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LRMS 5200A

TABLE OF CONTENTS

Section1

1-1 INTRODUCTION

1-2 The LRMS 5200A digital micro ohmmeter is a fully microprocessor controlled instrument that contains features not currently found in similar instruments. The 5200A gives you the capability of storing specific information about particular components such as motors, armatures, contactors, coils etc. and to recall this information (setups) whenever a test of that component is desired. The 5200 can store 32 such setups. Four separate measurement storage areas (job storage areas) capable of storing 180 measurements each are also provided. These areas are valuable when many resistance measurements must be taken on a component such as a DC armature or sets of measurements need to be saved for preventative maintainence or engineering use. Hardcopy or printout capabilities (optional) are provided through a built in parallel port. The port is Centronics compatible and can be used with most dot matrix printers. An optional RS232 serial interface can also be provided. A 40 character alphanumeric display shows measurement and configuration status and gives operator prompting in the form of screen menus when required, A 4 digit numeric display shows the current value of resistance.

1-3 The 5200A is both fully portable and line operated. The internal battery will recharge to 90% capacity in about 1 hour when the 5200 is plugged into 120Vac. The 5200A will automatically shut itself off when operating on batteries and no measurement has been made for ten minutes. This feature helps conserve battery life . The battery charge staus will be displayed on the second line of the display whenever the battery drops to 85% or less and the 5200A will shut itself down when the battery capacity drops below 5% This feature ensures that the internal battery can not be deeply discharged as this would severely limit the number of times the battery can be recharged to 100% capacity. The main battery which is manufactured by Gates Energy Products is of the sealed lead acid type used in modern computer power backup systems and will give a long trouble free service life (see section 6). Main memory which holds data and job setups is backed up by a lithium battery which has a nominal life of 2 years. The built in battery charger will maintain the proper charge level for the main battery whenever the 5200A is plugged into 120Vac (see section 6-5).

1-4 The 5200A can be used in any position and has rubber feet for vertical or horizontal use as well as a convenient flip down stand for bench top use. Convenient storage is provided in the front cover for cables and cords.

1-6 Since the main battery used in the 5200 can supply 130 amps short circuit current, the 5200 is shipped from the factory without fuses installed as a safety

precaution against internal shorts caused during shipment. Refer to section 6-5 for correct fuse installation.

1-7 Should shipment of the 5200 be required either for calibration or maintenance, the two fuses located on the rear of the instrument MUST BE REMOVED for safety. In this event store the fuses in the front cover.

1-8 Long term storage or periods of no usage (several months or more) of the 5200 requires that the fuses located on the rear panel be removed. Fuses can be stored in the front cover for convenience. Failure to remove the fuses in the event of storage of the 5200 may cause permanent damage to the main battery.

1-10 ACCESSORIES/OPTIONS

Table 1-1 Options

OPTION	DESCRIPTION
KC-4	1 set of 48" shielded Kelvin clips
KC-0	1 set Kelvin clips as ordered (15ft max)
KP-4	1 set of 48" shielded Kelvin probes.
KM-1	Conductivity measurement stand.

1-11 Several options are available for use with the 5200A. A list of these is provided in table 1-1. Further details can be found in section 7.

1-15 SPECIFICATIONS

1-16 Technical specification of the 5200A are listed in table 1-2.

Table 1-2 Specifications

Range	Resolution	Normal Mode	Transformer Mode
200 microhms	+/- .1 micohm	5A	5A
2 milli-ohm	+/- 1 microhm	5A	5A
20 milli-ohms	+/- 10 microhm	1A	5A
200 milli-ohms	+/- 100 micro	1A	5A
2 ohm	+/- 1 milli-ohms	100ma	1A
20 ohms	+/- 10 milli-ohms	10ma	100ma
200 ohms	+/- 100 milli-ohms	1ma	10ma
2kohm	+/- 1 ohms	.1ma	1ma

Accuracy	.15% +/- 1 digit 25 C +/- 10 C
	.25% of reading +/- 1 digit 0-50 C
Measurement type	Four wire
Inductive compliance voltage	6v
Input protection	6v on voltage inputs
Maximum sample rate	7.5 samples/sec
Autoranging delay	1 second/decade
Temperature range	Operating 0-50 C
	Storage -40 to +65 C
Pyrommeter range	0-100 C
Pyrommeter readout	Fahrenheit or Celsius
Readouts	40 character alphanumeric LCD
	4 digit LCD
Terminals	Gold plated 4 way banana posts
Power requirements	120Vac (220Vac available)
	Internal rechargeable 6v sealed lead acid
	3v lithium coin for internal memory
Construction	All steel case and cover

Section 2

2-1 INTRODUCTION

2-2 The LRMS 5200 series digital micro ohm meters are fully micro processor controlled instruments. The instrument has no front panel switches (other than on/off), dials knobs or adjustments. Control of the 5200 is done entirely with the keypad. The 5200 uses the top display to prompt you in the operation and setup of the instrument. This prompting is done through the use of menus and is commonly called a menu driven system. These menus make the operation of the 5200 very easy and do away with having to constantly refer to the operating manual. Once you have familiarized yourself with all the capabilities of the 5200 you will find that using this instrument is quite easy.

2-2 LRMS 5200 FRONT PANEL

2-3 The LRMS 5200. front panel (see fig. 1) consists of a power on/off push button, two displays, a 20 element keypad, four measurement terminals, and the temperature probe jack.

2-4 The power on/off button is a push-on push-off switch used to turn th internal micro-processor and electronics on and off. When turning the unit off you should wait about 1 second before turning it back on again. A built in off reset delay is present in the 5200 which allows the micro-processor and internal power down electronics time to properly reset. An improper off reset will not harm the 5200 but no measurements can be made. Should an improper status display be present when the 5200 is turned on simply turn it off, wait 1 second then turn it on again. The power switch does not control the 120Vac line. LINE POWER IS ALWAYS PRESENT INSIDE THE UNIT WHENEVER THE LINE CORD IS PLUGGED IN and the main battery is on a controlled charge insuring full battery capabilities for portable operation.

2-5 The top display is a 40 character 2 line alphanumeric LCD (liquid crystal display) used to indicate measurement status, menu selections, temperature readings, data storage, data retrieval and operator prompts as required. This display is also used to show verification of keypad inputs as they are entered. Whenever the 5200 is turned on, the operating configuration that was set when the unit was turned off is recalled. The status display or measurement screen always shows the present configuration of the 5200. The status display indicates the mode of operation (auto, manual, etc.) and the function status (limits, tempco etc).

2-6 The second display is a four digit LCD that displays the resistance of the item being measured and is also used to indicate an out of limit or go/nogo condition (if limits have been selected) for the item being measured

2-7 Connections to the item being measured are made through the four

banana posts. The banana posts will accept banana jacks, bare wire or spade lugs as connections. Two of these posts (current+ and current-) supply constant current to the item under test. The other two (volts+ and volts-) are used to measure the voltage drop across the item. DO NOT APPLY EXTERNAL VOLTAGE to any of the posts. Refer to section 4 on resistance theory for further information.

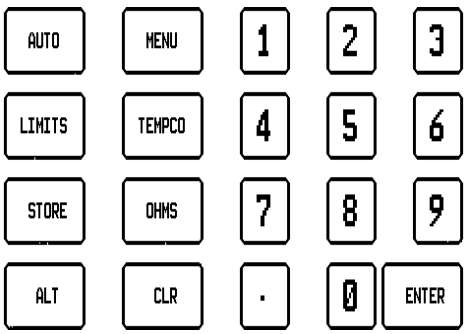
2-8 The temperature probe jack is for the temperature sensor or it's extension cable. The temperature sensor is used when displaying ambient temperatures or the temperature coefficient function is turned on. The temperature sensor is not required for general non-compensated resistance measurements. When measuring temperatures make sure that the temperature probe is at the same temperature as the component you are testing. Failure to do this will give erroneous readings when the TEMPCO function is activated. You must allow sufficient time for the probe to stabilize to the ambient or component temperature. The probe is very sensitive and will react even to air currents in the vicinity.

2-10 KEYPAD

2-11 The keypad (fig.2) has 20 keys. These keys can be broken into four different groups or classes referred to as mode, function, command and numeric. The mode keys (AUTO, MENU and ALT) are used to select a measurement mode such as autorange, manual, inductive, data storage, data recall or print. The function keys (LIMITS and TEMPCO) are used to set function values and turn these functions on and off while in any of the operating modes. Command keys (ENTER, CLR and STORE) are used to enter or clear selections and to store data. The numeric keys (0 through 9) allow entry of numeric information such as job setups, data storage areas, resistance values, temperature coefficients, limits etc.

AUTO

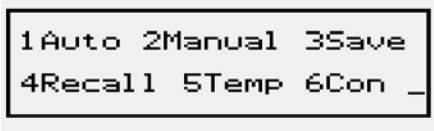
This is a mode key that selects the autoranging mode. Pressing this key will put you in the autorange mode and will cancel the manual or temperature measurement mode. The AUTO key has no effect on any function keys such as limits or tempco and these functions



along with their values will remain as previously selected. The Auto key is therefore used as a quick means to select autoranging.

MENU

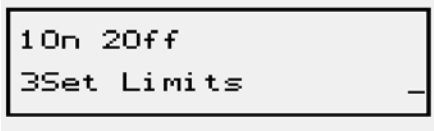
This is a mode key that is used to select the mode menu. When pressed followed by ENTER the top display will contain the mode menu. The mode menu allows selection of one of the six different



operating modes. These are AUTOrange, MANUAL, SAVE (store), RECALL, TEMPerature, and CONtrol. A detailed description of each mode can be found beginning with section 2-20

LIMITS

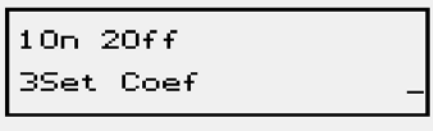
This is a function key and is used to select the limits menu which will then be present on the top display. The limits menu can then be used to set high and



low limit values, mean and % values and to turn the limits function on and off. An out of limits reading will turn on the internal audible alarm.

TEMPCO

This is a function key used to select the tempco menu. When the key is pressed the top display will show the tempco menu . This menu allows selection of the built in temperature coefficients for copper, aluminum, German silver or gold.



The menu also allows user definable temperature coefficients to be entered or selected and the temperature compensation funcion to be turned on and off.

OHMS

The OHMS key is a function key that is used in conjunction with the limits menu and allows a value that has been entered on the numeric keypad to represent a ohms, milliohms or microhms value. The OHMS key is not used for selecting the range in the manual mode.

STORE

This is a command key used to store actual resistance measurements into the job data storage areas. Each time a measurement is made the value that is present on the numeric display can be saved to data storage if STORE is pressed. The STORE key is active only when in the save operating mode. Refer to section 2-70 for further details.

ALT

The ALT key is a command key that is used to initialize the 5200A's memory to zero. Selecting the FACTORY INIT function will destroy all measurements and setups that you may have previously stored. The ALT key can also be used for selecting custom alternate functions that can be provided by Monolithic Industries. These functions can be custom tailored to suit various industries and OEM's. Please contact Monolithic Industries with your specific requirements.

CLR

The CLR command key is used to clear values and menu selections when a keypad entry has been made. Functions and values previously entered are not affected. This key is similar to the clr key on a calculator.

ENTER

The ENTER key is used to tell the micro-processor that the value or selection you have just made is OK and to proceed with that selection or value. This key is generally used after another key has been pressed. It is similar to the return key on a typical computer keyboard.

0-9

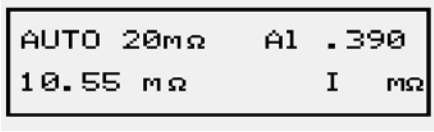
The numeric keys are used for entering numbers that may represent resistances, temperature coefficients, job setups etc. and are pretty much self explanatory.

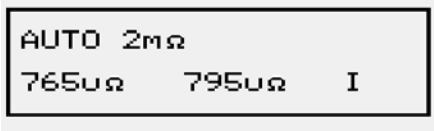
2-20 OPERATING MODES

2-21 AUTOMATIC OPERATION

2-22 Automatic operation of the 5200 is achieved by the Autorange or AUTO mode and is most often used when the resistance of the component being measured is unknown. The autoranging mode can be selected by one of two different means, pressing AUTO ENTER or the following key strokes, MENU ENTER, 1 ENTER. The autorange mode will select the proper measurement range and display the resistance value on the 4

digit LCD with the range (ohms, milliohms or micro-ohms) indicated in the lower right hand corner of the top display. Any function such as TEMPCO or LIMITS that were previously selected will still be active and their status will be indicated on the top display. This means that if you were in the manual mode and had turned the temperature compensation function on this function will still be on if you change to the autoranging mode. Functions can only be altered or turned on and off from the LIMITS or TEMPCO menus



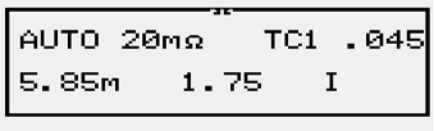


2-22 When using the autorange mode there are a couple of points to keep in mind. Since the 5200 is capable of supplying up to 5 amps on some of the ranges (see specifications section 1-? for range current values) trying to measure the resistance of a 1 amp fuse may blow the fuse. You should use the manual measurement mode in this case (see 2-30, manual operation).

2-23 The 5200 autoranges both up and down to find the proper range. When the voltage sensing leads (the black leads in each shielded cable) are open or not connected to a component the 5200 will have selected the highest resistance and the lowest current. When the voltage sensing leads are connected to a component or are shorted together the 5200 will select the proper current and the proper resistance range. You can therefore force the 5200 to the lowest current selection by making certain that the voltage sensing leads are open and connecting them last.

2-30 MANUAL OPERATION

2-31 Manual operation may be selected by the following keystrokes, MENU



ENTER 2 ENTER. When the MANUAL mode is selected the first line of top display will show the resistance range and the amperage used by that range. The bottom line of the display shows that

the resistance range may be increased to the next higher range by pressing the 1 numeric key and decreased to the next lower range by pressing the 2 key. When the proper resistance range has been selected press the ENTER key to return to the status screen. The 5200 is now in the manual mode and all measurements will made with the range and amperage selected.

2-32 The manual mode of operation is handy when measuring the resistance of a component that might be damaged by excessive current such as the fuse mentioned in 2-22. As an example the resistance of a 1 amp fuse might be .085 ohms. If you were to measure the fuse in the autorange mode the 5200 would automatically select the 100 milliohm range which would also supply 1 amp through the fuse which may blow it. In this case you would select manual mode and the 1 ohm range which would supply .1 amps maximum thus allowing you to safely measure the fuse without destroying it.

2-33 The manual range selected is automatically stored into RAM (random access memory) so that even if the 5200 is turned off then back on, the last range selected will be displayed when the manual mode is entered from the mode menu. This saves unnecessary keystrokes when using the 5200 for repetitive measurements on a daily basis.

2-40 CONTROL

2-41 This mode (6 Con) controls the measurement method of the 5200. The 5200 utilizes four different methods for making measurements. The first method (CON menu selection 1) is used for general purpose resistance measurements and must also be used when measuring components having large inductances such as shunt fields

and large transformers. The second measurement mode (CON menu selection 2) is used when making precision measurements in the presence of thermal EMF's caused by dissimilar metallic junctions. This mode is recommended when measuring components with little inductance such as series fields, armatures, bus bars, circuit breakers and contacts. The EMF mode should always be used when measuring resistances below 200 micro ohms. The 5200 also contains a built in filter that can be switched in or out for use in very noisy environments or when measurements are

being made in the presence of large magnetic fields. CON menu selection 2FILTER selects the resistance mode with the filter in. CON menu selection 3XFORMER is a special mode used for measuring large transformers. This selection increases the applied current to the transformer and automatically inserts the filter stage. When using the XFORMER mode it is reccommmended that the manual range selection be used instead of autorange. **Current to the test leads will be turned off when ever a 0 has been selected and entered in the CON menu.** After a 0 has been selected and entered you can verify that the current is off by observing the lower right side of the top display. A 0 indicates no current while an I indicates that current is present in the leads. The 4 digit display will continue to read out. You must wait for a zero or near zero reading before disconnecting the test leads. A zero reading indicates that the stored energy in inductive components, especially large transformers, has been absorbed. **FOR SAFETY ALWAYS MAKE SURE THE CURRENT IS OFF AND THE DISPLAY READS ZERO WHEN DISCONNECTING THE LEADS FROM INDUCTIVE COMPONENTS.**

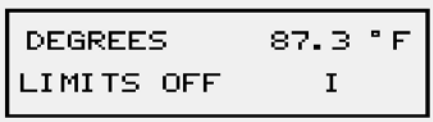
2-45 TEMPERATURE MODE

2-46 The LRMS 5200 can be used as a digital pyrometer when the TEMP mode is selected from the main menu. The temperature range is from 0-150 oC. To use the 5200 as a pyrometer press MENU ENTER, 5 ENTER. You can now select whether 1 (Fahrenheit) or 2 (Celsius) readings will be displayed. The temperature will be displayed on the top

display.

2-50 FUNCTIONS

2-51 The TEMPCO function is used to



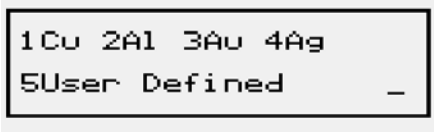
calculate or normalize the resistance of a component to 20 oC. In order for the

5200 to calculate the absolute resistance of the component it needs to know the temperature coefficient of resistivity for the component and the temperature of the component at the time of measurement. Refer to section 4-10 for more details on temperature coefficients.

2-52 The 5200 has built in temperature coefficients for copper (Cu), aluminum (Al), silver (Ag) or gold (Au). These coefficients or Tc's are selected from the tempco menu. The tempco menu can be entered by the following keystrokes, TEMPCO, ENTER. The tempco menu will now be displayed on the top display. Since you wish to select a coefficient press,3 , ENTER. the coefficient selection menu is now displayed. A particular Tc can be selected by these

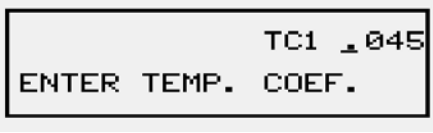
keystrokes,1 (for copper), 2 (for aluminum etc.), ENTER. You will now exit back to the status screen.

2-53 In addition to the four built in



coefficients, the 5200 has the capability of storing 5 additional or user defined coefficients and referred to as TC1, TC2 etc. User defined coefficients provide for special cases (rotor bars, special wire etc.) where metals other than copper, aluminum etc or alloys such as brass and steel are being measured. These coefficients must be entered into the 5200's memory before they can be recalled or selected (the 5200 is shipped from the factory with the user TC's set to 0%). All temperature coefficients are expressed in % per oC. Copper for example has a temperature coefficient of .0039%/oC. To enter a user defined coefficient perform the following keystrokes (with the status display showing), TEMPCO ENTER, 3 ENTER, 5 ENTER. The user Tc menu will be displayed. Select the Tc you wish to define with 1 (for TC1) ENTER. The display will show the present value for the Tc selected. You can now Key in a new temperature coefficient in %/oC if desired. The value you must enter is the temperature coefficient X 100 For example the temperature coefficient for

brass is .002 you would key in .2 ENTER. If you make a mistake when entering the value simply press CLR and reenter the



value. A table of various temperature coefficients can be found in section 4.

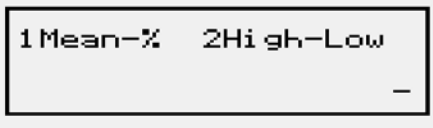
2-54 Recalling a user defined tempco is identical to storing one. The only difference is that when you select a user

defined Tc (TC1 etc) and the value of that Tc is displayed do not enter a new value, simply press ENTER to select the value shown.

2-55 The TEMPCO function is turned on or off by the following keystrokes, TEMPCO ENTER, 1 (on) 2 (off) ENTER. When the TEMPCO function is on, the Tc selected and it's value will be displayed in the upper right hand corner of the status display. When the TEMPCO function is off the upper right hand portion of the display will be blank.

2-60 The LIMITS function of the 5200 is used to indicate when a measurement value is above or below a preset value. Actual resistances such as 135 milliohms, 2.54 ohms 320 micro ohms etc can be used as values for high and low limits. For example, a hypothetical large DC armature has a nominal bar to bar resistance of 1.35 milliohms. The acceptable variation from nominal might be 1.42 milliohms as a high value and 1.22 miliohms for a low value. Using the procedure in 2-61 the high and low resistance values would be entered and the LIMIT function turned on. Should the bar to bar resistance exceed these values the 5200 would audibly indicate that an out of limits condition exists. Limits can also be set as a +/- percentage value of a measured or stored resistance. Using the same hypothetical DC armature, a variation of +/- 2.5% from the nominal 1.35 milliohm might be acceptable. After performing the procedure given in 2-63 the 5200 would again audibly indicate an out of limits condition whenever the resistance varied more than 2.5%. The difference between the two limit types is that a percentage limit is always an equal amount above or below an actual resistance, whereas an absolute limit can be any value of resistance high or low as desired. Absolute limits are handy when working with wiring, bussbars, and continuity testing. Percentage limits are most often used when measuring resistors, motors, armatures, windings etc. Whenever LIMITS are enabled or turned on, the status display will show the absolute lower and upper settings or the stored resistance and percent value. The 5200 will indicate an out of limits condition only when the LIMITS function is on. The LIMIT function can be used in any of the 5200's operating modes (autorange, manual etc.)

2-61 Absolute limits can be set by the following keystrokes, LIMITS ENTER, 3 ENTER. Since you wish to set absolute high and low limits press 2 ENTER. The top display will now ask you to ENTER LOW LIMIT. The resistance value can be entered in decimal or integer form (10 milliohms or .01 ohms). If you make an error, simply press CLR to clear the value entered. Now use the OHMS key to specify whether the numeric value entered is in micro ohms, milliohms or



ohms,. The top display indicates micro ohms to start with. Pressing the OHMS key once will step to milliohms. Pressing OHMS again will step to ohms, OHMS again will step back to micro ohms etc. When you are satisfied with your entry press ENTER. The display will now ask

```
ENTER LOW LIMIT
10.00uΩ 999.9Ω
```

for ENTER HIGH LIMIT. The low limit just entered will be displayed in the exact form you entered it in. The high limit is entered the same way as the low limit.

2-62 Percentage limits can be set by the following keystrokes, LIMITS ENTER, 3 ENTER, 1 ENTER. The top display will now ask you to ENTER MEAN. Using the values for the fictional armature in 2-60, you would key in 1.35 and use the OHMS key to step to milliohms. Press ENTER. You are now asked to ENTER %. Key in 2.5 followed by ENTER. You have just set the mean and percent limits and the top display will now be back to

```
ENTER HIGH LIMIT
.01 Ω   999.9Ω
```

the status screen.

2-63 To turn the LIMITS on or off press LIMITS ENTER, 1 (on) 2 (off) ENTER. When the LIMITS function is on the status display will indicate the absolute limits set in 2-61 or the mean and percent limits set in 2-62.

2-70 DATA SAVE

```
ENTER MEAN
1.000 Ω 00.0%
```

2-71 Capabilities

Since the LRMS 5200 is a micro processor controlled instrument it has the

```
ENTER %
1.35mΩ  00.0%
```

capability of storing and retaining setups and data. A setup is information which

```
1On 2Off
3Set Limits
```

pertains to the operation of the 5200. Setups are used by the instrument to preset operating modes, functions, data storage areas and any other system parameters that are required on a

repetitive basis. Setups need only be entered once for each motor, contactor, coil etc. As an example the absolute resistance, temperature compensation and limits for a 752 traction motor can be entered once and then recalled each time a 752 is to be tested, or the resistance and limits for a particular contactor or circuit breaker may be entered and then recalled weeks or months later when measurements on the same contactor are taken to see if any resistance change has occurred. Setups can be thought of as performing functions similar to the switches, knobs and dials found on most other equipment. The 5200 can store 32 different setups at the same time.

2-72 Measurement data can also be stored in the job storage areas. There are four such areas in the 5200, each area can store 180 actual measurements. The job storage areas are useful for storing complete sets of measurements, such as a complete armature or 10 different points on a contactor, for analysis or printouts at a later time. The job storage areas are quite handy for measurements taken in the field or for measurements on the same piece of equipment that are taken over a period of time and used to track the performance of that equipment for preventative maintenance or engineering studies.

2-73 Setups and stored data are kept in RAM and will be retained (approx. 1 yr.) by the lithium battery backup system. Provision has been made for replacement of the lithium battery without the loss of any stored information (see section 6-5).

2-75 SETUPS

2-76 Setups can be stored with the following keystrokes, MENU ENTER, 3 ENTER. The display now asks whether you want to save a setup or a measurement. If you want to save the present configuration of the 5200 as a setup you would press 1 ENTER. The display will now ask you to assign a setup number. Key in the number (1-32) and press ENTER to return to the status screen.

2-77 When a setup number is assigned, the existing configuration of the 5200 is saved to memory. This means that the operating mode (autorange, manual etc.) and functions (limits, tempco etc.) currently in use will be stored to the setup number you keyed in.

2-78 For example the armature of a

typical large traction motor may have a bar to bar resistance of 765 micro ohms at 20 C with an acceptable deviation of +/- 3% and the armature conductors are copper. You would enter the resistance

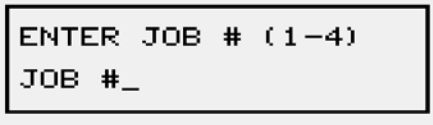
and the % deviation from the limits menu and turn the limits function on. Then the temperature compensation (Tc) for copper would be selected from the tempco menu and the tempco function turned on. The 5200 configuration is now set. This configuration can be saved in memory if a setup number is assigned to it. The configuration of the 5200 can be saved at any time simply by assigning a setup number.

2-79 A setup may be recalled by selecting MENU ENTER 4 ENTER 1 ENTER, and then selecting the setup number you wish. to recall. Whenever a setup number is recalled the 5200 will be automatically reconfigured with the parameters that were prestored for that particular setup number.

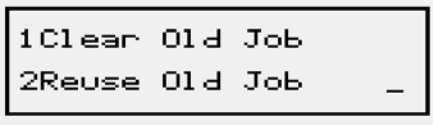
2-85 JOB STORAGE AREAS

2-86 Job storage areas are used to store actual resistance measurements and temperatures. They differ from setups in that setups configure the 5200 and storage areas store measurements. There are four separate job storage areas capable of storing 180 measurements in each area. To select a job storage area press MENU ENTER, 3 ENTER, 2 ENTER. You will now be asked to enter the job storage area (1-4) you wish to use. Key in the storage area and press ENTER. You now have the choice of clearing all data previously stored in that area or reusing the area. If you select 1CLR all data in the job storage area selected (1-4) will be cleared out and measurements will be stored starting at sample# 1. If you select 2REUSE any data previously stored will be retained and storage of new data will begin at the location where the old data ended. The REUSE capability allows separate sets of measurements taken at different times to be retained for comparison at a later date.

2-87 When the store mode has been



selected from the main menu and job storage has also been selected from the storage menu, each measurement taken will be stored whenever the STORE key is pressed. The data that will be stored at



this time is the reading displayed on the 4 digit numeric display along with the temperature measured by the sensor. Each time the STORE key is pressed the sample number will be incremented. The sample number along with the contents of the sample and the job storage area selected will be displayed on the top display.

2-88 Samples may be recalled by entering the sample number followed by the ENTER key. The top display will show the contents of that sample. You

can now make a new measurement and store it into that sample location by pressing the STORE key. Keep in mind that the sample number automatically increments to the next sample location every time the STORE key is pressed and you will overwrite any existing data in that sample location. As an example, consider the case where you have made 50 out of 65 measurements and you wish to go back and redo measurement number 43. Key in 43 on the numeric keys and then press ENTER. The top display will show the 43rd measurement stored. If desired make the 43rd measurement again and press the

STORE key. Now key in 51 followed by ENTER to resume with measurement 51 on up.

2-89 The capability of recalling a setup that has previously been stored can be very useful when combined with the job storage mode. For example, the setup for the traction motor given in 2-62 can be selected which will configure the 5200 for that motor, then the job storage mode can be selected to record the actual bar to bar resistances measured.

2-90 The resistance values displayed are dependent on the configuration of the 5200 and will be calculated based on the temperature coefficient selected, and whether the tempco function is turned on. The resistance shown will be the resistance normalized to 20 C.

2-95 DATA RECALL

2-96 Information that has been previously stored in RAM can be recalled at any time. This information will be either setups (2-75), or actual resistance measurements contained in the job storage areas (2-85)

2-97 Setups are recalled by selecting the recall option from the main menu and then the setup option from the recall menu.

2-98 Job storage areas that contain measurements are recalled by selecting the recall option from the main menu and then the job option from the recall menu.

2-100 GENERAL RESISTANCE MEASUREMENTS

2-101 Connections made to the component under test should be made with the standard cables supplied or one of the optional cables available from Monolithic Industries. The use of factory supplied cables is not an absolute requirement but is highly recommended to insure the best operation of the 5200. Should the requirements of a measurement be such that factory cables cannot be effectively used special cables can be made up as required. Satisfactory

performance will be achieved by following a few simple rules.

1. Make good connections to the banana posts

2. Make good connections to the component being tested.

3. Use shielded cables if possible.

4. Keep cable lengths as short as possible and cable resistance as low as possible (1/2 ohm maximum for the current cables).

2-120 There are four connections necessary to measure the resistance of a component. Two of these connections (current+ and current-) supply one of six constant currents to the component. The other two connections (volts+ and volts-) sense the voltage drop across the component. All that is necessary to measure the resistance of an item is to attach the four connections to the item (fig. 3) and read the displays. The resistance being measured will be resistance between the voltage sense connections, not the resistance between the current connections. Refer to 4-20 for further information on four wire measurements.

Section 3

Section 4

4-1 RESISTANCE THEORY

4-2 Resistance

Resistance is a measure of the opposition offered to a current flow through a material. The unit of resistance is the ohm. One ohm is the unit of resistance that causes a potential drop of one volt when a steady current of one amp flows through the resistive material.

4-3 All materials have resistance. Those materials with high resistance are generally referred to as insulators and have resistances in the megohm range. Materials with low resistance are called conductors. Most conductors are metals and have resistances in the micro ohm range.

4-4 There are five important factors that determine the resistance of any material. These factors are:

1. Chemical composition

2. Physical state (is the material a liquid, solid, or gas?)

3. Temperature of the material

4. Length of the material

5. Cross sectional area of the material

4-5 Resistance is defined by the formula
$R=p\ l/a$

where R is the resistance in ohms, l is the length of the material, and a is the cross sectional area. The p in the equation takes into account the first three factors and is referred to as the coefficient of resistivity. All materials have different values for p. According to the formula for resistance it can be stated that the resistance of a conductor is directly proportional to it's length (the longer the length the higher the resistance), and it's resistance is inversely proportional to the cross sectional area (the larger the diameter the lower the resistance becomes).

4-10 FOUR WIRE MEASUREMENTS

4-11 Resistance is actually measured by measuring the voltage drop across an unknown resistance that has a known current flowing through it. The actual resistance is then calculated according to ohms law. A normal ohm meter generally uses only two test leads to measure resistance. If the resistance being measured is very low, the resistance of the test leads themselves can cause considerable error in the measurement. In the four wire method of measuring, two of the test leads (current+ and current-) supply a known current to the unknown resistance and the remaining two test leads (volts+ and volts-) sense the voltage drop across the unknown resistance. The LRMS 5200 supplies a constant current through the current leads regardless of the resistance of the current leads or the actual resistance of the conductor being measured. This gives the LRMS one element (I) of the equation. The voltage or sense leads measure the voltage across the unknown resistance giving the other unknown (E).

The microprocessor then calculates the resistance according to ohms law R = E/I. Should the TEMPCO function be selected, the value of R is modified by the equation given in 4-17 before it is displayed on the four digit readout. Refer to figure 4-1 which shows the four wire method of resistance measurement.

4-15 TEMPERATURE EFFECTS

4-16 Temperature variations have an effect on most materials. A variation in temperature can cause the resistance of a material to increase, decrease, or essentially remain the same. Materials can be classified as having a positive (increasing resistance with temperature rise), negative (decreasing resistance with temperature rise), or zero

temperature coefficient. The vast majority of metallic conductors such as copper, aluminum, gold, silver, iron, etc have a positive temperature coefficient (tempco). Tempco;s are measured as a percentage change in resistance per degree centigrade (Celsius). The tempco's for a few common metals are listed below.

Aluminum	.0039
Bismuth	.004
Brass	.002
Copper (annealed)	.00393
Copper (hard drawn)	.00382
Gold	.0034
Iron	.0052-.0062
Nichrome	.00017
Nickel	.0047
Phosphor-bronze	.003
Tungsten	.0045
Zinc	.0044

4-17 The change in resistance due to a change in temperature can be calculated by using the following formula

Rn = Ro[1 + a(Tn-To)]

Where Ro= the resistance at 20C, To= the temperature at which Ro was measured, Tn= the new operating temperature, and a= the temperature coefficient of the material. As an example, a hypothetical copper wound field coil has a resistance of 10 ohms at 20 degrees C (68 F). Assume the temperature of the coil has risen to 85C after it has been carrying current for a while. The resistance of the coil is now

Rn = 10[1 + .00393(85-20)] = 12.55 ohms.

4-18 The LRMS 5200A has the capability of automatically calculating the effects of temperature for various materials through the use of the TEMPCO function (refer to 2-50).

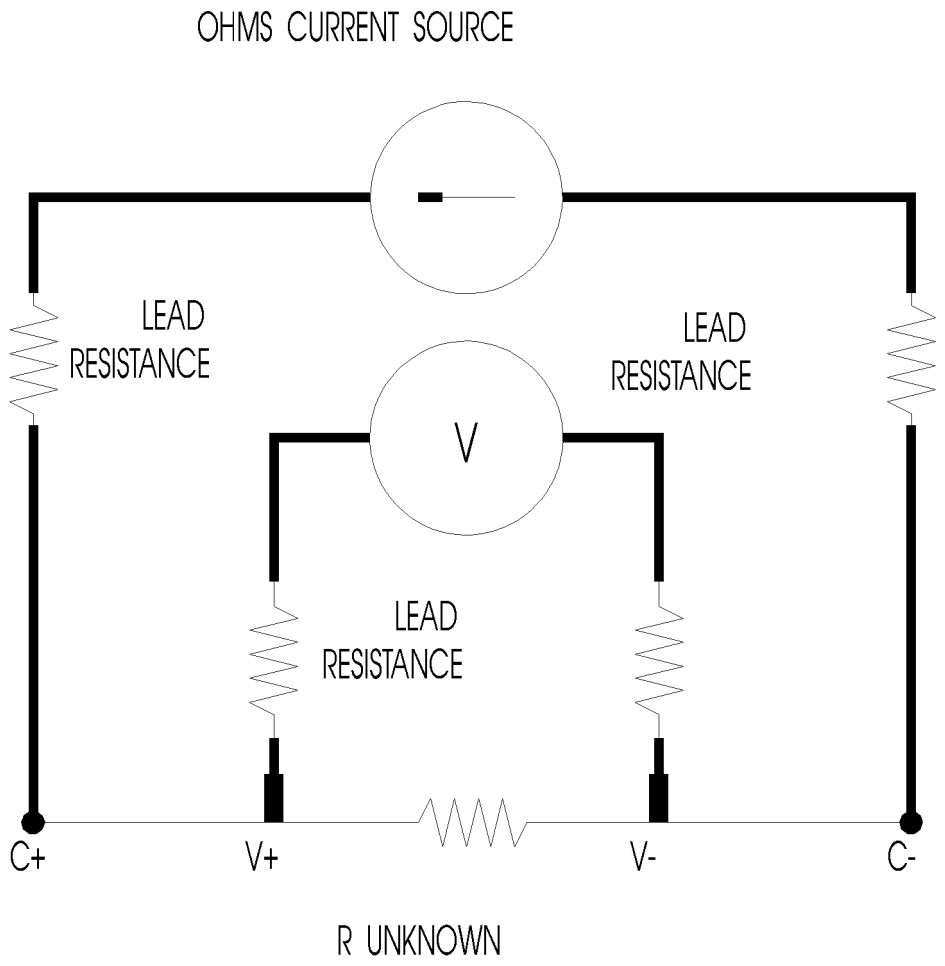

OHMS CURRENT SOURCE
LEAD
RESISTANCE
LEAD
RESISTANCE
V
LEAD
RESISTANCE
C+
V+
V-
C-
R UNKNOWN

Figure 4-1

Section 5

5-1 CALIBRATION

5-2 Calibration check

The following equipment is required to check the LRMS 5200A's calibration.

4 point Standard resistors

1K ohm

100 ohm

10 ohm

1 ohm

.1 ohm

.01 ohms

.001 ohms

.0001 ohms

5-3 With the unit in the AUTO RANGE and mode 1 selected (see section 2-40 to select RES mode 1), check each range with the appropriate standard resistor (the last two ranges must be checked using EMF mode 4. See section 2-40). If any range requires calibration proceed to 5-4.

range	min	max	mode
2k ohms	999	1001	1
200 ohms	99.9	100.1	1
20 ohms	9.99	10.01	1
2 ohms	.999	1.001	1
.2 ohms	99.9	100.1	1
.02 ohms	9.99	10.01	1
.002 ohms	.999	1.001	4
200 u ohms	99.5	100.5	4

5-4 CALIBRATION PROCEDURE

5-5 Equipment required

5 1/2 digit dc voltmeter .01% accuracy

Standard resistors

1k ohm

100 ohm

10 ohm

1 ohm

.1 ohm

Decade resistance box (0-10k ohm 1w 1%)

5-6 CURRENT BOARD CALIBRATION PROCEDURE

5-7 All adjustments referenced are located on the CURRENT board (fig 5-1). The voltmeter readings are taken at the resistors not the banana posts. The LRMS 5200A current sources are calibrated with the standard resistors and th dvm.

5-8 Turn the LRMS on and enter the following keystrokes, MENU, ENTER, 6, ENTER, 1, ENTER, MENU, ENTER, 2,

ENTER, 1, 1, 1, 1, 1, 1, 1. DO NOT hit the ENTER key again until all current sources have been calibrated. The display should indicate the 2k 100ua range. Attach the 1k standard resistor across the current + and - banana posts. Measure the voltage across the resistor (right at the resistor not the LRMS banana posts.) and adjust p1 for 100 millivolts +/- 30uv.

5-9 Depress keypad numeral "2" once. 200 ohms 1ma should be indicated. Adjust p2 for 1.000V +/- 300uv.

5-10 Remove the 1k standard resistor and replace it with the 100 ohm standard resistor. Note and record the voltmeter reading (100.0mv +/- 30uv).

5-11 Depress keypad numeral "2" once. 20 ohms 10ma should be indicated. Adjust p3 for 1.000V +/- 300uv.

5-12 Remove the 100 ohm resistor and replace with the 10 ohm standard resistor. Note and record the voltmeter reading (100.0mv +/- 30uv).

5-13 Depress keypad numeral "2" once. 2 ohms 100ma should be indicated. Adjust p4 for 1.000V +/- 300uv.

5-14 Remove the 10 ohm resistor and replace with the 1 ohm standard resistor. Note and record the voltmeter reading (100.0mv +/- 30uv).

5-15 Depress keypad numeral "2" once. 200m ohms 1A should be indicated. Adjust p5 for for 1.000V +/- 300uv.

5-16 Remove the 1 ohm resistor and replace with the .1 ohm standard resistor. Note and record the voltmeter reading (100.0mv +/- 30uv).

5-17 Depress keypad numeral "2" twice. 2m ohms 5A should be indicated. Adjust p6 for for .5000V +/- 1mv.

5-18 Depress keypad ENTER, AUTO, ENTER. This completes the current source calibration procedure.

5-19 Repeat step 5-3.

5-20 If all or most of the ranges are still out of calibration proceed to step 5-21. If ranges are within calibration proceed to step 5-24

5-21 ANALOG CALIBRATION PROCEDURE

5-22 All potentiometers and test points referenced are located on the analog board. Attach - voltmeter lead to analog board pin TP2 (gnd). Measure the voltage at the junction of R1 and D1 (figure 5-2). Adjust potentiometer p1 for 5.000V +/- 200uv.

5-23 Measure the 1 ohm standard resistor with the LRMS and adjust p2 for a reading of 1.000.

5-24 200 micro ohm calibration

5-25 Make sure the LRMS is in AUTO range and mode 4 is selected (see sect

2-40). Attach the .0001 ohm standard resistor and adjust p5 for 100.0 +/- .2 micro ohms.

5-24 TEMPERATURE ZERO ADJUST

5-25 Remove the temperature probe and attach the decade resistance box to the green and white wires of the temperature jack. Measure the voltage across the same green and white wires. Adjust the decade box (nominally 2k-3k) until a reading of 2.732V is obtained.

5-26 Enter the following on the keypad, MENU, ENTER, 5, ENTER, 2, ENTER. The display should now indicate temperature in Celsius.

5-27 Adjust p4 for a reading of 0 degrees +/- .5 degree. (This adjustment is somewhat touchy on earlier 5200's.)

5-28 There are two other potentiometers on the analog board. These are factory adjustments and do not require any periodic calibration.

5-29 Refer to fig 5-2. Should the analog board have gain adjustments p6-p11, contact the factory for further information as to the proper calibration procedure.

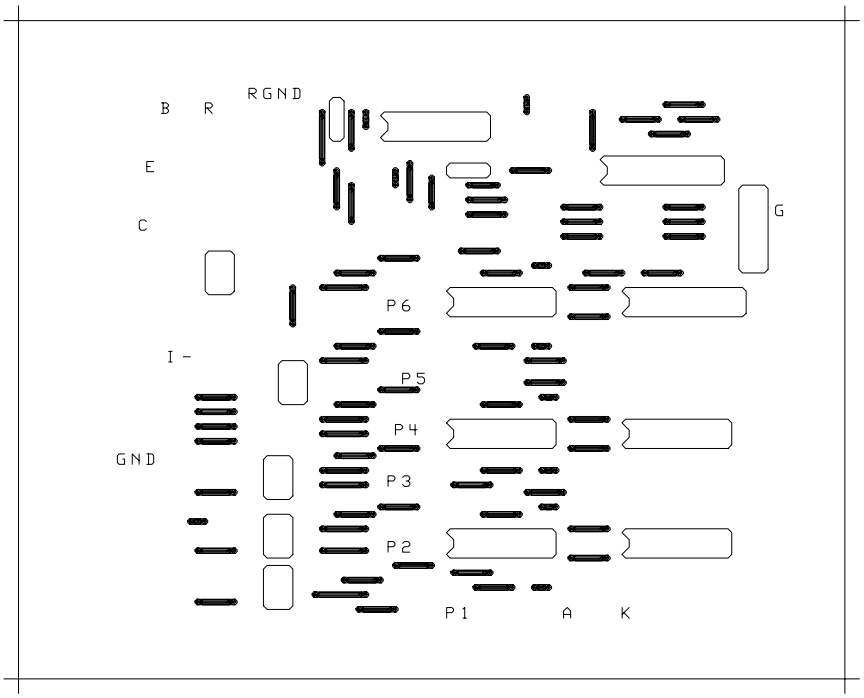


Figure 5-1

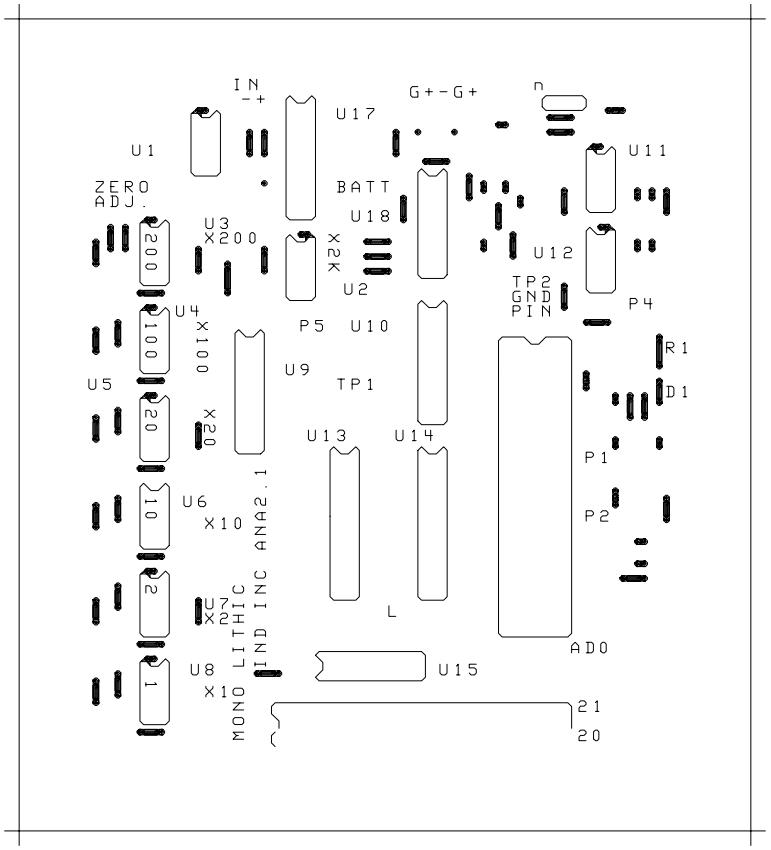


Figure 5_2

Section 6

Section 6.

6-1 MAINTENANCE

6-2 General

6-3 The LRMS 5200A should require little or no maintenance of any internal parts or components. The mylar faceplate can be cleaned with alcohol and a soft cloth when necessary. Test leads should be checked every once in a while for good joints and secure connections using standard practices.

6-4 The LCD readouts are made of glass and will not survive shocks or impacts from screwdrivers or other implements and care must be exercised to ensure against cracking them.

6-10 Batteries

6-11 The LRMS 5200A contains 2 batteries. The main battery is a 6v sealed lead acid type. The other battery is a lithium coin cell used to retain the microprocessor RAM memory. Replacement batteries can be ordered from Monolithic Industries, or you may send the LRMS to us should a new battery be required.

6-15 Lithium cell replacement (approximately every 3 years)

6-16 **TURN THE POWER OFF AND UNPLUG THE LRMS 5200A**. The cover can be removed by removing the eight button head screws that fasten it to the case. The Lithium cell is located just behind the top display on the printed circuit board. TURN THE LRMS ON. Failure to turn the LRMS on and enter the following keystrokes will destroy any stored data in memory if the lithium battery is removed prior to the unit being on. Press ALT ENTER 2 ENTER. Gently remove the old battery and insert the new one. OBSERVE THE BATTERY POLARITY BEFORE INSERTING IT. The plus side must make contact with the plus marking on the battery holder clip as shown in fig 6.1. If the lithium cell is inserted backwards permanent damage to the memory chips will occur. Turn the unit off. Replace the cover making sure that the thin metal strip welded to the inside top front of the cover is behind the front panel and no gap exists between the top of the cover and the front panel. Replace the eight (8) button head screws. This completes the lithium cell

replacement

6-20 Fuse Replacement

6-21 There are two fuses in the LRMS

(fig. 6-2). The top fuse is a 3AG 20A @250V that is used for battery power. The bottom fuse is an MDL 2A @250V used for line power. **Make sure that the LRMS is off and unplugged from AC power before replacing either fuse.**

6-30 TROUBLE SHOOTING.

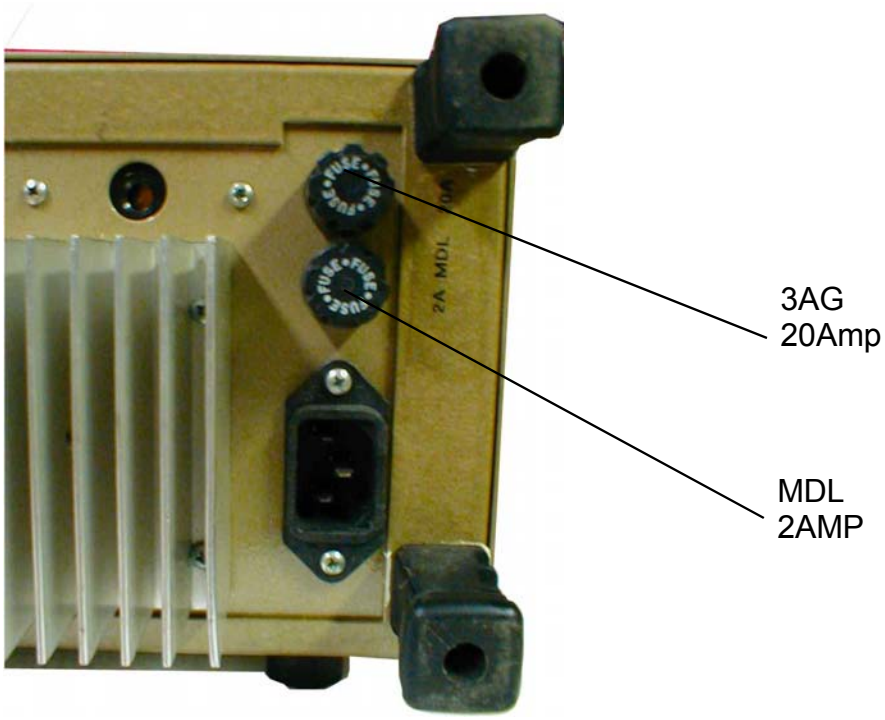


Figure 6_2

6-32 If unit will not make measurements first ensure that the current is enabled as indicated by an "I" in the lower right hand side of the top display. If an "O" is present perform 6-74. Second make sure that you are making connection with ALL FOUR of the leads. If you are using the supplied Kelvin clips, carefully inspect the wire that crosses over by the plastic pivot. Test the leads for continuity. Bad connections or broken leads are the most common problem.

6-34 Upper display is garbled or unit is performing erratically. Perform 6-72. If top display continues to be erratic replace Lithium cell (6-15) and then perform 6-72 again.

6-36 Check the four fuses on the internal protection board (LRMS serial numbers 1946 and up). Replace these fuses with type 3AG 6amp fast blow only. The protection board can be accessed by removing the top cover.

6-70 Rebooting the LRMS 5200A.

6-72 The LRMS utilizes random access memory to hold operating setups, stored data, internal flags and other system markers. Every once in a while these flags may become disrupted by external arcs, sparks, or intense magnetic fields. When this occurs these flags must be restored. This is the same as rebooting a personal computer. To reboot the LRMS 5200A (Factory initialization) press ALT ENTER 1 ENTER. The character display should be blank except for a cursor line on the left side. Turn the LRMS off. When you turn the LRMS 5200 on again the display should indicate properly. Remember to renable the current by turning it back on.

6-74 Enabling the current. To enable the current press MENU ENTER 6 ENTER 1 ENTER.

CAUTIONS

1. **Make sure that all power is off to the equipment you are testing**.
2. **When testing highly inductive components, large transformers especially, read and follow the procedure given in section 2-40 pages 14&15 for the proper method of connecting and disconnecting the test leads to avoid inductive shock hazard.**
3. Do not apply any external voltage to the leads of the LRMS 5200A.
4. Do not plug the LRMS 5200A line cord into any power outlet over its' rated voltage.
5. Do not use any other value for fuses except those listed in the manual.

OPERATING TIPS

1. Use the **AUTO** mode when in doubt about measuring.
2. Make certain that the LRMS current is enabled, there should be an **"I"** displayed in the lower right hand side of the top display. If a **"0"** is displayed the current is off. Read section 2-40 pages 14 & 15 to turn the current back on.
3. You are making a 4 point Kelvin measurement, so all four leads, **both sides** of each Kelvin clip, must make contact with whatever you are testing.
4. When testing components with large inductance, the LRMS may cycle between 2 ranges and may not be able to automatically select a range. If this happens use **MANUAL** mode and select the highest range that the LRMS is cycling about. See section 2-30 page 14 for MANUAL mode.
5. Quick cycle recharge of the battery is sufficient for day to day operation. To insure continued full battery capacity and battery longevity, recharge the battery overnight (12 to 14 hours) every month or two.