F/N 3922:440-1

meriam process technologies

a Scott Fetzer company

ULTI-Cal

Handheld Multifunction Indicator - Simulator

User's Manual

INTRODUCTORY NOTE

*This manual includes all the information you need to install, operate and maintain the **MULTI-Cal** MultifunctionCalibrator and its accessories.*

***Meriam** has used the best care and efforts in preparing this book and believes the information in this publication to be accurate. **Meriam** products are subjected to continuous improvement; these improvements could require changes to the information of this manual. **Meriam** reserves the right to change such information without notice.*

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***MULTI-Cal Multifunction Calibrator** uses sophisticated analog and digital technologies. Any maintenance operation must be carried out by qualified personnel **ONLY**. **Meriam** supplies instructions and operative procedures for any operation on the instrument. We recommend contacting our technicians for any support requirements.*

***MULTI-Cal** is fully tested in conformity with the Directive No.89/336/CEE Electromagnetic Compatibility. **Meriam** shall not be liable in any event, including technical and publishing errors or omissions, for any incidental and consequential damages, in connection with, or arising out of the use of this book.*

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1 GENERAL PERFORMANCE

MULTI-Cal is a complete system to test, measure and calibrate a variety of field device with a single handheld instrument. This indicator-simulator is a multifunction instrument, with 2 isolated and independent channels, designed to meet the needs of instrumentation engineers on the test bench and in the field. Accurate, compact, rugged, and easy to use MULTI-Cal is the ideal solution to measure and simulate millivolts, volts (up to 10V) and mA on active and passive loop. The two channels allow simultaneous measurement and simulation for voltage (up to 30V) and current on active and passive loop.

Channel 1 (In-Out)

- millivolt
- volt
- milliampere
- ohm
- temperatures with thermocouples
- temperatures with resistance thermometers

Channel 2 (In)

- volt
- milliampere

The MULTI-Cal has been developed using the most advanced microprocessor technology to provide high accuracy on extended ranges and powerful operating flexibility.
The modular firmware includes the algorithms of thermocouples and resistance thermometers in accordance with IEC, DIN standards. IPTS68 and ITS90 linearization are memory stored and can be selected through the keyboard.
The simulation-measurement of resistance and temperature with resistance thermometer uses a special proprietary active circuit (Patent no. 206327).
A unique internal automatic Reference junction (Rj) compensation system allows the MULTI-Cal to provide accurate input and output readings over wide operating conditions, with a temperature range from -5°C to +50°C. External compensation is also available with temperature adjustable from -50°C to +100°C.
The selection of operating functions is made on a polycarbonate thermoformed membrane keyboard which assures up to one million operations per key.
Two thick film membrane "slidewires" (Patent Pending) are used to set the simulated signal value.
Measured and simulated values are indicated on a high quality LCD dot matrix display which provides good contrast even in poor light conditions.
A menu-driven procedure allows for the generation of up to 60 memory stored values, or for continuous or step ramp simulation values.
The instrument executes mathematical functions for averaging unstable input signals and, when used in combination with the scale factor, for square root calculations.
The shock-resistant ABS case is ergonomically designed for easy and practical use.
The instrument is powered by a rechargeable Ni-MH rechargeable battery pack. An external battery charger is supplied as a standard accessory.

1.1 MULTI-Cal model code

Cat. 3922 - A - B

Each instrument is supplied with rechargeable battery pack, AC charger / power adapter, soft case, NIST traceable certificate + data and User's Manual.

Table	**A**	**Battery type**
	1	Ni-MH rechargeable battery pack with external charger / AC power supply Plug Types (specify plug type with order): Ni-MH/120VAC 50/60 Hz – USA plug Ni-MH/230VAC 50/60 Hz – Schuko plug Ni-MH/230VAC 50/60 Hz – UK plug Ni-MH/230VAC 50/60 Hz – European plug Ni-MH/100VAC 50/60 Hz – USA/Japan plug

Table	**B**	**Options**
	0	No NIST certificate
	1	NIST certificate + data

1.2 Specifications

International Temperature Scale:	both IPTS 68 and ITS 90
Reference Junction Compensation (Rj):	internal automatic from -5°C to +50°C (+23°F to +122°F) External programmable from -50°C to +100°C (-58°F to +212°F)
Reference Junction accuracy:	± 0.15°C/°C for temperatures below or exceeding the +18°C to +28°C (64°F to 82°F) band
Common Mode Rejection:	>130 dB at 50/60 Hz ±1 Hz
Normal Mode Rejection:	>65 dB at 50/60 Hz ±1 Hz
Temperature stability:	for temperatures below or exceeding the +18°C to +28°C (64°F to 82°F) band Span: ±0.003% of rdg/°C (Channel 1 only) ±0.015% of rdg/°C (Channel 2 only) Zero: ±0.2 μV/°C (Channel 1 only) ±0.5 mV/°C or ±0.4 μA/°C (Channel 2 only)
Rtd and Ω measurement excitation current:	0.25 mA
Rtd and Ω simulation excitation current:	from 0.2 to 3 mA
Rtd cable compensation error:	±0.005°C/Ω of total cable resistance
Rtd cable compensation limit:	100 Ω each wire
Shunt resistance (mA range):	38 Ω (Channel 1 only) 105 Ω (Channel 2 only)
mA measurement and generation	Active and Passive loop
Input impedance:	10 MΩ 1 MΩ (10 V range and Channel 2 only)
Output Impedance (mV and Tc):	<0.5 Ω with a maximum current of 0.5 mA
Maximum resistance load:	1000 Ω at 20 mA
Maximum input overvoltage:	50 V 5 V (Rtd ranges only)
Maximum input overcurrent:	100 mA 6 mA (Rtd ranges only)
Source resistance effect:	1 μV/1000 Ω
Engineering unit indication:	4 characters directly on the display
Power supply:	n. 4 rechargeable Ni-MH battery Mains operation and battery charge 100, 115, 230 V 50/60 Hz
Recharging time:	max 12 h at 90%
Battery life:	12 h on measuring mode - 4 h on 20 mA passive loop
Display:	high contrast alphanumeric LCD with backlight device
Operative ambient temperature:	from -10°C to 50°C (15°F to 122°F)
Storage temperature:	from -30°C to 60°C (-22°F to 140°F)
Case:	ABS 120x60x230 mm
Weight:	net 1 kg gross 1.5 kg

1.4.1 Table of ranges and accuracy MULTI-Cal

Sensor or parameter		Total range	Accuracy Range	Resolution	Accuracy (%of rdg)
Tc type **J**	°C	-210 to +1200	-170 to 1200	0.1	±0.03% (2)
	°F	-346 to +2192	-274 to 2192	0.1	±0.03% (2)
Tc type **K**	°C	-270 to +1370	-120 to 1300	0.1	±0. 03% (1)
	°F	-454 to +2498	-184 to 2372	0.1	±0. 03% (1)
Tc type **T**	°C	-270 to +400	-120 to +400	0.1	±0. 03% (1)
	°F	-454 to +752	-184 to 752	0.1	±0. 03% (1)
Tc type **R**	°C	0 to +1760	+500 to +1700	0.1	±0. 03% (3)
	°F	+32 to +3200	+932 to +3092	0.1	±0. 03% (3)
Tc type **S**	°C	0 to +1760	+800 to +1760	0.1	±0. 03% (3)
	°F	+32 to +3200	+1472 to +3200	0.1	±0. 03% (3)
Tc type **B**	°C	+200 to +1820	+1000 to +1820	0.1	±0. 03% (3)
	°F	+392 to +3308	+1832 to +3308	0.1	±0. 03% (3)
Tc type **C**	°C	0 to +2300	0 to +2300	0.1	±0. 03% (3)
	°F	+32 to +4172	+32 to +4172	0.1	±0. 03% (3)
Tc type **G**	°C	0 to +2300	200 to +2300	0.1	±0. 03% (3)
	°F	+32 to +4172	+392 to +4172	0.1	±0. 03% (3)
Tc type **D**	°C	0 to +2300	0 to +2200	0.1	±0. 03% (3)
	°F	+32 to +4172	+32 to +3992	0.1	±0. 03% (3)
Tc type **U**	°C	-200 to +400	-120 to +400	0.1	±0. 03% (1)
	°F	-328 to +752	-184 to +752	0.1	±0. 03% (1)
Tc type **L**	°C	-200 to +760	-180 to +760	0.1	±0. 03% (1)
	°F	-328 to +1400	-292 to +1400	0.1	±0. 03% (1)
Tc type **N**	°C	0 to +1300	0 to +1300	0.1	±0. 03% (1)
	°F	+32 to +2372	+32 to +2372	0.1	±0. 03% (1)
Tc type **E**	°C	-270 to +1000	-150 to +1000	0.1	±0. 03% (1)
	°F	-454 to +1832	-238 to +1832	0.1	±0. 03% (1)
Tc type **F**	°C	0 to +1400	0 to +1400	0.1	±0. 03% (1)
	°F	+32 to +2552	+32 to +2552	0.1	±0. 03% (1)
Pt 100	°C	-200 to +850	-200 to +600	0.1	±0. 03% (2)
IEC	°F	-328 to +1562	-328 to +1112	0.1	±0. 03% (2)
Pt 100	°C	-200 to +850	-200 to +600	0.1	±0. 03% (2)
JIS	°F	-328 to +1562	-328 to +1112	0.1	±0. 03% (2)
Pt 100	°C	-200 to +850	-200 to +600	0.1	±0. 03% (2)
US	°F	-328 to +1562	-328 to +1112	0.1	±0. 03% (2)
Ni100	°C	-60 to +180	-60 to +180	0.1	±0. 03% (1)
	°F	-76 to +356	-76 to +356	0.1	±0. 03% (1)
Ni120	°C	0 to +150	0 to +150	0.1	±0. 03% (1)
	°F	+32 to +302	+32 to +302	0.1	±0. 03% (1)
mV		-18 to +21	-18 to +21	1µV	±(0.02%+3µV)
mV		0 to +100	0 to 21	1µV	±(0.02%+3µV)
			21 to 53	10µV	±(0.02%+3µV)
			53 to 100	10µV	±(0.02%+6µV)
mV		0 to 1000	0 to 1000	100µV	±(0.02%+60µV)
V		0 to 10	0 to 10	1mV	±(0.02%+0.4mV)
mA		0 to 21	0 to 21	1µA	±(0.02%+0.5µA)
Ω (IN)		0 to 400	0 to 400	10mΩ	±(0.02%+38mΩ)
Ω (OUT)		0 to 400	0 to 400	10mΩ	±(0.03%+78mΩ)
		MULTI-Cal (CH2)			
mA (IN)		0 to +22	0 to +22	1µA	±(0.03%+1µA)
V (IN)		0 to 30	0 to 30	1mV	±(0.03%+1.2mV)

Note:

- The relative accuracies shown are stated for 360 days and operative conditions from +18°C to +28°C (+64 °F to +84°F).
- Typical 90 days relative accuracy can be estimated by dividing the "% of rdg" specifications by 1.8.
- Typical 2 year relative accuracy can be estimated by multiplying the "% of rdg" specifications by 1.5.
- All input ranges: additional error ±1 digit.
- Meriam traceability chart and uncertainty can be supplied on request

(1) zero error ±0.1°C
(2) zero error ±0.15°C
(3) zero error ±0.5°C

2 GENERAL FEATURES

2.1 Input and output flexibility

Advanced flexibility of performance has been achieved using microprocessor technology. Each instrument, through a menu-driven procedure, allows measurement or simulation of mV, V, mA, Ω, or any normalized IEC, DIN and JIS thermoelectric sensor J, K, T, R, S, B, C, U, L, N, E, F, G, D, Pt100, Ni100 and Ni120.
The microprocessor performs automatic polynomial linearization and cold junction compensation to assure high accuracy. °C or °F selection can be made through a reconfiguration set-up.

2.2 Self calibration

The hardware-firmware design allows an automatic calibration of the instrument. A precision source (from 0 to 10V), a 0°C reference system, a standard resistor of 400Ω (±0.02% accuracy) and an ohm meter are necessary. The calibration procedure is protected by a security code.

2.3 Keyboard

A thermoformed metal-click tactile polycarbonate membrane keyboard, with a working life of one million operations per key, seals the internal electronics from the surrounding environment.
Contact closure of membrane keys is acknowledged, as a coded signal, directly by the microprocessor. Two membrane slidewires (patent pending) allow operator setting of the simulation value.

2.4 Display

The high contrast alphanumeric LCD display with dot matrix (2 rows x 16 characters) allows easy reading, even in poor light conditions, and simultaneously indicates the active function (measured or simulated), engineering unit and type of sensor or signal.

2.5 Scale factor function

Menu-driven set-up to measure or simulate electrical signal values in terms of engineering units.
Four programmable alphanumeric characters are available 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.

2.6 Square root function

Can be programmed during the set-up procedure (e.g. linear ranges only) to obtain direct readings of flow from a ΔP transmitter signal. The display limits are 0 and +2500.

2.7 Average measurements

For measurement of unstable input signals by a progressive averaging of a programmable number of conversions.

2.8 Simulation programs

Menu-driven set-up to generate:

- a continuous or step ramp output where the user enters total time, start point, end point and size of the step as prompted by the set-up procedure menu

- a manual repeat increment through keyboard
- an automatic sequence of up to 60 stored values (20 groups of 3 memories).

2.10 Case

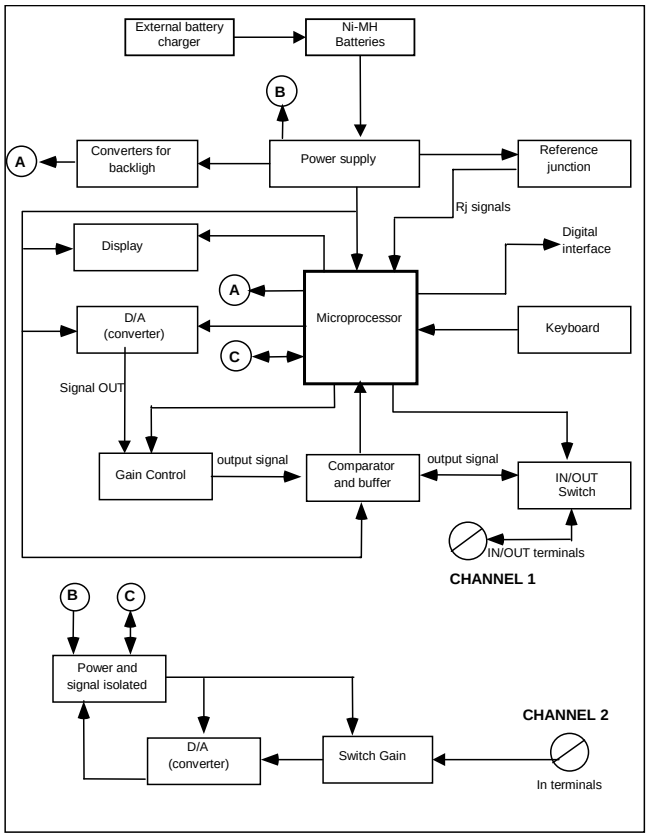
The case is designed for easy hand held operation and transportation.
The body is injection moulded, shock-resistant ABS with internal metal coating.
A soft carrying case with shoulder strap is supplied with the instrument as a standard accessory.

3 PHYSICAL DESCRIPTION

The MULTI-Cal portable calibrator consists of a rugged and compact case, a mother board with all base functions, a daughter board for the auxiliary functions, a tactile membrane keyboard, an LCD display and a rechargeable NiMH battery pack.
The internal surface of the case is metal coated to improve the characteristics of electrical noise shielding and thermal equalization of all internal circuits.
The battery container is located on the lower part of the case, and it is accessible through a cover fastened by a metal screw.
The two halves of the case are joined together by four metal screws located on the back side.
The soft case, with shoulder strap, assures better protection of the instrument against mechanical knocks or scratches.

4 FUNCTIONAL DESCRIPTION

The MULTI-Cal portable calibrator block diagram is shown below.



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

4.1 Power supply

The instrument is powered by an internal Ni-MH battery pack that can be recharged through an external charger module / AC power supply that is supplied as a standard accessory.

Pressing the <**ON**> key will provide all instrument supply:

Channel 1

+ 5 Vdc	for logic and analog circuits
- 5 Vdc	for analog circuits
+24 Vdc	for current loop power supply

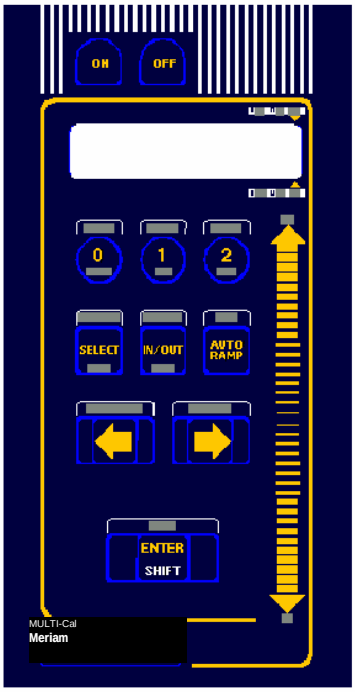
Channel 2

+ 5 Vdc	for logic and analog circuits
- 5 Vdc	for analog circuits
+24 Vdc	for current loop power supply

The above voltage levels are required to work with an external resistance of 1000Ω maximum when in current simulation mode (20 mA - 20 V).
Recommendations and instructions to use the external power supply and charging module are in sections 8.3.

4.2 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 recognises the operators instructions.
Keys are interconnected on a 4x3 matrix; the microprocessor directly identifies the active key.
The values of the **<⬆>** and **<⬇>** keys (membrane slidewires) are acknowledged through the converters built in the microprocessor chip.

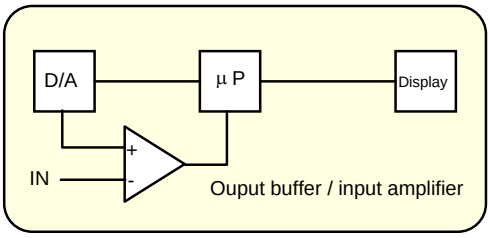


ON	Power ON switch
OFF	Power OFF switch
IPTS68-ITS90	Temperature Scale selection
Rj	Reference junction internal-external selection
<⬆ and <⬇	Membrane slidewires to set the simulation value (to scroll the menu of input tables and library of engineering characters).
STORE	Memory load
<← > <→>	Parameter selection or decimal point position
START	Low limit setting of the simulation cycle
END	High limit setting of the simulation cycle
STEP	Step value setting of the simulation cycle
MODE	Simulation cycle mode selection
SOAK	Soak time setting of the simulation cycle
TIME	Total time setting of the simulation cycle
0, 1, 2	In/Out memories
°C/°F	Technical unit selection
SELECT	Parameter selection procedure
AVERAGE	Average measurements
IN/OUT	In/Out (measure/simulate) mode selection
CONVERT	Technical unit to equivalent electrical signal

AUTORAMP	Ramp program start
PROGRAM X	Scale factor program
BATTERY	Battery voltage indication
ENTER	Memory store key
SHIFT	Key secondary function
LAMP	Display backlight ON/OFF

4.3 Input circuit

The input circuit is based on an 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 acknowledges 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 and 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.
The microcomputer provides highly sophisticated, on- chip peripheral functions including: 256 bytes of static RAM, an 8 channel analog to digital (A/D) converter (used to read the Rj value, the setting of the input comparator, the battery package voltage and the value of the two membrane slidewires), a serial communication interface (SCI) subsystem, and a serial peripheral interface (SPI) subsystem.
The microprocessor works with an 8-bit communication bus to the EPROM and EEPROM memories and is interfaced with a decoder, a latch of address and an inverter-driver.

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 application system firmware is resident on the non-volatile memory (EEPROM) of the microprocessor chip. It is used to store the installation parameters (autocalibration data, programs data, etc.)

4.6 Display

The digital display, mounted on an auxiliary board, uses high contrast LCD technology (STN liquid).
Character generation is made by a secondary dedicated microprocessor driven by two integrated circuits with signal input from the bus of the main microprocessor. The 16 characters are displayed with a 7x5 dot matrix.
MULTI-Cal is equipped with a backlight device for easy readings in poor light conditions.

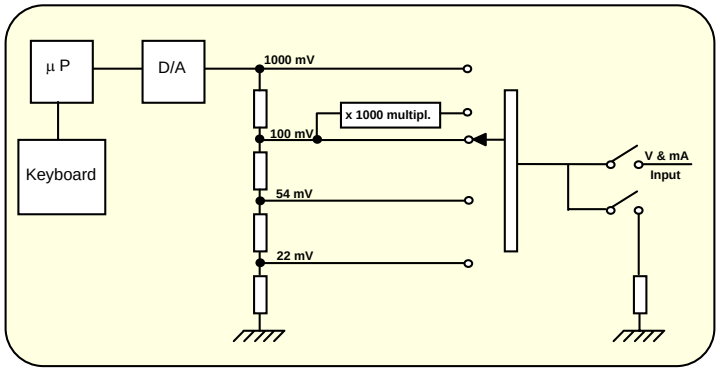
4.7 Digital to analog converter

A 16-bit digital to analog device, driven directly by the microprocessor converts the digital value of the selected parameter into an analog current output.

The current signal is converted into a voltage signal across a resistance strip network.
One analog switch and 2 opto-fets select ranges. The four ranges are:

-18	to	+22 mV	Tc type R, S, B, T and the negative portion of all Tc's
-0.2	to	+54 mV	all other thermocouples
-0.2	to	+100,1 mV	100 mV range and Rtd
-2	to	+1001 mV	1000 mV range and 0-20 mA range
-0.02	to	+10.010 V	10 V range

The above signal, through an output buffer, is sent to an integrated circuit that will generate the voltage or current requested by the operator keyboard settings.

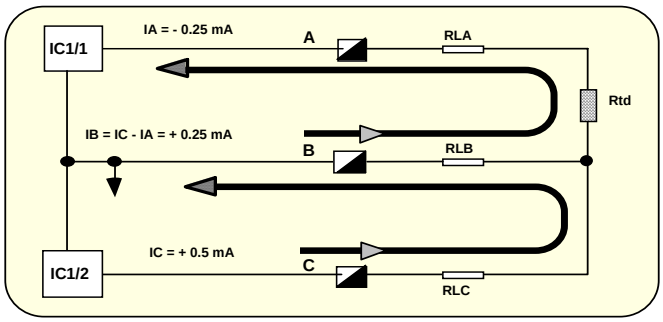


4.8 Battery charger

The auxiliary module, supplied as a standard accessory, allows operation from 110-120 Vac or 220-240 Vac 50/60 Hz.
The calibrator, if needed, can be operated directly from a line source through the charger.
The plastic case of the battery charger incorporates the line voltage plug and a cable with connector for interconnection to the instrument.
The charger circuit is designed with an insulating transformer and a voltage stabilizer circuit.
The step-down transformer reduces the power line (110-120 Vac or 220-240 Vac nominal) to a value of 10 Vac.
The above voltage is full wave rectified , filtered and stabilized.
The output voltage of 6.6 V is the ideal value to recharge the internal Ni-MH batteries.
adaptor to convert TTL to RS 232 voltage levels can be obtained on request.

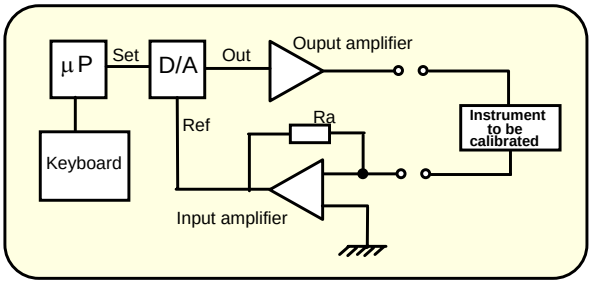
4.9 Resistance and RTD measurements

The resistance thermometer (Rtd) is connected to terminals A-B-C in a 3-wire configuration (see figure on the next page).
Two constant current generators are provided by the auxiliary module for supplying the Rtd.
The first half of "IC1" generates the negative current. I_A= - 0.25 mA that flows from terminal B to terminal A through the Rtd and line resistances RLA and RLB. I_A is kept constant by the microprocessor that controls the zero voltage level. The second half of "IC 1", with the associated resistors, generates the positive current I_C that flows from terminal C to terminal B through line resistances RLC and RLB. Current I_C is kept exactly = 2 x I_A, so the resultant current $I_B = I_C - I_A$ flows through RLB. The input measured signal across terminals A and B is the algebraic sum of drop voltages across Rtd and line resistances RLA and RLB.
As drop voltages across RLA and RLB are exactly the same (providing that line resistances RLA and RLB are equals), but with opposite poles, the resultant voltage across terminals A and B is proportional to Rtd resistance variation, with no influence of line resistance.
The measured signal is then handled by the microprocessor that linearizes it and displays the corresponding value in engineering units.



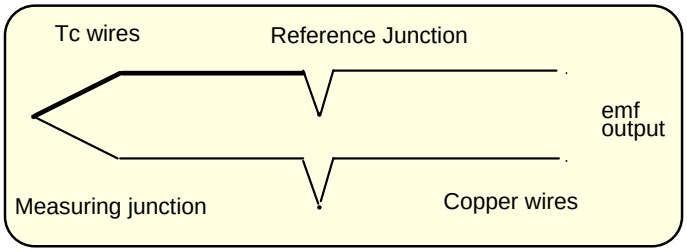
4.11 Resistance and RTD simulation

The MULTI-Cal portable calibrators are equipped with an electronic circuit for the active simulation (Patent no. 206327) of platinum and nickel resistance thermometers and resistances.
It is based on the assumption that the instrument to be calibrated will supply the excitation current to the sensor; this current must be between 0.2 and 5 mA (typical working values).
A lower value will generate an insufficient precision level and a higher current won't permit the simulation of high resistance values (maximum voltage drop on the simulated resistance is 2 V).
The excitation current must be applied to the pertinent terminals as indicated in par. 7.1 (simulation).
That current, flowing through resistance " Ra" (precision ± 0.01%) will generate a voltage drop that will be amplified and sent to the D/A converter. The output amplifier will simulate the variation of the output resistance as a function of the value set by the operator through the keyboard.
The connection between "+" and "-" terminals must be left open.



4.12 Thermocouples IN/OUT

A thermocouple 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.



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 a practical tool 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 Practical Temperature Scales (IPTS68 or ITS90).
The portable calibrator MULTI-Cal has the reference junction located in the negative (black) terminal post. To improve overall accuracy the terminals are designed with a very low thermal capacity.
Inside the body of the negative 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 requirements.

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.

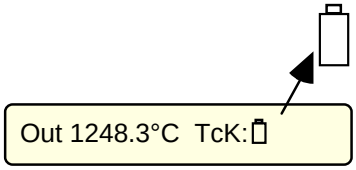
Inspect the instrument for scratches, dents, damage to case corner etc. which may have occurred during shipment.
If any mechanical damage is noted, report the damage to the shipping carrier and then notify **MERIAM** directly or it's nearest agent, and retain the damaged packaging for inspection.

A label located on the back of the case indicates the serial number of the instrument.
Refer to this number for any inquiry for service, spare parts supply, application or technical support requirements.

6 PRE-OPERATIONAL CHECK

The MULTI-Cal portable calibrator is powered by a rechargeable Ni-MH battery pack.
The external battery charger, supplied as standard, may be ordered for either 110/120 Vac or 220/240 Vac power source.
Before using the instrument carefully verify the nominal voltage value of the charger.

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 4.6 V) the display will show the appropriate symbol.
An empty symbol means that the battery package has enough energy for about 30 minutes operation.
A black symbol means that batteries charge is below the minimum acceptable level: operation of the instrument is no longer possible. In this condition the instrument battery pack must be recharged.

7 ELECTRICAL CONNECTIONS

Appropriate extension wires should be used between the thermocouple (or instrument under calibration) and the MULTI-Cal unless the thermocouple leads permits 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 wires connection is heated.
Colour codes of compensating cables change in different countries. Check the appropriate table.
For Rtd connection use a cable of adequate gauge to lower the overall input resistance.
The use of a cable with a good resistance balance between conductors is also necessary.

Table A
Colour code & polarity for extension wires (ANSI)

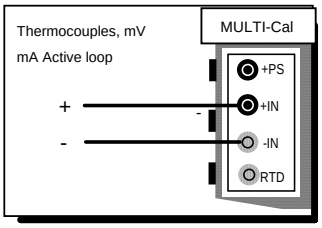
Thermocouple			Wires	Colour code
E	Chromel	(+)	Chromel	Purple
	Constantan	(-)	Constantan	Red
J	Iron	(+)	Iron	White
	Constantan	(-)	Constantan	Red
K	Chromel	(+)	Chromel	Yellow
	Alumel	(-)	Alumel	Red
R	Pt 13% Rh	(+)	Copper	Black
	Platinum	(-)	Alloy 11	Red
S	Pt 10% Rh	(+)	Copper	Black
	Platinum	(-)	Alloy 11	Red
T	Copper	(+)	Copper	Blue
	Constantan	(-)	Constantan	Red
B	Pt 6% Rh	(+)	Copper	
	Pt 30% Rh	(-)	Copper	
N	Nicrosil	(+)	Nicrosil	Orange
	Nisil	(-)	Nisil	Red

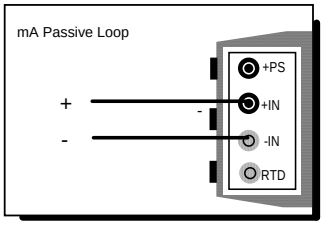
7.1 Wiring practice

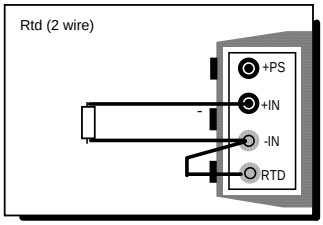
Although the portable calibrator is designed to be insensitive to transients or noise, the following recommendations should be followed to reduce AC pick up in the signal leads and to ensure good performance.
The input leads should not be run near AC line wiring, transformers and heating elements.
Input/output 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.
Above figure shows some examples of input/output wiring and connections.

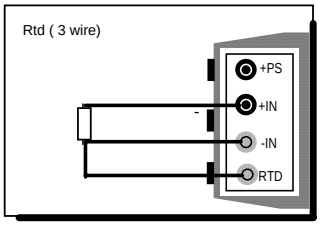
Examples of input /output wiring and connections

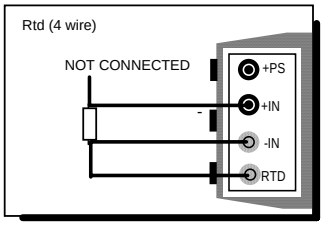
MEASURE CH1



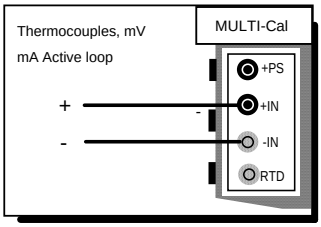


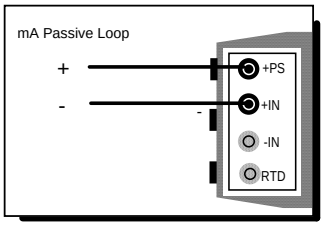


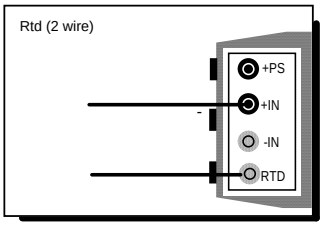


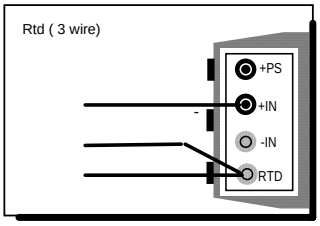


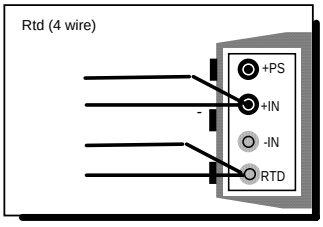
SIMULATION CH1



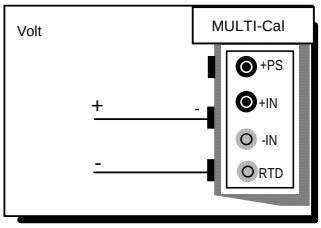


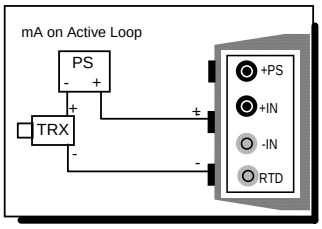


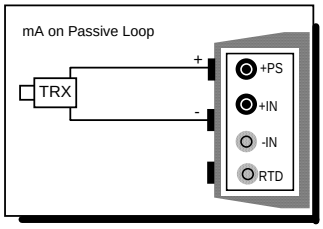




MEASURE CH2







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 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 thermocouples.

Limit of Error of thermocouple wires

The range indicated is the temperature limit for the indicated errors Cold junction at 0 °C

Tc	Class 1	Class 2	Class 3
type T	0.5°C (-40 to +125°C) 0.004. T (T >125°C)	1°C (-40 to 133°C) 0.0075. T (T >133 °C)	1°C (-67 to 40°C) 0.015. T (T <-67°C)
T range	-40 to +350°C	-40 to +350°C	-200 to 40°C
type E	1.5°C (-40 to 375°C) 0.004.T (T >375°C)	2.5°C (-40 to 333 °C) 0.0075.T (T >333°C)	2.5°C (-167 to +40°C) 0.015.T (T <-167°C)
T range	-40 to 800°C	-40 to 900°C	-200°C to 40°C
type J	1.5°C (-40 to 375°C) 0.004.T (T >375°C)	2.5°C (-40 to 333 °C) 0.0075.T (T >333°C)	2.5°C (-167 to +40°C) 0.015.T (T <-167°C)
T range	-40 to 750°C	-40 to 750°C	-----
type K e N	1.5°C (-40 to 375°C) 0.004.T (T >375°C)	2.5°C (-40 to 333 °C) 0.0075.T (T >333°C)	2.5°C (-167 to +40°C) 0.015.T (T <-167°C)
T range	-40 to 1000°C	-40 to 1200°C	-200°C to 40°C
type R e S	1°C (0 to 1100°C) 1 + 0.003 (T-100) (T >1100°C)	1.5°C (-40 to 600 °C) 0.0075.T (T >600°C)	4°C (600 to +800°C) 0.005.T (T>800°C)
T range	0 to 1600°C	0 to 1600°C	----
type B	1°C (0 to 1100°C) 1 + 0.003 (T-100) (T >1100°C)	1.5°C (-40 to 600 °C) 0.0075.T (T >600°C)	4°C (600 to +800°C) 0.005.T (T>800°C)
T range	-----	600 to 1700°C	600 to 1700°C

8 POWER SUPPLY

8.1 Rechargeable batteries

The MULTI-Cal portable calibrator is powered by a rechargeable Ni-MH battery pack. The instrument is shipped with an average level of charge. After unpacking, a full charge of the pack is recommended; connect the instrument to the charger module ("OFF" condition) for a period of 10 hours minimum.
The Ni-MH rechargeable pack does 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 discharge, 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 original supplied charging module. The module incorporates protection and current limiting devices not normally found in other commercial chargers.

- When the MULTI-Cal is connected to the battery charger module, pressing keys <**SHIFT**> + <**BATTERY**> will result in the following displayed:

Battery: Line Op

If a numeric value appears, it indicates that the charger is probably faulty.
Replace the battery charger module; if the indication persists, contact **Meriam** -Technical Assistance Dept.

8.2 Battery Charger

The external battery charger is configured, before shipment, for a supply voltage of 110-120 Vac or 220- 240 Vac, upon order specification. The nominal voltage value is indicated on the front label of the charger. Check for the correct input voltage before connect it to the line.

8.3 How to maximize the battery life

Disconnect the AC mains supply when the battery is charged. Use the battery until it is completely discharged.
Leaving the AC mains supply plugged in will decrease the life of the battery.
Keeping the battery terminal clean will help maximize the operating time. Periodically wipe the positive and negative terminals with a dry cloth.
Removing and replacing the batteries will ensure electrical contact. This should be done when using a battery that has not been used for a long time.
Note that the operating time decreases at low temperatures.
A Ni-MH battery can be recharged about 500 times when used with the recommended instructions.
Always replace the Ni-MH battery pack with a completely new pack.

9 OPERATION & APPLICATIONS

The MULTI-Cal portable calibrator is factory calibrated before shipment. During start-up the operator should only select and load the pertinent application parameter as described below.

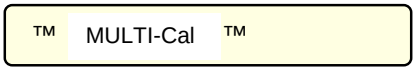
9.1 Power ON

ATTENTION: VALUES IN THE FOLLOWING FIGURES ARE ONLY LISTED AS EXAMPLES ONLY.

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

<A> + <B> Press and hold the **<A>** key and then press 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 be displayed for a few seconds:



- The instrument runs an autodiagnostic routine for the self-checking of critical circuits and components. A positive check will be shown briefly with the indication:

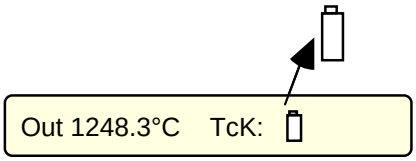
- The number on the right side of the display indicates the version of the memory installed on the instrument. The instrument is ready for measurement (IN mode) with the previously selected operating mode, as indicated below:

Any faulty conditions that may be indicated are described in section 10.1.

9.2 Battery voltage indication

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

- The horizontal bar indicates the level of charge of the battery (each bar is equivalent to 25% of the full capacity)
- The "low" limit of the battery voltage, for the correct operation of the instrument, is +4.6V.
- Press any key to reset the main operation mode.
- During normal operating modes (measure or simulation), "low battery" condition will be shown as follows:



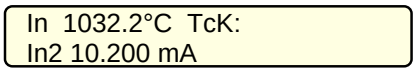
The battery symbol indicates that the battery has enough energy for about 30 minutes operation.
A black symbol means that battery charge is below minimum: batteries must be recharged.

9.3 Operating mode

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

9.3.1 IN/OUT mode selection

- Press the **<ON>** key to power the instrument.
- After diagnostic routine, the calibrator will be forced into the "IN" function with the active parameter previously selected (i.e. with the indication of a measured value of +1032 °C with thermocouple type "K").



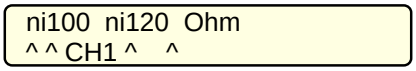
- Open input terminals will cause a fluctuation of the reading up to "Underflow " or "Overflow" conditions.
- To select the simulation mode press the <**IN-OUT**> key (the indication will be for example, relative to a simulated value of 0 °C for a thermocouple type "K").

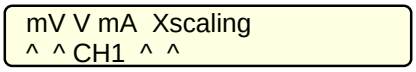
- The output value can be programmed using the two membrane slidewires (< ⬆> and < ⬇> keys).
- Keep the key pressed to cause a continuous variation of the simulated value; the speed of variation will change by moving the pressure to the extremity of the keys.
- By touching a point, near the two central zones, the value will increase or decrease by one single digit.
- Press simultaneously < ⬆ and < > ⬇ cursor slidewires to set the simulated value to zero.

9.3.2 Parameter or sensor selection

To select the electrical parameter or the sensor required by the application, in any measuring or simulation mode, follow the procedure indicated below.

- Switch the instrument -ON-
- Press the <**SELECT**> key : the display will show one of the following menu pages:





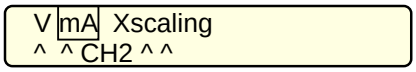
- Press <⬆ or < ⬇ cursor slidewire to select the appropriate page.
- Select the desired parameter or sensor by moving the flashing cursor left or right with keys <◀> or <▶> (e.g. to activate the thermocouple type T choose the correct page and cursor position as indicated below).

- Press the <**ENTER**> key to memory load the selection; the instrument will return to the previous operative mode with the newly selected electrical signal or sensor.

  NOTE: By pressing the <**SELECT**> key instead of <**ENTER**>, the instrument will not acknowledge any variation and return to the previous parameter or sensor.

9.3.3 Channel 2 - Parameter selection

- To set up the channel 2 parameter enter into the pertinent procedure with the **<SELECT>** key and scroll pages with **<⬆>** and **<⬇>** to obtain the following page:



- Press the <◀> or <▶> key to address the Channel 2 parameter required.
- Store the above selection with the <**ENTER**> key.

9.3.4 Celsius/Fahrenheit selection

To change the technical unit from °C to °F (or vice-versa) follow the procedure indicated below:

- Switch the instrument -OFF-
- Keep pressed the <**SELECT**> key and switch the instrument <**ON**> obtaining the following reading:

Use the same procedure to return to °C;

- Switch the instrument -Off-
- Press the <**SELECT**> + <**ON**> key to read:

9.3.5 Decimal point position

To increase or decrease the desired resolution, press either of the <◀> or <▶> keys.
The instrument will automatically convert values in °C or °F from decimal to integer (and vice-versa) when they are in the range limits stated in Section 1.2.1.
For mV or V mode, one of the following decimal point positions can be obtained:

0.000	V
0.0	mV
0.00	mV
0.000	mV

Decimal conversion is not possible for the mA mode; mA is always displayed with three decimal points.

9.3.6 International Temperature Scale selection

The memory of the instrument stores both linearization of the old International Practical Temperature Scale of 1968 (IPTS68) and the new International Temperature Scale of 1990 (ITS90).

The active linearization is indicated by the top square on the far right side of the display as follows:

■ ITS 90 ❑ IPTS 68

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

9.3.7 Rj mode selection

The instrument can operate with an internal automatic cold junction (Rj) compensation or a remote programmable cold junction compensation from -50 to 100°C.
The active Rj compensation mode is indicated by the bottom square on the far right side of the display as follows:

❑ internal automatic ■ external programmable

- To change the reference junction (Rj) compensation mode, press <**SHIFT**> + <**Rj**> keys.

9.3.8 Convert function

The "convert" function allows readings of the electrical signal equivalent to the technical unit indication. Can be used in both -IN- or -OUT- mode for thermocouples, resistance thermometers and x scaling.

- To "convert" the type of indication, with the instrument operative in any of the above indicated modes, press **<SHIFT> + <CONVERT>** keys obtaining for example the following indications:

Out 100.0 °C TcK

- Press <**SHIFT**> + <**CONVERT**> keys to obtain the equivalent mV indication:

Cvt 3.185

In 100.0 °C Pt

- Press <**SHIFT**> + <**CONVERT**> keys to obtain:

Cvt 138.0

- To return in technical unit indication press the **<ENTER>** key.

9.3.9 Average function

The use of the "Average" function is advised with unstable input signals. The average represents a progressive integration of the input signal.

- To enable the "Average" mode press keys **<SHIFT> + <AVERAGE>**: the display will show:

Avg 128.6°C TcK :

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

9.4 IN/OUT data memories

The instrument has 60 slots of memory (30 for channel 1 and 30 for channel 2). This is a useful feature for both simulation and measurement modes.
In the IN (measurement) mode it can be used to store a number of input values for later review or recall.
In the OUT (simulation) mode, the permanent availability of 60 calibration values can be useful to store frequently used calibration procedures (e.g. calibration of the scale of different recorders).

9.4.1 Data memory configuration; Storing (STO) measured values to memory

Three memory slots (labelled 0, 1 and 2) are available in each of 10 groups (labelled A – J). Each memory slot stores Channel 1 and Channel 2 for IN mode (measured values). OUT mode (simulate values) memory stores Channel 1 only. Each group of three slots is identified by a group letter:

Group: **A, B, C, D, E, F, G, H, I, J** Slot: **1, 2, 3** Channels: **1 and 2**

To select the required group follow the procedure indicated below:

- Set the operating mode to IN or OUT as needed
- Press the **<SELECT>** key to obtain one of the menu pages
- Press the **<0>** key to obtain the following indication:

Sel STO Group: A

- Press the < ↑ or < > key ↓ to select the required group number
- Press the **<0>** key to confirm the selection and to return to the previously selected operative mode.
- Once a target group has been selected, values can be stored to each memory slot by pressing the following keys:

  <SHIFT> + <0>

  <SHIFT> + <1>

  <SHIFT> + <2>

- Channel 1 and channel 2 measured values are simultaneously saved using the above procedure

9.4.2 Data memory manual recall

To recall data memory values, first select the desired group letter (see Section 9.4.1) and then press the **<0>, <1>,** or **<2>** key. The display will return to the prior mode when the key is released.

9.4.3 Data memory automatic scanning; Saving automatic simulation procedures

A total of 60 stored simulation points can be assigned using group letters and slot numbers to a pre-programmed sequence. The programmed sequence (a number of calibration points, or a number of data items to be supervised), includes a linear sequence of memory beginning from a "start" point and finishing with an "end" point.
Memory for seven different pre-programmed sequences is available. The procedure to accomplish this is given below.
The parameter numbers, memory locations and numerical values indicated below are an example of memory loading 5 simuation points for a scale of a potentiometric recorder (temperature with a thermocouple type K).

1	A0	-50°C
2	A1	0°C
3	A2	+100°C

4 B0 +200°C
5 B1 +500°C

As described in Section 9.4.1, memory store the calibration data as follows:

point 1 = group A - memory slot 0
point 2 = group A - memory slot 1
point 3 = group A - memory slot 2
point 4 = group B - memory slot 0
point 5 = group B - memory slot 1

After the simulation values are entered in memory, the simulation program set-up procedure is used to identify the start point and the end point of each procedure in terms of memory locations. For example Prog #1 can start with memory value A0 and end at B1.; Prog #2 can start with location B2 and end at C2.

- Press the **<SELECT>** key to obtain any one of the menu pages
- Press the **<1>** key to obtain the following display:

SEL Program # 1

- Press the **<** ⬆ and **<** ⬇ keys to enter the program number required (1 to 7)
- Press the **<1>** key to confirm the selection of the program number and to return to the any one of the menu pages
- Press the **<2>** key to obtain the following display:

Prog #1 from A1

- Press the < ⬆ > and < ⬇ keys to select the "start" memory location (e.g. A1 above)
- Press the **<2>** key to confirm the "start" point obtaining the following indication:

Prog #1 to A2

- Press **<** ⬆ **>** and **<** ⬇ **>** keys to select the "end" memory location (e.g. A2 above)
- Press the **<2>** key to confirm the selection and to return to the menu page
- Press the **<AUTORAMP>** key to obtain [Sel: Autoramp 1], [Sel: Autoramp 2] or [Sel: Program] display
- Use the < ⬆ and < ⬇ keys to until the "Sel:program" option is displayed

Sel : Program

- Press the **<AUTORAMP>** key to confirm the selection and to return to the menu page
- Press the **<SELECT>** key to memory load the program and to return to the main operation mode

9.4.4 Manual stepping through AUTORAMP program

To run the program with manual step advance, press the **<AUTORAMP>** key obtaining the following indication:

.A0 -50 TcK :

The symbol on the left of the display has the following meaning:
O = output
I = input

- Press the **<AUTORAMP>** key to advance one step in the program. After the "end" point (no. 5 in the example above - B1) the manual sequence will return again to the "start" point (no. 1 in the example – A0)
- To go back to the previous step press **<ENTER> + <AUTORAMP>** keys
- Press the < ⬆ or < ⬇ or **<SELECT>** or <◀> or <▶> key to exit the program

9.5 Automatic simulation cycle

The instrument can be programmed for simulating two types of pre-programmed automatic cycles; 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.
First select the technical unit (°C or °F), the type of thermocouple and then follow the procedure indicated below.
The example procedure considers a simulation in mV.

9.5.1 Simulation cycle selection

Two different automatic simulations identified as "Autoramp1" and "Autoramp 2" can be memory stored.
To select the desired program press the **<SELECT>** key to obtain any one of the menu pages.

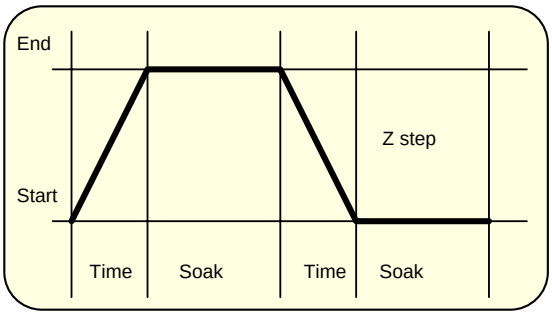
- Press the **<AUTORAMP>** key to obtain one of the following indications:

Sel : Autoramp 1

Sel : Autoramp 2

- Press the < ⬆ and < ⬇ key to select the desired Autoramp program
- Press the **<AUTORAMP>** key to confirm the selection and to return to the menu page display
- Press the **<SELECT>** key to return to the operation mode

The automatic ramp cycle has the following behaviour



- 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

Time 0h 0m 50s

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:

Start 0.0mV

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

End 100.0mV

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

Step 1.0mV

- Press < ⬆ and < > ⬇ cursors to set the size of each individual step.
  To obtain a continuous ramp set the minimum possible value (e.g. = 0.1)
- Press <**ENTER**> + <**STEP**> keys to memory store the new value
- Press the **<TIME>** key to obtain the following indication:

Time 0h 0m 50s

- 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 allows a manual step advance each time the <**AUTORAMP**> key is pressed.
- Press the **<SOAK>** key to obtain the following indication:

Soak 0h 0m 50s

- Press < ⬆ and < > ⬇ cursors to set the waiting time (or soak time). If the setting is 0h-0m-0s the waiting or soak time is excluded
- Press <**ENTER**> + <**SOAK**> keys to memory store the new value
- Press the **<MODE>** key to obtain one of the following indications:

Mode: 1 /| ramp	single cycle program
Mode: + /| ramp	repeated cycling program
Mode: 1 / \ ramp	single cycle program
Mode: + / \ ramp	repeated rise ramp program.

- Press the < ⬆ or < > ⬇ key to select the required program type.
- Press <**ENTER**> + <**MODE**> keys to memory store the new selection.
- Press the <◀> or <▶> key to exit the set-up procedure.

9.5.2 Simulation cycle

- Press the <**SELECT**> key to obtain any one of the menu pages.
- Press the <**AUTORAMP**> key to obtain one of the two following indications:

Sel : Autoramp 1

Sel : Autoramp 2

- Press < ⬆ or < ⬇ key to select the required program.
- Press the <**AUTORAMP**> key to memory store the selection and to return to the menu page.
- Press the <**SELECT**> key to return to the normal operative mode.
- To run the automatic simulation cycle press the <**AUTORAMP**> key
- The display indicates the actual cycle position as shown below:

Prg 18.0mV

- To stop the repeated cycling programs, press <**SHIFT**> + <**AUTORAMP**> keys.

9.6 Rj compensation mode check

The internal/external reference junction compensation is only enabled for temperature measurement or simulation with thermocouples.

- To check the type of reference junction mode previously installed for either simulation or measure mode, press the <**SELECT**> key to enter the type of sensor or parameter selection menu page.
- Press the <**IN/OUT**> key to obtain the following indication:

RJ : 22.8°C int

The above reading indicates that the instrument is pre-set with an internal automatic reference junction compensation. The temperature indication is the value measured by the precision thin film resistance thermometer placed inside the In/Out terminal. If, instead of the code "int" the following indication

RJ : 0.0°C ext

is displayed it means that an external reference junction compensation has been selected for a temperature of 0.0°C (programmable from -50°C to +100°C). The reference junction compensation mode can be reprogrammed as specified in Section 9.3.7. The external reference junction compensation value can be programmed as indicated in par. 9.8.2.

9.7 Scale factor program

The "scale factor" mode is a method to read or to simulate electrical signals values in terms of engineering 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 mbar to 400.0 mbar corresponding to the required electrical linear input signal.

- Press <**SHIFT**> + <**PROGRAM X**> keys to enter the "Scale Factor" set-up procedure. The display will indicate the low end of the scale e.g. in mbar.

LO: 0.0 Prog

- Press one of the <◀> or <▶> keys if a decimal point shift is required.
- Press the < ⬆ or < ⬇ keys to adjust to the required value.
- Press the **<ENTER>** key to load in the memory the value and to advance the program one step: the display will indicate the full scale value of the technical unit (e.g. mbar).

HI: 400.0 Prog

- Press the **< ⬆** or **< > ⬇** keys to adjust the full scale value.
- Press the **<ENTER>** key to load in the memory the value: the display will indicate one of the menu pages as follows:

Type : 0-1000 mV

Type : 0-100 mV

Type : 0-10 V

Type : 1-5 V

Type : 0-400 ä

Type : 4-20 mA

Type : 0-20 mA

Type: 4-20 mA IN2

Type: 0-20 mA IN2

Type: 0-10 V IN2

Type: 1-5 V IN2

- Select, through **< ⬆** or **< >⬇** keys, the required page and
- press the **<ENTER>** key to memory load the needed parameter
  The display will indicate one of the two following pages:

Mode : Linear

Mode : Square

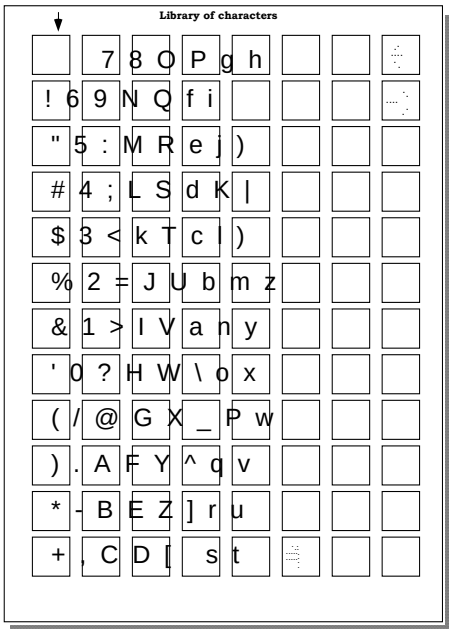
- Press the **< ⬆** or **< > ⬇** key to select the required page.
- Press the **<ENTER>** key to memory load the selection.
- The program will advance to the next step with the indication :

WORD: !

or from a previous set-up e.g.

WORD: mbar

This procedure 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 **< ⬆** or **< > ⬇** keys to scroll the internal library of characters and symbols and select the pertinent one. (i.e. by a proper setting you can obtain words as indicated below)

WORD: % RH

WORD: psi

WORD: hPa

If the application does not require a dedicated symbol, but the display of the electrical parameter (i.e. mV, mA, Ω), recall on the display the four blank spaces.

WORD: _ _ _ _

- With a random display indication remember that the four blank spaces will be settable, through single digit setting, by pressing the **< >** key on its higher side, for a few seconds.
- Press the **<ENTER>** key to load in the memory the symbol.
- The "scale factor" mode will be activated as follows:
- Press the **<SELECT>** key to obtain one of the menu pages.
- Move the flashing cursor to the "X scaling" position
- Press the **<ENTER>** key to memory load the selection
- The display will indicate the scaled input/output value.

Out 105.8 mbar

9.8 Installation parameter procedure

- Enter this procedure for the OFF mode by pressing the **<ENTER>** + <**ON**> keys
- The display will indicate as shown below (the indicated numerical value is only an example).

CAL? 65388 N=0

- To exit from the procedure, in any of the following steps switch the instrument -Off-.

9.8.1 Firmware version & 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:

Ver2.000 # 65535

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 **Meriam** 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:

CAL? 65388 N=0

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

9.8.2 External Rj compensation set-up

To enter the External Rj compensation set-up start with the instrument switched -Off- and press <**ENTER**> + <**ON**> keys to obtain the following indication:

CAL? 65388 N=0

- Press the **<AUTORAMP>** key to obtain:

RJ : 0.0°C ext

- Set, with <⬆> and <⬇ keys, the temperature of the external Rj compensation (adjustable from -50°C to +100°C).
- Press the **<AUTORAMP>** key to memory load the new temperature value of reference junction compensation.
- To end this procedure switch the instrument **-Off-**

10 MAINTENANCE

The MULTI-Cal portable calibrator has been factory tested and calibrated before shipment. The calibration should be varified 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 MULTI-Cal portable calibrator uses sophisticated analog and digital technologies. Service requires highly trained personnel.

10.1 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 voltage between input terminals and ground, as this voltage can be transmitted to other devices connected to the calibrator.

10.2 Error messages

During start up, measuring mode and simulation mode, faulty conditions of the instrument will be indicated with coded messages as follows:

Error Checksum 1	The message indicates a possible loss of data on "AUTORAMP" program or on the manual memories.
Error Checksum 2	The message indicates a possible loss of data on "PROGRAM X".
Error Checksum 3	The message indicates a possible loss of data on "AUTORAMP", "PROGRAM X" and/or on the manual memories.
Error Checksum 4	The message indicates a possible loss of calibration data.
Error Checksum 5	Indicates a possible loss of calibration data, and/or "AUTORAMP" data and/or on the manual memories
Error Checksum 6	The message indicates a possible loss of calibration data, and/or "PROGRAM X"data
Error Checksum 7	The message indicates a possible loss of calibration data, and/or "AUTORAMP" data, "Xscaling" and from the three manual memories
!!! ERROR 9 !!!	The message indicates a data writing on the EEPROM memory not verified.

When the above error codes are indicated repeat the set-up of the application parameters and/or autoramp data and/or In-Out memories.

- UNDER -	Indicates "underflow" conditions

+ OVER +	Indicates "overflow" conditions
ERROR 2	Indicates an environment temperature (in correspondence with **<IN/OUT>** terminals) exceeding the stated limits
ERROR 6	Indicates that the load is exceeding the stated limits. When in mA "OUT" function, the external load must not exceed 1000 Ω. When in mV or Tc "OUT" function the current flow must not exceed 0.5 mA.
ERROR 7	Indicates a possible error during scale factor computation.

The above indicated faulty conditions can be announced both during the autodiagnostic routine or in measure 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.

10.2 Protection fuses

The MULTI-Cal unit is protected against overvoltage and overcurrent inputs, by thermal fuses. When they activate, you should disconnect the electrical connections from the unit and switch the instrument off for about 2 minutes. The thermal fuses will be automatically restored and you can resume your work.

10.3 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 voltage between input terminals and the ground, as this voltage can be transmitted to other devices connected to the calibrator.

11.0 Accessories and Spare parts

A900032-00003	Soft carrying case
A900032-00004	ABS carrying case
A900032-00002	Compensated t/c type J, K, T, and R/S premium cables
A900032-02003	Charger 120V - USA plug for Ni-MH
A900032-02004	Charger 230V - Schuko plug for Ni-MH
A900032-02005	Charger 240V - UK plug for Ni-MH
A900032-02006	Charger 230V - European plug for Ni-MH
A900032-02007	Charger 100V - USA/Japan plug for Ni-MH
A900032-02009	Black binding post (for non-t/c black post)
A900032-02010	Red binding post
A900032-02011	Black binding post with Pt100 (for t/c black post)

10.5 Storage

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

11 CERTIFICATES

11.1 Warranty terms

Meriam warrants its products against defects in materials and workmanship. Meriam Standard Terms and Conditions are available upon request. If the unit should malfunction, it must be returned during the warranty period, transportation prepaid, to **Meriam** for evaluation. Upon examination, if the unit is found to be defective within the warranty period it will be repaired or replaced at no charge.
Meriam's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorised modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion, current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of **Meriam's** control.
This warranty applies to the original purchaser only. Please include a copy of the original invoice when returning warranty items for repair.

Direct all warranty and repair requests/inquiries to the **Meriam** Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO **MERIAM**, PURCHASER MUST OBTAIN A RETURN MATERIAL AUTHORIZATION (RMA) NUMBER FROM **MERIAM**'S CUSTOMER SERVICE DEPARTMENT IN ORDER TO AVOID PROCESSING DELAYS.
The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

11.2 Letter 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.

APPENDIX

A1 EMC Conformity

The instrument is designed to fulfil Directive 89/336/CEE Electromagnetic Compatibility. See the following page for the EMC declaration of conformity

A2 Declaration of Conformity

We : Meriam Process Technologies
(Supplier's name)

10920 Madison Avenue, Cleveland, OH 44103, USA
(Address)

declare under our sole responsibility that the product :

Multifunction indicator-simulator type MULTI-Cal
(Name and type)

cat. 3922
(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 Compability (EMC)

Sesto S. Giovanni, April 08th, 1999
(Place and date of issue)

(Signature of authorized person)

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