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Instruction Manual

DigiMite® and MultiMite®

Models 31160, 31161,
31127, 31137

NR 74/75

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TABLE OF CONTENTS

1-0 DESCRIPTION

1-1 Introduction

This manual contains all the information normally required to operate and maintain the DigiMite digital temperature indicator or a MultiMite equipped with a DigiMite. The serial number on the side of the chassis and the model number on the top of the case, identifies each instrument. Always refer to the serial number and model number in correspondence or when ordering replacement parts.

A booklet containing temperature-millivolt tables referenced at 75°F (25°C), for the most commonly used thermocouple calibrations is available upon request to Thermo Electric. Should you require additional information, contact your local Thermo Electric Applications Engineer or Thermo Electric's main office in Saddle Brook, New Jersey. We will be happy to be of assistance.

1-2 Application

This manual covers the operation and maintenance of standard models as described in the Thermo Electric DigiMite and MultiMite Catalogs.

1-3 General Description

The DigiMite is a highly accurate, compact and portable instrument which can be used to:

1. Measure temperature directly, using a thermocouple.
2. Measure millivolt signals directly.
3. Calibrate potentiometer type instruments.
4. Calibrate moving coil pyrometers (MultiMite configuration)

DigiMite is a portable, dual-range instrument with built in reference junction. The unit automatically displays the hot junction temperature of the attached thermocouple. Various ranges are available that offer resolutions of 1 degree F or C, 0.1 degree F or C or 10 microvolts.

Power required by DigiMite is supplied by a rechargeable battery pack. The battery charger/AC adapter cord (115 Vac standard, 220 Vac optional) is included. DigiMite operates in any position and can be optionally panel mounted.

MultiMites are also available with a DigiMite in either 6 or 12 point models. The six point model is a combination of a DigiMite and a variable direct current source. Six thermocouple or millivolt inputs can be connected to the MultiMite simultaneously. A six point switch allows selection of an individual input. Readings are either in Fahrenheit, Celsius or millivolts. A "D" cell battery supplies the current needed for calibrating moving coil instruments. The twelve point model consists of a DigiMite and a twelve point selector switch. It dispenses with the moving coil meter calibration capability but provides rapid switching of up to twelve thermocouple or millivolt inputs.

1-4 DigiMite Specifications

A. Display

Type: 7-bar gas discharge, 0.330-inch character height
No. of Digits: Four and minus sign
Maximum Full Scale: 9999 counts
Decimal Point Selection: Automatically selected w/range
Polarity Selection: Automatic
Overrange Indication: Display blinks OFF/ON
Open Thermocouple Indication: Same as Overrange
Low Battery Indication: Display modulates DIM/BRIGHT
Reading Rate: Approximately 2 per second.

B. Operating Controls (See section 3 for operation of controls)

1. ON/OFF pushbutton
2. Range I, Range II: Interlocking pushbuttons — see top label for identification of ranges
3. Check Mode, Measure Mode, Source Mode: Interlocking pushbuttons
4. Source Mode Set: Continuously variable 10-turn potentiometer

C. Electrical

Sensitivity: As low as 2 uV/count
Noise: Less than 1 uV, RMS
Zero Drift: Less than 0.5 uV/°C
Scale Factor Drift: Less than 50 ppm/°C
Linearization: Full digital, 16 segments per range
Read Only Memory: 32 x 16 (512 bits)
External Resistance: Up to 200 ohms without loss of accuracy
Differential Overdrive: Up to 50 V indefinitely
Up to 100 V for short periods
Normal Mode Rejection: Better than 50 dB at 60 cps
Common Mode Rejection Ratio: 140 dB with 300 V isolation (on AC adapter only)
Setting Time: 0.5 second (10 time constants)
Source Mode Output: Continuously variable, -10 mV to +50 mV
Source Mode Impedance: 50 ohms
Check Mode Source: 1.52 mV +2.5%
Battery Complement: (5) 1.2 AH NICAD cells
Recharging Time: 12 hours

D. Environmental

Ambient Operating Temperature: 0 to 50°C
Humidity: 0 to 80% noncondensing

MultiMite Specifications

Battery: "D" cell 1.5 volts, leakproof type (6 point model only)
Terminals: Insulated color coded binding posts with retained caps. Will accomodate flat terminals or wire to 12 AWG.
Dimensions: 12" L x 8 1/2" W x 7 3/4" H
Weight: 11 pounds
External Resistance Capability: 20 ohms standard
100 ohms optional

2-0 INSTALLATION

2-1 Unpacking

Unpack immediately upon receipt and check for shipping damages. Instruments are usually shipped with small accessory items in the same box. Check all items against the packing list before discarding the shipping container and packing material.

2-2 Location

The DigiMite and MultiMite should be operated in an area which remains within the ambient temperature limits of 40 to 140°F (4.4 to 60°C).

2-3 Mounting

The DigiMite is a portable instrument which can also be used in table and bench use. Flush mounting is accomplished with an optional flanged case which is available on special order. The MultiMite is designed for table top use, but is readily transported.

3-0 OPERATING INSTRUCTIONS

3-1 Thermocouple Wiring

The thermocouple input wires are attached to the input binding posts of the DigiMite. NOTE: Care must be exercised when connecting the thermocouple leads to ensure the correct polarity. If a shielded thermocouple is used, it is recommended that the shield be returned to the black (+) input terminal of the DigiMite, along with the positive thermocouple lead.

3-2 Battery Charging

To charge the battery pack, insert the battery charger plug into the "RECHARGE" jack on the DigiMite front panel and then plug the opposite end into the AC line.

Use the 115 volt charger on 115 volts only. If only 220 volts is available, the optional charger should be used. NOTE: Care must be exercised to ensure that the plug is firmly seated in the connector. In most cases, the DigiMite may be run with the battery charger connected, with no degradation of performance. For maximum battery life, it is recommended that the unit be charged only when the low battery indication (display modulates DIM/BRIGHT) is observed. NOTE: Operation to the point of complete display extinction may result in permanent damage to the batteries.

3-3 Operating Controls, DigiMite

NOTE: Three (3) pushbuttons must be depressed at all times for proper operation.

ON/OFF Push to turn on, push again to turn off. To conserve battery power, turn off instrument when not in use.

RANGE I, RANGE II Interlocked pair. Push the appropriate button for desired range. Details of each range may be found on the label located on the top of the instrument. Make sure that the selected range corresponds with the thermocouple being used. One range button should be depressed at all times, otherwise, incorrect readings will result.

MODE Interlocked group of three pushbuttons as follows:

EMF (Measure of Indicate) Mode This is the normal operating mode used to indicate temperature or millivolts depending on the range selected.

OUTPUT (Source) Mode In this mode, the EMF terminals are driven with a voltage that may be varied by using the source control potentiometer on the front panel. When the Output Mode is used with a thermocouple range, the reference junction is functioning and a compensated millivolt equivalent of the display reading is available at the output terminals. When used with a millivolt range, the output voltage may be varied from -10 mV to +50 mV. The output voltage corresponds directly to the display reading. (Connecting a

thermocouple to the terminals in the Output Mode will short out the source voltage defeating the operation of this mode).

CHECK Mode In this mode, the input terminals are disconnected from the measuring circuitry and a stable 1.5 mV (± 2.5%) internal reference is measured. For each range, the normal Check Mode reading will be recorded on the label located on the top of the instrument. Obtaining this reading, ± 2 counts, is an indication that the measuring circuitry is functioning properly. (This is not a test for instrument accuracy).

3-4 Operating Controls, Six Point MultiMite

The Rotary Selector Switch (OFF to 6) delivers the millivolt input of the point selected to the DigiMite input terminals, whenever the shorting bars are connected between the switch output terminals and the DigiMite EMF terminals.

The MILLIVOLT COARSE and BATTERY SWITCH will deflect the coil of the millivoltmeter under test whenever the battery is switched from the OFF position. In the OFF position, the direct current source is removed from the circuit.

The MILLIVOLT FINE adjustment allows the moving coil of the instrument under test to be brought to the exact calibration point whenever the BATTERY SWITCH is on.

The EXTERNAL RESISTANCE potentiometer allows the external resistance of the millivoltmeter under test to be matched. The resistance is adjustable from 0-20 ohms or 0-100 ohms depending on model.

3-5 Operating Controls, Twelve Point MultiMite

The Rotary Selector Switch (OFF to 12) delivers the millivolt input of the point selected to the DigiMite input terminals whenever the shorting bars are connected between the output of the switch and the EMF terminals of the DigiMite.

3-6 Temperature Measurement

Connect the thermocouple extension leads from the thermocouple to the DigiMite terminal posts as outlined in Section 3-1. Depress the EMF mode pushbutton, and select the RANGE pushbutton which corresponds to the thermocouple type being used. Turn on the DigiMite and read the thermocouple temperature on the display. Readout is in °F or °C as stated on the label on the top of the instrument.

If measurements are to be made with a MultiMite, the thermocouple extension leads may be connected to the MultiMite input terminals. The Battery Switch should be OFF.

3-7 Millivolt Measurement (Millivolt Scale Models Only)

Connect the millivolt source to the DigiMite terminal posts. Depress the EMF mode pushbutton and the RANGE II (Millivolt Scale) pushbutton. Turn on the DigiMite and read the voltage, in millivolts, on the display.

If measurements are to be made with a MultiMite, the millivolt source leads may be connected to the MultiMite input terminals. The Battery Switch should be OFF.

3-8 Checking Potentiometer - Type Instruments With Thermocouple Input

To test or calibrate another instrument connect the DigiMite or MultiMite as shown in Figure 3-1, using thermocouple extension wire that matches the range of the instruments. If a MultiMite is used, the Battery Switch should be OFF.

Depress the OUTPUT and the appropriate RANGE pushbuttons. Turn on the DigiMite and adjust the source potentiometer until the display indicates the desired temperature. The DigiMite and the instrument being tested may be at different temperatures, since reference junction compensation functions in this mode.

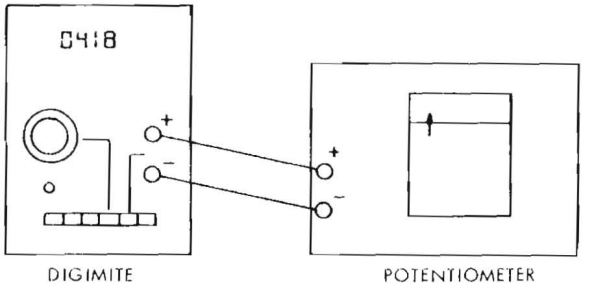

Figure 3-1. Checking Potentiometer Type Instruments with a DigiMite

3-9 Checking Potentiometer - Type Instruments with Millivolt Input (Millivolt Scale Models Only)

To test or calibrate another instrument connect the DigiMite or MultiMite as shown in Figure 3-1 using copper lead wires. If a MultiMite is used, the Battery Switch should be OFF. Depress the OUTPUT and RANGE II (Millivolt Scale) pushbuttons. Turn on the DigiMite and adjust the source potentiometer until the display indicates the desired millivolt value.

3-10 Calibrating Millivoltmeter - Type Instruments Using a MultiMite Equipped with a Temperature Scale

When calibrating millivoltmeter - type (moving coil) instruments with the following method, a variable direct current source is required with the DigiMite. Thermo Electric's Six Point MultiMite, which has a self contained current source, was designed for this purpose. Instructions

for checking millivoltmeter instruments with this MultiMite are listed below:

1. Depress the EMF mode pushbutton and the oppropriate RANGE pushbutton.
2. Short circuit the EMF terminal posts of the DigiMite with a short length of copper wire.
3. Turn on the DigiMite and read the temperature. This is the cold junction temperature at the DigiMite terminal posts.
4. Short circuit the input of the millivolt meter under test with a short length of copper wire.
5. Adjust the millivoltmeter to read the same temperature as obtained in step 3.
6. Remove the terminal shorting wires from both instruments. Connect copper leads from one set of terminal posts on the MultiMite to the millivoltmeter. Observe polarity. (The copper leads should be 20 AWG or larger and limited to a length of 6 feet).
7. Check the external resistance rating of the millivoltmeter under test. This value is usually marked on the scale. Turn the EXTERNAL RESISTANCE adjustment on the MultiMite to correspond to this value.
8. With the MV COARSE control deflect the millivoltmeter to its full scale setting. The MV FINE con then be used to adjust the pointer to the exact setting being checked.
9. The millivoltmeter should indicate the same temperature as the DigiMite. Several points on the scale should be checked to determine overall calibration.

3-11 Calibrating Millivoltmeter - Type Instruments Using a MultiMite Equipped with a Millivolt Scale

When calibrating millivoltmeter - type (moving coil) instruments with the following method, a variable direct current source is required with the DigiMite. Thermo Electric's Six Point MultiMite, which has a self contained current source, was designed for this purpose. Instructions for checking millivoltmeter instruments with this MultiMite are listed below:

1. Short circuit the input of the millivoltmeter under test with a length

of copper wire.

2. Adjust the millivoltmeter to indicate 75°F, 25°C or zero millivolts.
3. Remove the shorting wire from the millivoltmeter. Connect copper leads from one set of terminal posts on the MultiMite to the millivoltmeter. Observe polarity. (The copper leads should be 20 AWG or larger and limited to a length of 6 feet). Turn the rotary switch to the selected point. See Figure 3-2.
4. Depress the EMF and the Range II (Millivolt Scale) pushbuttons. Turn on the DigiMite.
5. Check the external resistance rating of the millivoltmeter under test. This value is usually marked on the scale. Turn the EXTERNAL RESISTANCE adjustment on the MultiMite to correspond to this value.
6. With the MV COARSE control deflect the millivoltmeter to its full scale setting. The MV FINE can then be used to adjust the pointer to the exact setting being checked.
7. The millivoltmeter should indicate the same value as the DigiMite. Several points on the scale should be checked to determine overall calibration. (If the millivoltmeter is equipped with a millivolt scale, the reading in millivolts may be directly compared to the DigiMite. If the millivoltmeter is calibrated in units such as temperature, this must be converted to equivalent millivolts. Refer to a temperature-millivolt table to determine the corresponding millivolt indication. A table referenced at 75°F or 25°C should be used).

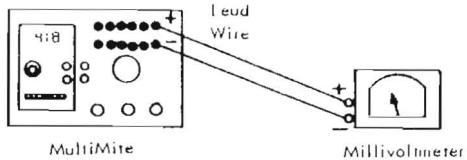

Figure 3-2. Calibrating Millivoltmeter Type Instruments with a MultiMite

4-0 THEORY OF OPERATION

The DigiMite dual range, digital temperature indicator with internal cold junction reference accepts the millivolt output of a thermocouple and provides a digital display of the equivalent temperature. To accomplish this, it contains the necessary circuitry to convert the input voltage to digital form and to display the result. As the voltage generated by the thermocouple is a nonlinear function of temperature, this circuitry includes a "linearizer" function.

The measuring circuitry of the DigiMite is shown in block diagram form in Figure 4.1. The circuitry includes the following elements:

4-1 Dual Slope Voltage to Time Interval Converter

The converter is a unique, low-level, double-loop autozeroing circuit with a capacitively coupled reference. The converter has three operating phases as follows:

Unknown Integration - 200 milliseconds. Gain is a function of the span attenuator which is range dependent.

Reference Integration - Generates a time interval proportional to unknown. A pulse train is counted during this time interval to obtain a digital result.

Autozeroing Phase - Any offsets in entire converter (including low level, front end) are zeroed out.

4-2 Cold Junction Measuring Circuit

A diode connected transistor is used as the cold junction sensing element. The diode drop at 0° is nulled out, and the remaining temperature varying voltage is divided by the cold junction scaling attenuator (which is range dependent) to match the thermocouple characteristic. The net cold junction compensation voltage is fed into the converter to add to the effective input in the measure and source modes.

4-3 Counter/Latch

This is an LSI integrated circuit that includes a four-decade counter. The counter functions to:

Time out the V to T.I. converter unknown integration period.
Accumulate the result during the reference integration period.
Time out the autozeroing interval.

The LSI circuit also includes a polarity store flip/flop and latch, output data latches, and latched output data scanning means.

4-4 Clock

This is a nominal 100 KHz clock oscillator used as the basis of all V to T.I. converter timing.

4-5 Digital Control

This circuitry includes a four-state V to T.I. converter control counter. The states of this counter are as follows:

State 10 — Unknown Integration. During this state, the clock is divided by two (to 50KHz) and counted by the LSI counter. The carry pulse from the LSI counter advances the control counter. Also during the carry pulse, the polarity information is stored.

State 11 — Reference Integration. During this state, the LSI counter counts pulses processed by the linearizer. The counter is advanced when the comparator within the V to T.I. converter changes state. At the end of this state, the data in the LSI counter is transferred to the latches within the LSI counter.

States 00 and 01. During these two states, the V to T.I. converter is autozeroing. The LSI counter counts as in State 10. Control counter advance occurs on the LSI counter carry pulse.

4-6 Digital Linearizer

The linearizer operates on the 100KHz clock during the unknown integration time to produce a result pulse train. The linearizer includes a Read Only Memory which controls a digital rate multiplier.

The linearizer approximates the thermocouple characteristic with 16 straight-line segments per range. If the range is bipolar, there are eight segments for each polarity. The Read Only Memory contains 10 bits of slope information, 4 bits of segment length information, and 2 bits that control overload detection, for each of the 16 segments.

The linearizer includes a 16-state segment counter which addresses the ROM.

To save battery power, the linearizer circuitry is only powered during the Reference Integration.

4-7 Scan Oscillator

This is an approximate 1KHz oscillator which controls the display scanning. The oscillator has a 1/3 on, 2/3 off duty cycle.

4-8 Display

A four-digit and minus sign gas discharge type display. The display is scanned at the rate determined by the scan oscillator.

4-9 Power Supply System

1. Battery Pack - 6.25V nominal output.
2. DC/DC Converter which converts the 6.25V into a -10V supply and a 175V supply.
3. Voltage Regulator for the +5V, -7.5V and 175V supplies.
4. Reference Supply. A precision zener diode acts as the reference voltage for the system. This diode has a temperature coefficient of 10 ppm/°C or better.
5. Battery Low Detector. This circuit compares the battery voltage with a system level related to the regulated -7.5V supply. If the

battery is low, the circuit causes display blinking from normal brightness to dim.

4-10 Source Mode Potentiometer

When the unit is in the source mode, this potentiometer is energized with the system regulated voltages. The potentiometer output, divided down with a resistor network, is switched to the system input terminals.

5-0 CALIBRATION CHECK

5-1 Method

Equipment:

1. Precision laboratory potentiometer
2. External galvanometer (may be part of precision potentiometer)
3. Calibrated reference junction thermocouple (material leads of the same calibration as the DigiMite) with copper extension leads for cold junction simulation
4. Thermocouple EMF vs Temperature conversion table, 32°F (0°C) reference temperature
5. Thermo Electric ICELL™ or 32°F (0° C) ice bath

5-2 Procedure

1. Connect equipment as shown in figure 5-1.
2. Depress range button for range to be tested.
3. Refer to the EMF vs Temperature table and set the precision potentiometer to the millivolt values corresponding to different temperature points throughout the span of the DigiMite observing the temperature indication for each point.
4. Compare the observed readings to the actual temperature indications expected. The error should be within the accuracy of the DigiMite.
5. Should accuracy be outside stated limits, contact your local Thermo Electric repair facility.