000 °C	-238 to 1832 °F -150 to 1000 °C	± (0.04%+0.54 °F or 0.3 °C)
F	32 to 2552 °F 0 to 1400 °C	32 to 2552 °F 0 to 1400 °C	176 to 2552 °F 80 to 1400 °C	± (0.04%+0.54 °F or 0.3 °C)
mV	0 to 100	0 to 100	0 to 21 21 to 100	±(0.05%+9μV) ± (0.04%+12 μV)

Note:

- Relative Accuracies shown are based on tests at 23°C ±2°C for 90 days
- Typical 1 year accuracy can be estimated by multiplying the "% of the reading" specifications by 1.6
- All Input ranges: additional error ± 1 digit
- Traceability chart to WECC available on request
- Thermocouple accuracy tested with external Rj at 0°C (32°F).

2 GENERAL PERFORMANCE

2.1 Input and output flexibility

Ease of operation has been achieved using advanced microprocessor technology.
Each instrument, through a menu-driven procedure, allows measurement or simulation of mV, or any normalized IEC / ANSI and DIN thermoelectric sensor J, K, T, R, S, B, C, U, L, N, E, F.
The microprocessor performs automatic polynomial linearization and cold junction compensation to assure high accuracy.
°C or °F selection is made directly on the membrane keyboard.

2.2 Self calibration

The hardware-firmware design allows for an automatic calibration of the instrument.
A precise reference source (from 0 to 100 mV) and a 0°C reference system are necessary.
The calibration procedure is protected by a security code .

2.3 Keyboard

A tactile polycarbonate membrane keyboard, with a working life of one million operations per key, protects the internal electronics from the surrounding environment.
It allows the selection of the operative mode, the type of thermocouple and the setting of simulation values with fast and slow upgrading.
A "beep" sound indicates that the instrument has received and acknowledged the keyboard operator instruction.
Contact closure of membrane keys is acknowledged, as a coded signal, directly by the microprocessor.

2.4 Display

The high quality alphanumeric dot matrix LCD display (7x5 dots per character - 16 characters) allows easy readings even in poor light conditions.
The operative mode (measurement or simulation), the technical unit and the signal value are simultaneously indicated.

2.5 Digital Interface

A digital interface, with TTL logic levels, is available as standard for communications with external units.
A 4 wire cable, with a male mini connector, and an auxiliary module for TTL to RS232 conversion is available as an option.

2.6 Scale Factor Function

Easy, menu-driven set-up, to read or simulate electrical signal value (0 - 100 mV) in terms of engineering units.
Four alphanumeric characters, selected from an internal library, are adjustable on the display, to show the symbol of the parameter (i.e. mbar, % RH, % CO, etc.)
The display will indicate the scaled input / output value.

2.7 Square Root Function

Can be programmed during the installation procedure (linear ranges only) to obtain direct readings of flow from a dP transmitter signal.
The display limits are 0 and +2500.

2.8 Average Measurements

The measurement of unstable input signals in accomplished with a progressive averaging each 32 conversions (approximately 10 seconds).

2.9 Ramp Simulation

Menu-driven set-up to generate a continuous step ramp output.
The total time, the start point, the end point and step size are requested by the set-up procedure to run the program.
A manual repeat increment is also possible.

2.10 Case

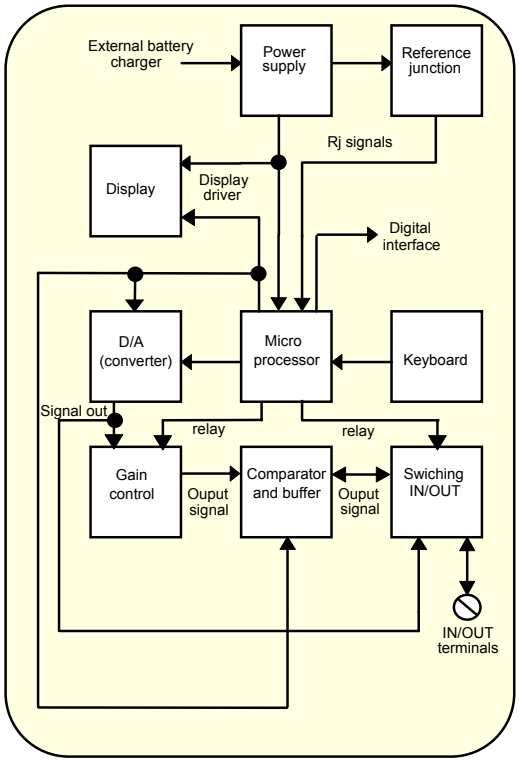
The case is designed for easy hand held operation and transportation.
The body is injection moulded, shock- resistant and self- extinguishing ABS .
A soft vinyl carrying case, with shoulder strap, is supplied with the instrument as a standard accessory.

3 PHYSICAL DESCRIPTION

The **UniCal Tc +** portable calibrator consists of a rugged and compact case, a mother board with all base functions, a tactile polycarbonate membrane keyboard , an LCD display and a group of four alkaline or Ni-Cd rechargeable batteries.
An external battery charger module is supplied as a standard accessory with rechargeable batteries.
The battery container is located on the back of the case and is accessible by sliding and removing the plastic cover.
The vinyl case assures better protection of the instrument against knocks and scratches.

4 FUNCTIONAL DESCRIPTION

The **UniCal Tc+** portable calibrator block diagram is shown on the figure below:



The functional blocks of the instrument are as follows:

- **power supply**
- **microprocessor (central unit + memory)**
- **input circuit**
- **cold junction compensator (Rj)**
- **LCD display**
- **membrane keyboard**
- **digital to analog converter**

4.1 Power supply

The instrument is powered by four internal alkaline or rechargeable batteries (AA type with a nominal voltage of 1.25 V) that can be recharged through an external charger module supplied as a standard accessory.
The voltage battery (approximately 5 V) is connected through the **<ON / OFF>** key to the power supply circuit that generates a -5V for analog circuits.

4.2 Operative Keyboard

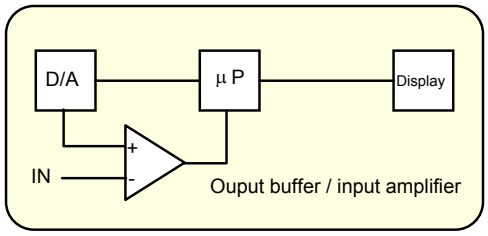
The front panel is a tactile polycarbonate membrane keyboard, and has a working life of one million operations per key.
The contact closure of the membrane keyboard is acknowledged as a coded signal by the microprocessor that recognizes the operators instructions.
Keys are interconnected on a 4 x3 matrix; the microprocessor identifies directly the active key.

ON	Power ON switch
OFF	Power OFF switch
STO	Memory load keys
</>	Parameter selection or decimal point position
START	Low limit setting on ramp simulation
END	High limit setting on ramp simulation
STEP	Step value setting on ramp simulation
TIME	Total time setting on ramp simulation program
0,1,2	IN / OUT memories
°C/°F	Technical unit selection
SELECT	Set-up procedure
AVERAGE	Average measurements
IN/OUT	Mode selection
AUTO RAMP	Program start
PROG X	Scale factor program
BATTERY	Battery voltage indication
LCD ▲ & ▼	Display contrast adjustment
FAST	Cursor accelerator
▲	Simulation values cursors
▼	Simulation values cursors
SHIFT	Key secondary function
ENTER	Memory load key

A "beep" sound indicates that the instrument has received and acknowledged the keyboard operator instruction.
The explanation of the key functions is summarised at chapter 8 ("OPERATIONS & APPLICATIONS").

4.3 Input circuit

The input circuit is based on the output buffer wired as an error amplifier.
The input signal drives the negative channel (-) of the integrated circuit.
The microprocessor recognizes if the D/A converter is generating a voltage signal higher or lower than the input signal and gives correcting instructions to keep the input amplifier output on the nearest value to zero.
In the above conditions the microprocessor will acknowledge the value of the input signal as equivalent to the setting of the digital to analog converter.

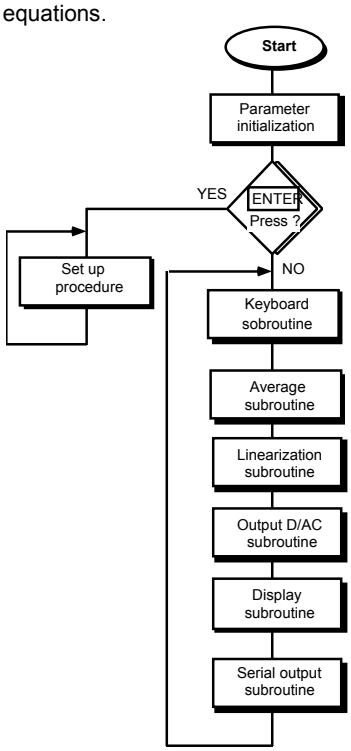


4.4 Microprocessor

The microprocessor handles all the logic functions of the instrument, performs the linearization for non linear transducers, compensates for the reference junction temperature, drives the digital display, acknowledges all operator instructions.
The heart of the circuit is a single-chip microcomputer that utilizes HCMOS technology to provide the low power characteristics and high noise immunity of CMOS plus the high speed operation of HMOS.
On-chip memory systems include a 8 K byte ROM and 512 bytes of electrically erasable programmable ROM (EEPROM).
The microprocessor works with an 8-bit communication bus to the EPROM and EEPROM memories.
The single-chip microcomputer incorporates a 256 bytes of static RAM and 8 channel analog to digital converter used to read the Rj value, the setting of the input comparator and the battery voltage.

4.5 Firmware

The operating system firmware handles all logic instructions to the internal peripheral circuits and performs the computation of the linearization equations.



The block diagram shows the modular architecture of the operating system firmware.
The application system firmware is resident on the non-volatile memory (EEPROM) of the microprocessor.
It is used to store the installation parameters (autocalibration data, programs data, etc.).

4.6 Digital Display

The digital display, mounted on an auxiliary board , uses high contrast LCD technology .
The character generation is by a dedicated secondary microprocessor driven by the bus of the main microprocessor.

The 16 characters are displayed in a 7 x 5 dots matrix.

4.7 Digital to Analog Converter

A 16-bit digital to analog circuit is driven by the microprocessor to convert the digital value of the selected parameter into an analog current output.
An integrated circuit converts the current signal into a voltage signal.
An integrated circuit selects one of the two available output span as function of the selected range.

The two ranges are:

-10	÷	+20 mV	Tc R, S, B, C e and the negative portion of all Tc
- 0.2	÷	+100 mV	100 mV range and remaining thermocouples

An high stability resistor in combination with an integrated circuit stabilizes the output voltage for load variations.

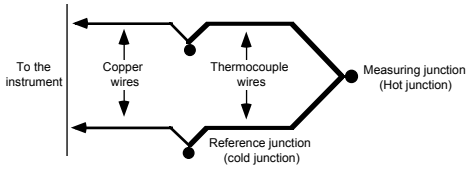
4.8 Battery charger. Operation from line source (only with rechargeable battery option)

The auxiliary module, supplied as a standard accessory, allows operation from ac line 110 -120 or 220 -240 V ac 50/60 Hz.
The calibrator, if needed, can be operated directly from a line source through the charger.
The charger is provided with replaceable main plugs (Schuko, USA, European, UK) and a cable for connection to the instrument.
The charger circuit is designed with an isolated transformer and a voltage stabilizer circuit.
The step-down transformer reduces the power line (110 -120 v or 220 -240 V nominal) to a value of 10 Vac.
The above voltage is full wave rectified , filtered and stabilized.
The output voltage of 6.45 Vdc is the correct value to recharge the internal Ni-Cd batteries.

4.9 Thermocouple input / output circuit

A thermocouple, a temperature sensor, in its most common form consists of two wires, of different composition, joined together at one end.
The two wires are joined together at two points which have different temperatures.
One of the joints is at a known temperature. This joint is, by definition, the reference junction.
The reference junction is also often, but less preferably, called the "cold" junction.
The temperature of the reference junction can be held constant or its variation electrically compensated in the associated measuring instrumentation.
The second junction is the measuring junction (or "hot" junction).
A thermocouple is useful for temperature sensing because it generates a measurable electrical signal.

The signal is proportional to the temperature difference between the measuring and reference junctions and is defined, by means of tables, based on the International Temperature Scale.
To improve overall accuracy the terminals are designed with a very low thermal capacity.
Inside the body of the negative polarity terminal is placed a thin film Pt100 resistance thermometer that dynamically measures, with high accuracy, the temperature of the reference junction.
The microprocessor uses the above signal (Pt100) to adjust the input signal to compensate for the Rj temperature.
Reference junction compensation can be internal or external, depending upon the application requirement (see the pertinent procedure in par. 8.5.10.2).



4.10 Serial digital interface

The serial digital interface circuit is essentially based on the serial communication interface subsystem (SCI) on the chip of the microprocessor at 0 to +5V level.
An adapter to convert TTL to RS232 voltage levels can be obtained on request.

5 UNPACKING

Remove the instrument from its packing case and remove any shipping ties, clamps, or packing materials.
Carefully follow any instructions given on any attached tags.
Inspect the instrument for scratches, dents, damage to case corner etc. which may have occurred during shipment.
If any mechanical damage is noted, report the damage to the shipping carrier and then notify **E Instruments** directly or its nearest agent, and retain the damaged packaging for inspection.
A label, inside the battery container, indicates the serial number of the instrument.
Refer to this number for any enquiry for service, spare parts supply or application and technical support requirements.
E Instruments will keep a data base with all information regarding your instrument.

6 PRE-OPERATIONAL CHECK

The **UniCal Tc+** indicator-simulator is powered by four alkaline or Ni-Cd rechargeable batteries.
The external battery charger may be ordered for either 110 -120 V or 220 -240 Vac power source.
To modify the charger's power voltage follow the instructions in par. 8.2.
Before using the instrument carefully verify the nominal voltage value of the charger; in case of modification do not forget to correct the pertinent label.
The instrument should be used in environments where the temperature does not exceed the specified limits (from -5°C to +50°C) and where the relative humidity is lower than 95%.

In case of "low" battery condition (voltage lower than 4.5 V ±0.1 V) the display will show the appropriate symbol.
A dotted symbol means that the battery package has enough power energy for about 30 minutes operation.
A black symbol means that the battery charge is below the minimum acceptable voltage level: operation of the instrument is no longer possible.
In this condition the batteries must be recharged for approximately 12 hours.

WARNING.

WHEN THE INSTRUMENT IS SUPPLIED WITH NI-CD RECHARGEABLE BATTERIES, DO NOT USE NORMAL ALKALINE BATTERIES.
ALKALINE BATTERIES, WHEN CONNECTED TO A DC VOLTAGE SUPPLY, UNDERTAKE AN OVERHEATING PROCESS WITH A RISK OF EXPLOSION.

7 ELECTRICAL CONNECTIONS

Appropriate extension wires should be used between the thermocouple (or instrument under calibration) and the **UniCal Tc +** unless the thermocouple wires permit direct connection.
Make sure that both thermocouple and compensating cable are connected with the correct polarity. If in doubt, the polarity of the compensating leads can be checked by connecting a length of lead to the indicator, shorting the free ends of the wires together and noting that the indicator reading increases when the wire connection is heated.
Colour codes of compensating cables change in different countries, check the appropriate table.

7.1 Wiring practice

Although the **UniCal Tc +** portable calibrator is designed to be insensitive to transient or noise the following recommendations should be followed to reduce ac pick up in the signal leads and to ensure good performance.
The input leads should not be run near ac line wiring, transformers and heating elements.
Input /output leads should, if possible, be twisted and shielded with the shield grounded at the end of the cable.
When shielded cables are used the shield must be connected to the positive terminal.

7.2 Thermocouple wires

When making measurements where additional wires have to be connected to the thermocouple leads, care must be exercised in selecting these wire types, not only where they are claimed to be of the same composition as the thermocouple involved, but also of their "quality".
Performance results where high precision is required and in circumstances where some types of thermocouple wire leads are added to the original installation should be reviewed carefully for the impact of the choice of the additional wire leads.
The quality of the thermocouple wire is established by the limit of error to be expected with its use.
There are three recognizable levels of quality:

- Special or Premium grade
- Standard grade
- Extension wire grade

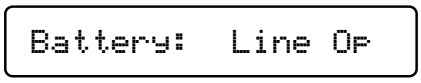
The error limits determining the grade quality differ from thermocouple type to thermocouple type, reflecting the degree of difficulty in maintaining the precise levels of purity of the metal used.
The table below summarizes the error limits for Premium and Standard grades, while Extension grade wire is characterized by limits of error exceeding those in the table.
Errors up to ±4°C may be experienced when using Extension grade thermocouple wire for J and K thermocouple.

8 OPERATIONS & APPLICATIONS

8.1 Rechargeable batteries option

The **UniCal Tc+** portable calibrator is powered by four built-in rechargeable batteries.
The instrument is shipped with an average level of charge.
After unpacking, a full charge of the battery is recommended; connect the instrument to the charger module ("OFF" condition) for a minimum period of 12 hours.
The Ni-Cd rechargeable batteries do not suffer when used in cyclic operations.
Cyclic operation is understood as a method of operation by which the battery is continually charged and discharged.
Note that a battery, at its lower limit of charge, risks a non uniform cell polarization. This condition makes it difficult to recharge with the charger supplied.
Avoid leaving the instrument, with batteries totally or partially discharged, for a long time without recharging.
To charge the batteries use only the standard module. The module incorporates protection and current limiting devices not normally found in other commercial chargers.

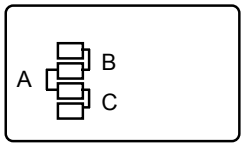
- When the **UniCal Tc+** is connected to the battery charger module, by pressing **<SHIFT>** + **<BATTERY>** keys the indication of fig. 8.1.A will be displayed



If a numeric value appears, it indicates that the charger is possibly faulty.
Replace the battery charger module. If the fault indication persists, replace the battery charger or contact **E Instruments** Department.

8.2 Battery charger. Power supplied from power line ac

The external battery charger is configured, before shipment, for a supply voltage of 110 -120 V ac or 220 - 240 Vac, upon order specification.
The nominal voltage value is indicated on the front label of the charger; if power supply voltage has to be modified, correct the indication on the front label.
To replace the mains plug, loosen the three bottom screws.
To modify the power supply voltage place the jumper, mounted on the circuit board of the charger, as indicated below:



Jumper "A": power line at 220-240 V 50/60 Hz

Jumpers "B" e "C": power line at 220-240 V 50/60 Hz

8.3 Power "ON"

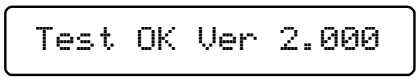
ATTENTION **All values in the following figures are only listed as an example.**

During set-up and load memory remember that the instructions of the manual related to key operation have the following meaning:

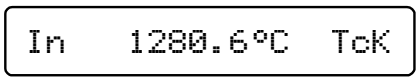
<A> + <B> Press the **<A>** key and keeping the pressure on the key, press then the **<B>** key
<A>, <B> Press in sequence first the **<A>** key and then the **<B>** key.

• To power the instrument press the **<ON>** key. The following indication will appear for a few seconds:

• With power -ON- the instrument will run a diagnostic routine for the self-checking of critical circuits and components.
• A positive check will be shown, with the indication below, for about one second:



• The number of the right site of the display indicates the version of the memory installed on the instrument.
• The instrument will be operative with the previously selected mode, e.g. as follows:

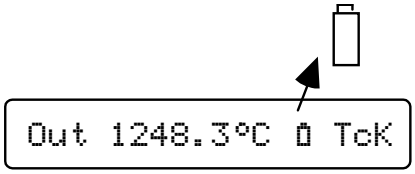


• Faulty conditions will be indicated as described in par. 8.6.

8.4 Battery voltage indication

- To recall the battery voltage on the display press **<SHIFT>** + **<BATTERY>** keys.
  The indication will be:

  The "low" limit of the battery voltage, for the correct operation of the instrument, is +4.6 V.
- Press any key to reset the operative mode.
- During normal operating modes, (measure or simulation), the "low battery" condition will be shown with the following indication:



An empty symbol means that the battery has enough energy for about 30 minutes operation.

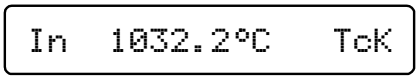
A black symbol means that the battery charge is below the minimum, batteries must be recharged.

8.5 Operating mode set-up

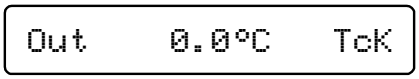
To select the required operating mode follow the procedures indicated below.

8.5.1 IN / OUT function selection

- Switch the instrument -ON-.
  After diagnostic routine, the calibrator will be forced into the "IN" function with the active parameter previously selected (e.g. with the indication shown below, related to a measured value of +1032 °C with thermocouple type K).



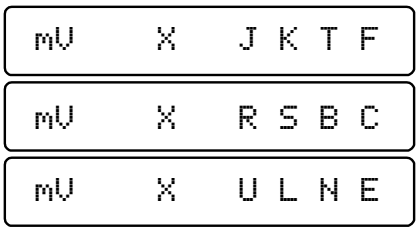
- Open input terminals will cause a fluctuation of the reading up to the limit of "Underflow" or "Overflow".
- To select the simulation mode press the **<IN / OUT>** key (i.e. for a simulated value of 0°C - thermocouple type "K" - the indication will be the following one).



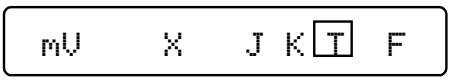
- The output value can be adjusted by pressing **<▲>** or **<▼>.**
- Keep the key pressed to cause a continuous variation of the simulated value; the speed of variation will change by pressing keys **<FAST>** + **<▲>** or **<FAST>** + **<▼>** (one third significative digit per step)
- Press simultaneously the **<▲>** and **<▼>** keys to set to zero the simulated value.

8.5.2 Parameter or sensor selection

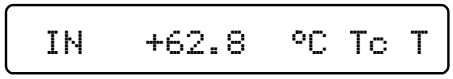
- To select the electrical parameter or the sensor required by the application follow the procedure indicated below:



- Switch the instrument -ON-
- Press the **<SELECT>** key to obtain one of the menu pages above.
  Press **<▲>** or **<▼>** key to select the appropriate page.
- Select the required parameter or sensor, moving left or right the flashing cursor, with **<←>**or **<_>** key (i.e. to activate the thermocouple "T" choose the page and cursor position as indicated below):



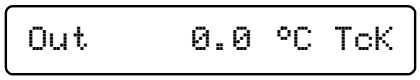
- Press the **<ENTER>** key to load the selection in the memory; the instrument will return to the previous function with the new selected thermocouple, as follows:



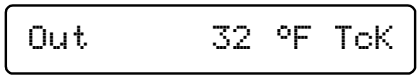
- By pressing any other key instead of **<ENTER>**, the instrument will not acknowledge any change and will return to the previous sensor parameter .

8.5.3 °C/°F selection

- To change the technical unit from °C to °F (or vice versa) press **<SHIFT>** + **<°C/°F>** keys; e.g. With a °C selection:



by pressing the**<SHIFT> + <°C/°F>** keys you will obtain an indication in °F:



8.5.4 Decimal point position

- The decimal point position, to increase or decrease the resolution upon the application, is made by pressing the keys **<←>** and **<_>**. The instrument will automatically convert value in °C or °F from decimal to integer (and vice versa) when they are in the range limits stated.

On mV or V mode one of the following decimal point position can be obtained:

0.00 mV
0.000 mV

8.5.5 International Temperature Scale selection

The memory of the instrument stores both linearizations of the old International Practical Temperature Scale of 1968 (IPTS 68) and the new International Temperature Scale of 1990 (ITS 90).
The active linearization is indicated after engineering unit °C or °F as follows:

Blank IPTS 68
90 ITS 90

- The change from one scale to the other is possible directly from the keyboard:
- Press **<SHIFT> + <FAST>** keys.

8.5.6 Rj mode selection

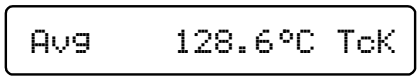
The instrument can operate with an internal automatic cold junction (Rj) compensated or a remote programmable from -50 to 100°C.

- To change the reference junction (Rj) compensation mode, press **<SELECT>**, to enter in the parameter menu selection, press **<IN/OUT>**, to display Rj compensation. Pressing **<FAST>** it will pass from internal to external (e.g. 0.0°C). Press **<ENTER>** to exit and confirm.

8.5.7 Average readings

The use of the **"Average"** mode is advised with unstable input signals.
The average represents a progressive integration of the input signal on the last 32 conversions (approximately 10 seconds).

- To enable the "Average" mode press **<SHIFT>** + **<AVERAGE>** keys.
  The display will indicate as follows:



- To disable the "Average" mode press again **<SHIFT>** + **<AVERAGE>** keys.

8.5.8 IN / OUT data memories

The availability of a 60 slots of memory represents an important feature both either in simulation and/or in measurement modes.
In the measurement mode it can be useful to store a number of input values pertinent to three special test conditions.
In the simulation mode, the permanent availability of 60 calibration values can be useful, e.g.. during the calibration of the scale of different recorders.

8.5.8.1 Data memory configuration

- To store each memory slot press the keys:

  <SHIFT> + <0>
  <SHIFT> + <1>
  <SHIFT> + <2>

The following data is stored:
- operative mode
- measured or simulated value
- decimal point position (e.g. 0.1°C or 1°C)
- °C or °F technical unit
- internal or external Rj mode
- type of sensor or selected parameters (e.g. thermocouple type)
- International Temperature Scale (IPTS 68 or ITS 90)
- 60 memory slots are available

Memory slots are split in 20 groups each of three memories for a total of 60 memories.
Each group is identified by a letter:
group **A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T.**

To select the required group follow the procedure indicated below:

- Press the **<SELECT>** key to obtain one of the menu pages
- Press the **<0>** key to obtain the following indication:

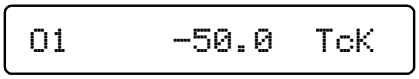
- Press the **<▲>** or **<▼>** keys to select the required group number
- Press the **<0>** key to confirm the selection and to return to the previously selected operative mode.

8.5.8.2 Data memory manual recall

To recall data memory values, first select the appropriate or required group number and then press the **<0>**, **<1>** or **<2>** key.

8.5.8.3 Manual step advance

To use manual step keep pressed the **<ENTER>** key and then press **<RAMP>**. On time display keep the key pressed until "Autoscan" will appear.
Press **<←>** or **<→>** to exit.
To run the program with manual step advance, press the **<RAMP>** key obtaining, for example, the following indication:



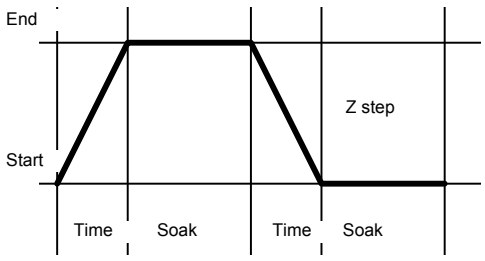
The symbol on the left of the display has the following meaning:

O = Output
i = input

- Press the **<RAMP>** key to advance one step of the program. After the "end" point the manual sequence will start again from the point 1.
- Press the **<▲>** or **<▼>** keys or **<SELECT>** or **<↵>** **<_>** keys to exit the program.

8.5.9 Automatic simulation cycle

The instrument can be programmed for simulating two types of pre-programmed continuous or step ramp output.
By programming the incremental steps to its minimum value (0.1 or 1 degree resolution) the step ramp can be assimilated to a continuous ramp.
Select first the technical unit (°C or °F), the type of thermocouple and then follow the procedure indicated below.
The procedure will consider a simulation in mV.



To memory load the cycle parameters, follow the procedure indicated below:

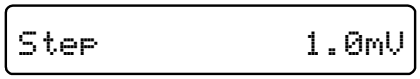
- Select the required technical unit or electrical parameters
- Select the required decimal point position
- Press **<SHIFT> + <TIME>** keys to enter the cycle set-up procedure obtaining the following indication:

related to the "time" in hours, minutes and seconds. The maximum setting is limited to 5 hours 33 minutes 20 seconds (20.000 seconds)

- Press the **<START>** key to obtain the following indication:

- Press the **<▲>** and **<▼>** cursors to set the "Start" level of the cycle
- Press the **<ENTER> + <START>** keys to memory store the new value
- Press the **<END>** key to obtain the following indication:

- Press **<▲>** and **<▼>** cursors to set the "End" level of the cycle
- Press the **<ENTER> + <END>** keys to memory store the new value
- Press the **<STEP>** key to obtain the following indication:



- Press **<▲>** and **<▼>**cursors to set the required step.
- Press the **<ENTER> + <STEP>** keys to memory store the new value.
- Press the **<TIME>** key to obtain the following indication:

- Press <▲> and <▼> cursors to set the required ramp time - max. 5h-33m-20s (20000 seconds)
- Press **<ENTER>+<TIME>** keys to memory store the new value
- A setting of 0h-0m-00s (AUTOSTEP) allows a manual step advance each time the **<RAMP>** key is pressed.
  Soak will be equal to the time of the ramp.
- Press the **<SELECT>** key to obtain the following indication:

repeated cycle only Up ramp

repeated cycle only Up Down ramp

repeated cycle only Up Soak Down ramp

Ramp: 1 Up	single cycle only Up ramp
Ramp: 1 Up Down	single cycle only Up Down ramp
Ramp: 1 Up Soak Down	single cycle only Up Soak Down ramp

- Press the <▲> or <▼> key to select one of the programs stated above.
- Press **<ENTER> + <SELECT>** keys to memory store the new selection.
- Press the **<↞>** or **<_>** key to exit the set-up procedure.

8.5.9.1 Simulation cycle

- To run the automatic simulation cycle press the **<RAMP>** key.
- The display indicates the actual cycle position as shown below:

Prg 18.0mV

Application Note

During the set-up procedure the operator must consider the limitation on steep ramps due to the minimum time required by the step generation (30 ms).
For a correct set-up take into consideration the following equation:

$$\frac{\text{Time x Step}}{\text{End - Start}} > 0{,}03$$

If the above requirement is not fulfilled the operator can still estimate the actual time using the following equation:

$$\text{Time} \cong \frac{\text{End - Start}}{\text{Step}} \text{ X } 0{,}03$$

Example:

In the case of the following set-up:

Start = 0
End = 1000°C
Step = 1°C
Time = 10 sec.

$$\frac{10 \text{ x } 1}{1000 - 0} = \frac{10}{1000} = 0{,}01$$

The result of the equation does not meet the correct requirements as 0,01 is lower than 0,0'. Therefore the total time of ramp will be:

$$\text{Time} = \frac{1000 - 0}{1} \times 0{,}03 = 30 \text{ sec.}$$

To obtain a total time of 10 sec., the operator should set the step value at 3°C.

8.5.10 Open Tc fault test

If you want to verify a thermocouple connected to input terminals in measuring mode, press the **<FAST>** key . After a few seconds, the message "Tc is open" will appear if the thermocouple is broken, otherwise the message "Tc is OK" will show that it works fine.

The above test is valid for thermocouples with resistance up to 100 ohm.

8.5.11 Scale factor mode

The "scale factor" mode is an easy menu-driven set-up to read or to simulate electrical signals value (0 to 100 mV) in terms of technical units.
The example explains the procedure of installing the "scale factor" function for the calibration of a potentiometric recorder with a scale from 0.0 to 400.0 mbar corresponding to an electrical linear input signal 0 to 100 mV.

- Press **<SHIFT>** + **<PROGRAM X>** keys to enter the set-up procedure.
  The display will indicate as follows:

```
LO :      +0.0 Prog
```

- Press <◄> or <_>key to shift the decimal point position.
- Press key to adjust the required value.
- Press the **<ENTER>** key to load in the memory the new value:

```
Hi :   +400.0  Prog
```

- Press keys **<▲>** and**<▼>**to adjust the full scale value.
- Press the **<ENTER>** key to load in the memory the new value.
  The display will indicate the page shown below:

```
Type :     0-100 mV
```

- Press the **<ENTER>** key
- The display will indicate one of the two menu pages below:

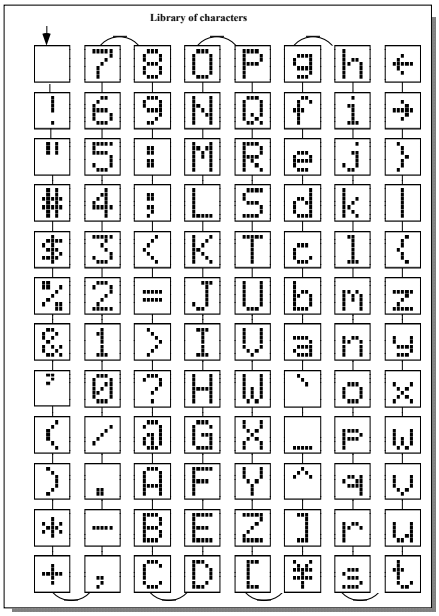
```
Mode :     Square
```

```
Mode :     Linear
```

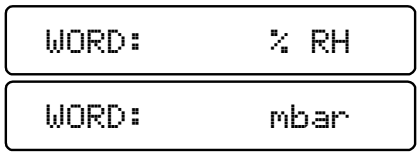
The first page indicates square root mode.

- Press keys **<▲>** and **<▼>** to select the required page and load memory the function with the **<ENTER>** key.
  The display will then show:

- This step allows the setting of four alphanumeric characters as a symbol of the measured or simulated parameter.
- By pressing keys <←> or <→> the needed character, identified by being underlined, will be activated.
- Press **<▲>** and**<▼>** keys to scroll the internal library of characters and symbols (picture below) and select the pertinent one.

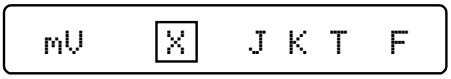


i.e. you can obtain symbols as indicated:



If the application does not require a dedicated symbol but the indication of the electrical parameter (i.e. mV) leave on the display four blanks.
With a random display indication remember that the four blanks will be settable, through single digit setting, by pressing the **<▼>** key for a few seconds.

- Press the **<ENTER>** key to load in the memory the symbol.
- To enable the "scale factor" mode enter the set-up procedure with the **<SELECT>** key.
- Move the flashing cursor on the position "X" :



- Press the **<ENTER>** key.

  The display will indicate the scaled In/ Out value.

8.5.12 Installation parameter mode

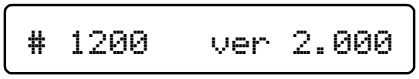
To start this procedure keep **<ENTER>** key pressed while switching the instrument -ON- .
The display will indicate as follows:

(The numerical value indicated is only an example).

8.5.12.1 Firmware version code - Serial number

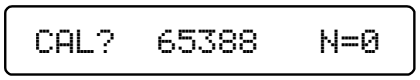
From the above step of the procedure it is possible to view the software version code .

- Press the **<IN/OUT>** key to obtain the following indication:



The reading on the display indicates that the instrument is equipped with a memory release code 2.000.
The above information is extremely useful to understand the update status of the instrument and to simplify information exchange with **E Instruments** engineers during repair or service operations.
The second number on the right side of the display is the Serial Number of the instrument.

- Press any key to exit the procedure with the following indication:

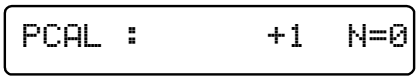


- Switch the instrument **-OFF-** to end the procedure.

8.5.12.2 External reference junction compensation set-up

- From step 8.5.10.1 and 2 you can set the appropriate Rj compensation.
- Press the **<AUTORAMP>** key to obtain the following indication:

- If the application requires a different remote reference junction compensation (i.e. the internal temperature of a remote, field mounted, temperature controlled junction box) set the required temperature value through the **<▲>** and **<▼>** keys.
- Press the **<AUTORAMP>** key to load in the memory the required type of reference junction compensation.
  The display will indicate the following reading:



- Switch the instrument **-OFF-** to end the program procedure.

8.6 Faulty operating conditions

During start up, measuring or simulation modes, faulty condition of the instrument will be announced with coded messages as follows:

- indicates a possible loss of data on "AUTORAMP" program or on the three manual memories ("0", "1", "2".

- indicates a possible loss of data on "PROGRAM X".

- indicates a possible loss of data on "AUTORAMP", "PROGRAM X" and / or on the three manual memories ("0", "1", "2") - (error 1 + error 2).

- indicates a possible loss of calibration data.

- indicates a possible loss of calibration data, and / or "AUTORAMP" data and/or on the three manual memories (error 1 + error 4).

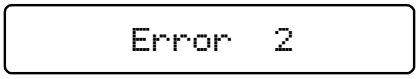
- indicates a possible loss of calibration data and/or "PROGRAM X" data (error 2 + error 4).

- indicates a possible loss of calibration data, and /or "AUTORAMP" data, "PROGRAM X" and on the three manual memories error 3 + error 4).

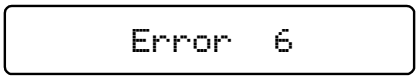
- indicates a data writing on the EEPROM memory not verified.

- indicates "underflow" conditions.

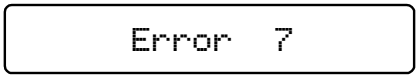
- indicates "overflow" conditions.



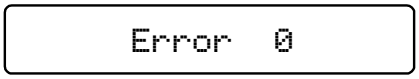
- indicates an environment temperature (in correspondence with the IN / OUT terminals) exceeding stated limits.



- Indicates that the load is exceeding stated limits.
  The current generated by the instrument must not exceed 0.5 mA.



- indicates a possible error during "Scale Factor" computation.



- The error code indicates that the input value is exceeding the limits.

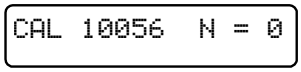
The above indicated faulty conditions can be announced both during the auto diagnostic routine or in measuring or simulation modes.
If the faulty condition is critical for the type of application it is recommended to re-run the pertinent set-up procedure.

8.7 Digital interface

The **UniCal Tc+** portable calibrator is equipped with a digital interface.
The interface circuit is essentially based on the serial communication interface subsystem (SCI) on the chip of the microprocessor.
The output voltage levels are TTL at 0 to +5 V.
An optional adapter to convert the voltage level from 0 to +5 V to RS232 levels can be supplied on request. This adapter is required to interface the **UniCal Tc+** with a Personal Computer.

8.7.1 Digital interface program mode

- To enter the procedure, keep the key **<ENTER>** pressed and press the key **<ON>;** the display will be as follows:

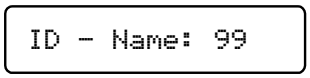


- To enter the program mode press the **<2>** key.

The numerical value of the "baud rate" can be one of the following:

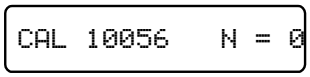
19200 - 9600 - 4800 - 2400 - 1200 - 600 - 300

- Select, through the **<UP>** or **<DOWN>** keys the "baud rate" used by the receiver unit and transmission lines.
- Load the value in the memory by pressing the **<2>** key; the display will indicate as shown below, and represents the address code assigned to the instrument:



It can be programmed from 01 to 99 through the **<UP>** or **<DOWN>** keys.
Load the set value in the memory by pressing the **<2>** key.

- The display will return to the original indication:



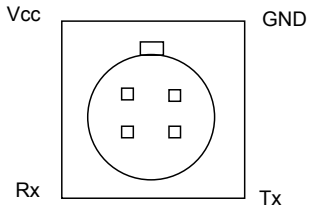
- To exit the procedure press the **<OFF>** key.

8.7.2 Digital output wiring practice

The wiring to the digital output signals is made through a mini connector mounted on the right side of the case.
The pertinent connections are indicated below:

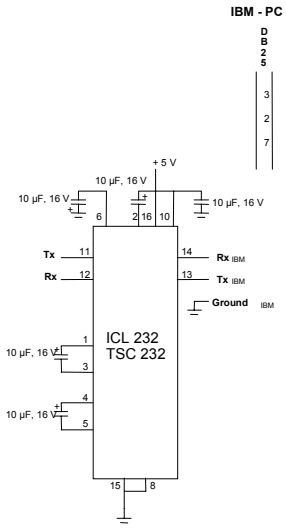
SERIAL CONNECTOR SIGNALS UniCal

Front view



8.7.3 Adapter TTL / RS232

The adapter consists of a cable to which are connected a male mini DIN connector (to the **UniCal Tc +**) and a DB 25 connector, that contains the electrical circuitry, to the Personal Computer.
The basic circuit and interconnections are indicated in below:



TTL to RS 232 converter

8.7.4 Communication protocol from UniCal Tc+ to a PC

The exchange of information when a **UniCal Tc+** is interconnected with a Personal Computer are as follows:

COMPUTER REQUEST

Computer		**UniCal Tc+**	
Tx IDNAME	→	Rx IDNAME	Proceed if name acknoledged
Rx IDNAME	←	Tx IDNAME	If not, do not answer

Tx Instruction	→	Rx Instruction
Rx Instruction	←	Tx Instruction
Tx char	→	Rx char
Rx DATA 1	←	Tx DATA 1
Tx char	→	Rx char
Rx DATA 2	←	Tx DATA 2
Tx char	→	Rx char
Rx DATA 3	←	Tx DATA 3
Tx char	→	Rx char
Rx DATA 4	←	Tx DATA 4
Tx char	→	Rx char
Rx CHKSUM	←	Tx CHKSUM

IDNAME, Instruction, DATA 1, DATA 2, DATA 3, DATA 4 and CHKSUM are 8-bit values (1 byte)

Notes	**Instruct**	**DATA 1**	**DATA 2**	**DATA 3**	**DATA 4**
Actual value	24	display(actual)	lin(actual)	Value Hi(actual)	Value Lo(actual)
STO 0 Group A	164	x	x	Display (0)	Lin (0)
STO 0 Group A	165	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group A	165	x	x	Display (1)	Lin (1)
STO 1 Group A	166	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group A	166	x	x	Display (2)	Lin (2)
STO 2 Group A	167	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group B	168	x	x	Display (0)	Lin (0)
STO 0 Group B	169	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group B	169	x	x	Display (1)	Lin (1)
STO 1 Group B	170	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group B	170	x	x	Display (2)	Lin (2)
STO 2 Group B	171	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group C	172	x	x	Display (0)	Lin (0)
STO 0 Group C	173	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group C	173	x	x	Display(1)	Lin (1)
STO 1 Group C	174	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group C	174	x	x	Display (2)	Lin (2)
STO 2 Group C	175	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group D	176	x	x	Display (0)	Lin (0)
STO 0 Group D	177	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group D	177	x	x	Display (1)	Lin (1)
STO 1 Group D	178	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group D	178	x	x	Display (2)	Lin (2)
STO 2 Group D	179	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group E	180	x	x	Display (0)	Lin (0)
STO 0 Group E	181	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group E	181	x	x	Display (1)	Lin (1)
STO 1 Group E	182	Value Hi (1)	Value Lo (1)	x	x

STO 2 Group E	182	x	x	Display (2)	Lin (2)
STO 2 Group E	183	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group F	184	x	x	Display (0)	Lin (0)
STO 0 Group F	185	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group F	185	x	x	Display (1)	Lin (1)
STO 1 Group F	186	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group F	186	x	x	Display (2)	Lin (2)
STO 2 Group F	187	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group G	188	x	x	Display (0)	Lin (0)
STO 0 Group G	189	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group G	189	x	x	Display (1)	Lin (1)
STO 1 Group G	190	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group G	190	x	x	Display (2)	Lin (2)
STO 2 Group G	191	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group H	192	x	x	Display (0)	Lin (0)
STO 0 Group H	193	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group H	193	x	x	Display (1)	Lin (1)
STO 1 Group H	194	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group H	194	x	x	Display (2)	Lin (2)
STO 2 Group H	195	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group I	196	x	x	Display (0)	Lin (0)
STO 0 Group I	197	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group I	197	x	x	Display (1)	Lin (1)
STO 1 Group I	198	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group I	198	x	x	Display (2)	Lin (2)
STO 2 Group I	199	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group J	200	x	x	Display (0)	Lin (0)
STO 0 Group J	201	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group J	201	x	x	Display (1)	Lin (1)
STO 1 Group J	202	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group J	202	x	x	Display (2)	Lin (2)
STO 2 Group J	203	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group K	204	x	x	Display (0)	Lin (0)
STO 0 Group K	205	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group K	205	x	x	Display (1)	Lin (1)
STO 1 Group K	206	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group K	206	x	x	Display (2)	Lin (2)
STO 2 Group K	207	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group L	208	x	x	Display (0)	Lin (0)
STO 0 Group L	209	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group L	209	x	x	Display (1)	Lin (1)
STO 1 Group L	210	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group L	210	x	x	Display (2)	Lin (2)
STO 2 Group L	211	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group M	212	x	x	Display (0)	Lin (0)
STO 0 Group M	213	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group M	213	x	x	Display (1)	Lin (1)
STO 1 Group M	214	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group M	214	x	x	Display (2)	Lin (2)
STO 2 Group M	215	Value Hi (2)	Value Lo (2)	x	x

STO 0 Group N	216	x	x	Display (0)	Lin (0)
STO 0 Group N	217	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group N	217	x	x	Display (1)	Lin (1)
STO 1 Group N	218	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group N	218	x	x	Display (2)	Lin (2)
STO 2 Group N	219	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group O	220	x	x	Display (0)	Lin (0)
STO 0 Group O	221	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group O	221	x	x	Display (1)	Lin (1)
STO 1 Group O	222	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group O	222	x	x	Display (2)	Lin (2)
STO 2 Group O	223	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group P	224	x	x	Display (0)	Lin (0)
STO 0 Group P	225	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group P	225	x	x	Display (1)	Lin (1)
STO 1 Group P	226	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group P	226	x	x	Display (2)	Lin (2)
STO 2 Group P	227	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group Q	228	x	x	Display (0)	Lin (0)
STO 0 Group Q	229	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group Q	229	x	x	Display (1)	Lin (1)
STO 1 Group Q	230	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group Q	230	x	x	Display (2)	Lin (2)
STO 2 Group Q	231	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group R	232	x	x	Display (0)	Lin (0)
STO 0 Group R	233	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group R	233	x	x	Display (1)	Lin (1)
STO 1 Group R	234	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group R	234	x	x	Display (2)	Lin (2)
STO 2 Group R	235	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group S	236	x	x	Display (0)	Lin (0)
STO 0 Group S	237	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group S	237	x	x	Display (1)	Lin (1)
STO 1 Group S	238	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group S	238	x	x	Display (2)	Lin (2)
STO 2 Group S	239	Value Hi (2)	Value Lo (2)	x	x
STO 0 Group T	240	x	x	Display (0)	Lin (0)
STO 0 Group T	241	Value Hi (0)	Value Lo (0)	x	x
STO 1 Group T	241	x	x	Display(1)	Lin(1)
STO 1 Group T	242	Value Hi (1)	Value Lo (1)	x	x
STO 2 Group T	242	x	x	Display (2)	Lin (2)
STO 2 Group T	243	Value Hi (2)	Value Lo (2)	x	x
RAMP	132	x	x	Time Hi	Time Lo
RAMP	133	Start Hi	Start Lo	Stop Hi	Stop Lo
RAMP	134	Step Hi	Step Lo	Lin	Display
RAMP	135	Mode	x	x	x
X SCALING	136	x	x	LOX Hi	LOX Lo
X SCALING	137	Hix Hi	Hix Lo	Decimal point	Type X
X SCALING	138	Mode X	CHAR 1	CHAR 2	CHAR 3
X SCALING	139	CHAR 4	x	x	x

VARIE	141	x	STO group	x	x
VARIE	32	Vbat	x	x	x

display (name).AND.10hex=	0	= Rj int
	10hex	= Rj ext
display (name).AND.8 =	0	= ITS68
	8	= ITS90
display (name).AND.07hex =	0	= 1.9999
	1	= 19.999
	2	= 199.99
	3	= 1999.9
	4	= 19999
display (name.AND.40hex =	0	= °C
	40hex	= °F
display (name).AND.20hex =	0	= IN
	20hex	= OUT
lin (name)	0	= Tc J
	1	= Tc K
	2	= Tc T
	3	= Tc F
	4	= Tc R
	5	= Tc S
	6	= Tc B
	7	= Tc C
	8	= Tc U
	9	= Tc L
	10	= Tc N
	11	= Tc E
	12	= Tc mV
	13	= Tc x
Lin (name).AND.80hex =	0	= value OK
	80hex	= error
if line (name).AND.80hex = 80hex corresponding "Value Lo"	0	= under
	1	= over
	2	= error 7
	3	= error 2
	4	= error 6
	6	= error 0

if line (name).AND.80hex = 0
value (name) = 2nd complement (16 bit) Value Hi (name).256 + Value Lo (name)

Mode =	0	= multi ramp Up
	1	= multi ramp Up Down
	2	= multi ramp Up Soak Down
	3	= single ramp Up
	4	= single rampUp Down
	5	= single ramp Up Soak Down
Mode X	0	= linear
	1	= square
STO Group selected	0	= A
	1	= B
	2	= C
	...	= ...
	n (max. 19)	= n (max. T)
Volt Vbat		= (Vbat x 2) / 51

CHKSUM (checksum) = DATA1 + DATA2 + DATA3 + DATA4).AND. FF

The above is useful to verify the integrity of transmitted and received data
The minimum time-out of the **UniCal Tc +** is 5 seconds.

8.7.5 Computer request for UniCal Tc+ settings

Computer		**UniCal Tc+**	
Tx IDNAME	→	Rx IDNAME	Proceed if name acknoledged
Rx IDNAME	←	Tx IDNAME	If not, do not answer
Tx Instruction	→	Rx Instruction	
Rx Instruction	←	Tx Instruction	
Tx DATA 1	→	Rx DATA 1	
Rx char	←	Tx char	
Tx DATA 2	→	Rx DATA 2	
Rx char	←	Tx char	
Tx DATA 3	→	Rx DATA 3	
Rx char	←	Tx char	
Tx DATA 4	→	Rx DATA 4	
Rx char	←	Tx char	
Tx CHKSUM	→	Rx CHKSUM	
Rx char	←	Tx char	

The **UniCal Tc+** receives and verifies CHKSUM; when not valid, it does not accept the transmitted data

Each PC instruction for operative mode request must be followed by the CHECSUM recalculation Instruction 47 (with the pertinent A and B values) as per the table below

Notes	**Instr**	**DATA 1**	**DATA 2**	**DATA 3**	**DATA 4**	**A**	**B**
Set Lin	25	Lin (actual)	x	x	x	---------	
Set display	26	Display (actual)	x	x	x	---------	
Set value	27	Value Hi (Out)	Value Lo (Out)	x	x	---------	
Start ramp	28	x	x	x	x	---------	
Start ramp	33	x	x	x	x	---------	
TIME RAMP	127	0	18	Time Hi	Time Lo	0	16
START RAMP	127	0	20	Start Hi	Start Lo	0	16
STOP RAMP	127	0	22	Stop Hi	Stop Lo	0	16
STEP RAMP	127	0	24	Step Hi	Step Lo	0	16
Lin/Dis RAMP	127	0	26	Lin	Display	0	16
MODE RAMP	127	0	28	Mode	0	0	16
LoX	127	0	34	LoX Hi	LoX Lo	0	32
HiX	127	0	36	HiX Hi	HiX Lo	0	32

DP/TYPE	127	0	38	DP	TYPE	0	32
MODE/Char 1	127	0	40	MODE	Char 1	0	32
Char 1/Char 2	127	0	41	Char 1	Char 2	0	32
Char 3/Char 4	127	0	43	Char 3	Char 4	0	32
Dis/Lin STO 0 #A	127	0	146	Display (0)	Lin (0)	0	144
Value STO 0 #A	127	0	148	Value Hi (0)	Value Lo (0)	0	144
Dis/Lin STO1 #A	127	0	150	Display (1)	Lin (1)	0	144
Value STO 1 #A	127	0	152	Value Hi (1)	Value Lo (1)	0	144
Dis/Lin STO 2 #A	127	0	154	Display (2)	Lin (2)	0	144
Value STO 2 #A	127	0	156	Value Hi (2)	Value Lo (2)	0	144
Dis/Lin STO 0 #B	127	0	162	Display (0)	Lin (0)	0	160
Value STO 0 #B	127	0	164	Value Hi (0)	Value Lo (0)	0	160
Dis/Lin STO1 #B	127	0	166	Display (1)	Lin (1)	0	160
Value STO 1 #B	127	0	168	Value Hi (1)	Value Lo (1)	0	160
Dis/Lin STO 2 #B	127	0	170	Display (2)	Lin (2)	0	160
Value STO 2 #B	127	0	172	Value Hi (2)	Value Lo (2)	0	160
Dis/Lin STO 0 #C	127	0	178	Display (0)	Lin (0)	0	176
Value STO 0 #C	127	0	180	Value Hi (0)	Value Lo (0)	0	176
Dis/Lin STO 1 #C	127	0	182	Display (1)	Lin (1)	0	176
Value STO 1 #C	127	0	184	Value Hi (1)	Value Lo (1)	0	176
Dis/Lin STO 2 #C	127	0	186	Display (2)	Lin (2)	0	176
Value STO 2 #C	127	0	188	Value Hi (2)	Value Lo (2)	0	176
Dis/Lin STO 0 #D	127	0	194	Display (0)	Lin (0)	0	192
Value STO 0 #D	127	0	196	Value Hi (0)	Value Lo (0)	0	192
Dis/Lin STO 1 #D	127	0	198	Display (1)	Lin (1)	0	192
Value STO 1 #D	127	0	200	Value Hi (1)	Value Lo (1)	0	192
Dis/Lin STO 2 #D	127	0	202	Display (2)	Lin (2)	0	192
Value STO 2 #D	127	0	204	Value Hi (2)	Value Lo (2)	0	192
Dis/Lin STO 0 #E	127	0	210	Display (0)	Lin (0)	0	208
Value STO 0 #E	127	0	212	Value Hi (0)	Value Lo (0)	0	208
Dis/Lin STO 1 #E	127	0	214	Dispaly (1)	Lin (1)	0	208
Value STO 1 #E	127	0	216	Value Hi (1)	Value Lo (1)	0	208
Dis/Lin STO 2 #E	127	0	218	Display (2)	Lin (2)	0	208
Value STO 2 #E	127	0	220	Value Hi (2)	Value Lo (2)	0	208
Dis/Lin STO 0 #F	127	0	226	Display (0)	Lin (0)	0	224
Value STO 0 #F	127	0	228	Value Hi (0)	Value Lo (0)	0	224
Dis/Lin STO 1 #F	127	0	230	Display (1)	Lin (1)	0	224
Value STO 1 #F	127	0	232	Value Hi (1)	Value Lo (1)	0	224
Dis/Lin STO 2 #F	127	0	234	Display (2)	Lin (2)	0	224
Value STO 2 #F	127	0	236	Value Hi (2)	Value Lo (2)	0	224
Dis/Lin STO 0 #G	127	0	242	Display (0)	Lin (0)	0	240
Value STO 0 #G	127	0	244	Value Hi (0)	Value Lo (0)	0	240
Dis/Lin STO 1 #G	127	0	246	Display (1)	Lin (1)	0	240
Value STO 1 #G	127	0	248	Value Hi (1)	Value Lo (1)	0	240
Dis/Lin STO 2 #G	127	0	250	Display (2)	Lin (2)	0	240
Value STO 2 #G	127	0	252	Value Hi (2)	Value Lo (2)	0	240
Dis/Lin STO 0 #H	127	1	2	Display (0)	Lin (0)	1	0
Value STO 0 #H	127	1	4	Value Hi (0)	Value Lo (0)	1	0
Dis/Lin STO 1 #H	127	1	6	Display (1)	Lin (1)	1	0
Value STO 1 #H	127	1	8	Value Hi (1)	Value Lo (1)	1	0
Dis/Lin STO 2 #H	127	1	10	Display (2)	Lin (2)	1	0

Value STO 2 #H	127	1	12	Value Hi (2)	Value Lo (2)	1	0
Dis/Lin STO 0 #I	127	1	18	Display (0)	Lin (0)	1	16
Value STO 0 #I	127	1	20	Value Hi (0)	Value Lo (0)	1	16
Dis/Lin STO 1 #I	127	1	22	Display (1)	Lin (1)	1	16
Value STO 1 #I	127	1	24	Value Hi (1)	Value Lo (1)	1	16
Dis/Lin STO 2 #I	127	1	26	Display (2)	Lin (2)	1	16
Value STO 2 #I	127	1	28	Value Hi (2)	Value Lo (2)	1	16
Dis/Lin STO 0 #J	127	1	34	Display (0)	Lin (0)	1	32
Value STO 0 #J	127	1	36	Value Hi (0)	Value Lo (0)	1	32
Dis/Lin STO 1 #J	127	1	38	Display (1)	Lin (1)	1	32
Value STO 1 #J	127	1	40	Value Hi (1)	Value Lo (1)	1	32
Dis/Lin STO 2 #J	127	1	42	Display (2)	Lin (2)	1	32
Value STO 2 #J	127	1	44	Value Hi (2)	Value Lo (2)	1	32
Dis/Lin STO 0 #K	127	1	50	Display (0)	Lin (0)	1	48
Value STO 0 #K	127	1	52	Value Hi (0)	Value Lo (0)	1	48
Dis/Lin STO 1 #K	127	1	54	Display (1)	Lin (1)	1	48
Value STO 1 #K	127	1	56	Value Hi (1)	Value Lo (1)	1	48
Dis/Lin STO 2 #K	127	1	58	Display (2)	Lin (2)	1	48
Value STO 2 #K	127	1	60	Value Hi (2)	Value Lo (2)	1	48
Dis/Lin STO 0 #L	127	1	66	Display (0)	Lin (0)	1	64
Value STO 0 #L	127	1	68	Value Hi (0)	Value Lo (0)	1	64
Dis/Lin STO 1 #L	127	1	70	Display (1)	Lin (1)	1	64
Value STO 1 #L	127	1	72	Value Hi (1)	Value Lo (1)	1	64
Dis/Lin STO 2 #L	127	1	74	Display (2)	Lin (2)	1	64
Value STO 2 #L	127	1	76	Value Hi (2)	Value Lo (2)	1	64
Dis/Lin STO 0 #M	127	1	82	Display (0)	Lin (0)	1	80
Value STO 0 #M	127	1	84	Value Hi (0)	Value Lo (0)	1	80
Dis/Lin STO 1 #M	127	1	86	Display (1)	Lin (1)	1	80
Value STO 1 #M	127	1	88	Value Hi (1)	Value Lo (1)	1	80
Dis/Lin STO 2 #M	127	1	90	Display (2)	Lin (2)	1	80
Value STO 2 #M	127	1	92	Value Hi (2)	Value Lo (2)	1	80
Dis/Lin STO 0 #N	127	1	98	Display (0)	Lin (0)	1	96
Value STO 0 #N	127	1	100	Value Hi (0)	Value Lo (0)	1	96
Dis/Lin STO 1 #N	127	1	102	Display (1)	Lin (1)	1	96
Value STO 1 #N	127	1	104	Value Hi (1)	Value Lo (1)	1	96
Dis/Lin STO 2 #N	127	1	106	Display (2)	Lin (2)	1	96
Value STO 2 #N	127	1	108	Value Hi (2)	Value Lo (2)	1	96
Dis/Lin STO 0 #O	127	1	114	Display (0)	Lin (0)	1	112
Value STO 0 #O	127	1	116	Value Hi (0)	Value Lo (0)	1	112
Dis/Lin STO 1 #O	127	1	118	Display (1)	Lin (1)	1	112
Value STO 1 #O	127	1	120	Value Hi (1)	Value Lo (1)	1	112
Dis/Lin STO 2 #O	127	1	122	Display (2)	Lin (2)	1	112
Value STO 2 #O	127	1	124	Value Hi (2)	Value Lo (2)	1	112
Dis/Lin STO 0 #P	127	1	130	Display (0)	Lin (0)	1	128
Value STO 0 #P	127	1	132	Value Hi (0)	Value Lo (0)	1	128
Dis/Lin STO 1 #P	127	1	134	Display (1)	Lin (1)	1	128
Value STO 1 #P	127	1	136	Value Hi (1)	Value Lo (1)	1	128
Dis/Lin STO 2 #P	127	1	138	Display (2)	Lin (2)	1	128
Value STO 2 #P	127	1	140	Value Hi (2)	Value Lo (2)	1	128
Dis/Lin STO 0 #Q	127	1	146	Display (0)	Lin (0)	1	144
Value STO 0 #Q	127	1	148	Value Hi (0)	Value Lo (0)	1	144

Dis/Lin STO 1 #Q	127	1	150	Display (1)	Lin (1)	1	144
Value STO 1 #Q	127	1	152	Value Hi (1)	Value Lo (1)	1	144
Dis/Lin STO 2 #Q	127	1	154	Display (2)	Lin (2)	1	144
Value STO 2 #Q	127	1	156	Value Hi (2)	Value Lo (2)	1	144
Dis/Lin STO 0 #R	127	1	162	Display (0)	Lin (0)	1	160
Value STO 0 #R	127	1	164	Value Hi (0)	Value Lo (0)	1	160
Dis/Lin STO 1 #R	127	1	166	Display (1)	Lin (1)	1	160
Value STO 1 #R	127	1	168	Value Hi (1)	Value Lo (1)	1	160
Dis/Lin STO 2 #R	127	1	170	Display (2)	Lin (2)	1	160
Value STO 2 #R	127	1	172	Value Hi (2)	Value Lo (2)	1	160
Dis/Lin STO 0 #S	127	1	178	Display (0)	Lin (0)	1	176
Value STO 0 #S	127	1	180	Value Hi (0)	Value Lo (0)	1	176
Dis/Lin STO 1 #S	127	1	182	Display (1)	Lin (1)	1	176
Value STO 1 #S	127	1	184	Value Hi (1)	Value Lo (1)	1	176
Dis/Lin STO 2 #S	127	1	186	Display (2)	Lin (2)	1	176
Value STO 2 #S	127	1	188	Value Hi (2)	Value Lo (2)	1	176
Dis/Lin STO 0 #T	127	1	194	Display (0)	Lin (0)	1	192
Value STO 0 #T	127	1	196	Value Hi (0)	Value Lo (0)	1	192
Dis/Lin STO 1 #T	127	1	198	Display (1)	Lin (1)	1	192
Value STO 1 #T	127	1	200	Value Hi (1)	Value Lo (1)	1	192
Dis/Lin STO 2 #T	127	1	202	Display (2)	Lin (2)	1	192
Value STO 2 #T	127	1	204	Value Hi (2)	Value Lo (2)	1	192

Notes	Instr	DATA 1	DATA 2	DATA 3	DATA 4	A	B
CHKSUM recalc.	47	A	B	0	0	----------	
SELECT GROUP	75	Group	0	0	0	----------	

The computer must split a 16 bit word into 2 words of 8 bit as follows

Value Hi (....) Value Lo (....)
Higher 8 bit Lower 8 bit
CHKSUM = (DATA1 + DATA2 + DATA 3 + DATA 4) .AND.7F

8.7.6 Communication programs

In this chapter are illustrated two examples of communication programs between the **UniCal Tc +** and an IBM or IBM compatible Personal Computer.

Example A:

Data transfer from UniCal Tc + to PC (see section 8.7.4)
Set IDNAME=1 and BAUD RATE=9600 on **UniCal Tc +** see 8.7.1).
Connect **UniCal Tc +**, through adapter BB530003 (TTL-RS232 converter), to personal computer communication port COM1.
Set the **UniCal Tc +** in mV measurement (IN) mode. Run the program and you will see on the screen of the computer the actual measured value (once).

Example B:

PC instructions to UniCal Tc + (see section 8.7.5)
Set IDNAME=1 and BAUD RATE=9600 on the **UniCal Tc +** (see 8.7.1).
Connect **UniCal Tc +**, through adapter BB530003 (TTL-RS232 converter), to personal computer communication port COM1.
Set the **UniCal Tc +** in OUT mode; running the program the **UniCal Tc +** will be automatically set to 20mV.

Example **A**:

```
1Ø CHAR = Ø
2Ø IDNAME = 1
3Ø INSTRUCTION = 24
35 OPEN "COM1: 96ØØ, N,8,1,CD,CS,DS,RS" FOR RANDOM AS # 1
4Ø PRINT #1, CHR$ (IDNAME);:REM TRANSMIT IDNAME TO UniCal Tc +
5Ø WHILE LOC (1) = Ø: WEND: REM WAIT RECEIVING IDNAME FROM UniCal Tc +
6Ø IDNAME = ASC (INPUT$ (1, 1)): REM READ RECEIVED IDNAME FROM UniCal Tc +
7Ø PRINT #1, CHR$ (INSTRUCTION);
8Ø WHILE LOC (1) = Ø: WEND
9Ø INSTRUCTION = ASC (INPUT$ (1, 1))
1ØØ PRINT #1, CHR$ (CHAR);
11Ø WHILE LOC (1) = Ø: WEND
12Ø DATA 1 = ASC (INPUT$ (1, 1))
13Ø PRINT #1, CHR$ (CHAR);
14Ø WHILE LOC (1) = Ø: WEND
15Ø DATA 2 = ASC (INPUT$ (1, 1))
16Ø PRINT #1, CHR$ (CHAR);
17Ø WHILE LOC (1) = Ø: WEND
18Ø DATA 3 = ASC (INPUT$ (1, 1))
19Ø PRINT #1, CHR$ (CHAR);
2ØØ WHILE LOC (1) = Ø: WEND
21Ø DATA 4 = ASC (INPUT$ (1, 1))
22Ø PRINT #1, CHR$ (CHAR);
231Ø WHILE LOC (1) = Ø: WEND
24Ø CHKSUM = ASC (INPUT$ (1, 1))
25Ø IF CHKSUM <> ((DATA1 + DATA2 + DATA3 + DATA4) AND &HFF) THEN PRINT "Error": END
26Ø VALUE = DATA3 * 256 + DATA4
27Ø IF VALUE > 32767 THEN VALUE =VALUE - 65536: REM 2'S COMPLEMENT
28Ø PRINT "VALUE: " ; VALUE / 1ØØ
29Ø END
```

Example **B**:

```
1Ø CHAR = Ø
2Ø IDNAME = 1
3Ø INSTRUCTION = 27
4Ø VALUE = 2ØØØ
5Ø VALUE$ = HEX$ (VALUE)
55 WHILE LEN (VALUE$)<4: VALUE$ ="Ø"+VALUE$: WEND
6Ø IF LEN (VALUE$) > 4 THEN VALUE$ =RIGHT$ (VALUE$,4)
65 DATA1 = VAL ("&H" + LEFT$ (VALUE$, 2))
7Ø DATA2 = VAL ("&H" +RIGHT$ (VALUE$, 2))
75 DATA3 = Ø
8Ø DATA4 = Ø
```

```
9Ø CHKSUM = (DATA1 + DATA2 + DATA3 + DATA4) AND &H7F
13Ø OPEN "COM1: 96ØØ,N,8,1,CD,CS,DS,RS" FOR RANDOM AS #1
14Ø PRINT #1, CHR$ (IDNAME)  ; : REM TRANSMIT IDNAME TO UniCal Tc +
15Ø WHILE LOC (1) = Ø: WEND: REM WAIT RECEIVING IDNAME FROM  UniCal Tc +
16Ø IDNAME =  ASC (INPUT$ (1 , 1)): REM READ RECEIVED IDNAME FROM UniCal Tc +
17Ø PRINT #1, CHR$ (INSTRUCTION) ;
18Ø WHILE LOC (1) = Ø : WEND
19Ø INSTRUCTION = ASC (INPUT$ (1 , 1))
2ØØ PRINT #1, CHR$ (DATA1) ;
21Ø WHILE LOC (1) = Ø : WEND
22Ø CHAR = ASC (INPUT$ (1 , 1))
23Ø PRINT #1, CHR$ (DATA2) ;
24Ø WHILE LOC (1) = Ø : WEND
25Ø CHAR = ASC (INPUT$ (1 , 1))
26Ø PRINT #1, CHR$ (DATA3) ;
27Ø WHILE LOC (1) = Ø : WEND
28Ø CHAR = ASC (INPUT$ (1 , 1))
29Ø PRINT #1, CHR$ (DATA4) ;
3ØØ WHILE LOC (1) = Ø : WEND
31Ø CHAR = ASC (INPUT$ (1 , 1))
32Ø PRINT #1, CHR$ (CHKSUM) ;
33Ø WHILE LOC (1) = Ø : WEND
34Ø CHAR = ASC (INPUT$ (1 , 1))
35Ø PRINT "Transmitted."
39Ø END
```

9 MAINTENANCE

The **UniCal Tc+** portable calibrator has been factory tested and calibrated before shipment.
The calibration should be verified and re-adjusted if the instrument is showing an error exceeding the declared specifications or when a critical active or passive component is replaced (either at component level or at board level)
The **UniCal Tc+** portable calibrator uses sophisticated analog and digital technologies.
Service requires highly trained personnel.
E Instruments will supply, on request, a technical reference manual, with all instructions and recommendation for service and calibration.
E Instruments engineers will give prompt support for any requests of assistance.

9.1 Safety recommendations

Primary elements (i.e. thermocouples, resistance thermometers, etc.) are normally linked to electrical potentials equal or near to the ground potential. However, in some applications, there may be present a common mode voltage to earth.
Check for the voltage between input terminals and ground as this voltage can be transmitted to other devices connected to the calibrator.

9.2 Spare parts

EE620005	1.25 V Ni-Cd rechargeable battery (AA size)
EE730008	Schuko mains plug
EE730009	European mains plug
EE730010	UK mains plug
EE730011	USA mains plug
BB880001	Soft plastic case with shoulder strap
BB290000	Battery charger module set at 220 - 240 V 50/60 Hz Schuko mains plug
BB290001	Battery charger module set at 110 - 120 V 50/60 Hz USA mains plug
BB290004	Battery charger module set at 220 - 240 V 50/60 Hz UK mains plug
BB290013	Battery charger module set at 220 - 240 V 50/60 Hz European mains plug
BB530003	TTL to RS232 adapter

9.3 Storage

If the instrument is left unused for a long time, it is recommended to remove batteries.
Store the instrument in the original package at a temperature from -30°C to +60°C, with R.H. less than 90% (non condensing).
If the instrument has been unused for a month check the battery voltage and charge the Ni-Cd batteries for at least 12 hours.

10 CERTIFICATES

10.1 Certificate of warranty

Each instrument is shipped with a certificate of warranty that indicates the validity conditions of the warranty itself.

E Instruments warrants its products against defects in material and workmanship for a period of 2 years from the date of original retail purchase.

Any misuse, abuse, or non **E Instruments** authorized alterations, modifications and/or repairs to the **E Instruments** product will void the warranty. If you discover a defect, **E Instruments** will repair or replace the product, provided you return the product during the warranty period, transportation prepaid, to **E Instruments**.

This warranty applies to the original purchaser only.
Please include a copy of the original invoice or a small service charge may be applied.
Prior to returning the product for warranty consideration, call **E Instruments** Technical Support for a returned material authorization number and shipping instructions.

10.2 Certificate of conformity

Each instrument is shipped with a Letter of Conformity, to grant that the characteristics of the instrument correspond to the required ones, and that the instrument calibration is traceable to National and International Standards.
The instrument has been found to conform in all respects to specifications, drawings, workmanship standards and order requirements.

APPENDIX

A1 EMC Conformity

The instrument case, made in shock-resistant injection moulded ABS + polycarbonate has an internal metal coating to fulfil the prevision of the directive 89/336/CEE Electromagnetic Compatibility.
In the following page you will find the EMC declaration of conformity

Declaration of Conformity

We : Eurotron Instruments S.p.A.
(Supplier's name)

Viale F.lli Casiraghi, 409/413 20099 Sesto S. Giovanni (MI) - Italy
(Address)

declare under our sole responsability that the product :

Portable indicator-calibrator type UniCal Tc+
(Name and type)

Cat. 3908
(Model)

to which this declaration relates is in conformity with the following normative documents :

EN 50082-2 (3/95)
IEC 1000-4-2 / IEC 1000-4-4 / IEC 1000-4-11
ENV 50140 - ENV 50141 - ENV 50204

EN 55011
(Title, number and date of issue of normative documents)

following the prevision of directive :

89/336/CEE Electromagnetic Compatibility (EMC)

Sesto S. Giovanni, January 08th, 1996
(Place and date of issue)

(Signature of authorized person)

eurotron