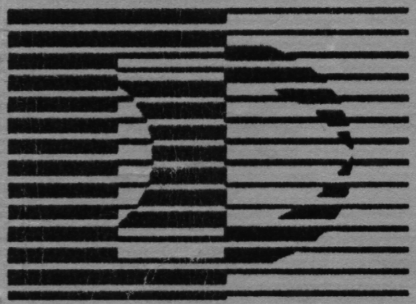

MC400 INSTRUCTION MANUAL

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SECTION 1 GENERAL INFORMATION

1.1 INTRODUCTION

The Daetron model MC400 is a compact hand held 4 digit LCD Component Analyser/Capacitance Meter capable of measuring over the full range of 0.1 pF to 1 FARAD (999.9 mF), in completely autoranging or manual modes. this instrument incorporates so many features that the user is well advised to read and understand this manual thoroughly so as to avoid any misunderstandings about how the unit works. Complex procedures involving certain features could lead an unwary user to think the unit is not working properly.

The basic method of measuring capacitance involves the use of charging and discharging the capacitor while counting the time of this cycle. the cycle time is converted to display a value which is equivalent to the value of the capacitor under test. the microprocessor controlling the circuitry senses when the value of any capacitor is over ranged for that value and switches to the next higher range resistor.

Component analysing is carried out by scanning any component mounted in the top 3 receptacles of the transistor socket and monitoring the behavior of the voltage outputs that these components produce. For operating the component analyser at its optimum level see the section on the AC adaptor.

1.2 INSTALLING THE BATTERY

To install a battery make sure the power switch is in the off position. Slide off the back cover and clip the 9 volt battery to the battery clip and insert it beside the spare fuse holder. Slide the cover back on. Always use an alkaline battery as this will last a lot longer than regular zinc carbon or heavy duty batteries. If using a nI-CAD battery, the ability to read zener diodes or analize components or read leakage will be impaired as it has a slightly lower voltage.

When the battery gets too low the display will read the word "bAtt" and no other functions will be available.

IT IS IMPORTANT THAT A GOOD QUALITY BATTERY BE INSTALLED AS THE WARRANTY IS VOID IF THE UNIT IS DAMAGED BY A LEAKY BATTERY.

1.3 PREDICTING BATTERY FAILURE.

The MC400 uses an unregulated 25 volt source derived from multiplying the battery voltage for testing zener diodes, leaky capacitors and analysing components. Since this voltage is unregulated it gives a pretty good idea on the condition of the battery. A fresh battery will create a multiplied voltage of approximately 20 to 22 volts. A weak battery from 13 to 15 volts. By monitoring this voltage battery failure can be predicted as the battery ages. to use this feature see the section on Zener diodes but don't install any diodes.

1.4 USING THE OPTIONAL AC BATTERY ADAPTOR (DAETRON MODEL PS100)

This option is highly recommended as the component analyser will not work at its full optimum level when being run on batteries only. that is to say that any components cannot be analyzed as the battery degrades with age. Whenever a function that uses the high voltage on the MC400 is activated it draws a lot of current. It is highly recommended that any time these functions are used, the AC adaptor is installed or else the life of the battery will be greatly reduced. Read the following procedure very carefully. Insert the plug of the adaptor into the MC400 jack on the top of the unit. next insert the adaptor into the AC outlet. Failure to use this procedure may result in damage to the AC adaptor. Also using an AC adaptor will allow a higher voltage Zener diodes to be read. (Max. of 25.5 VDC). the MC400's one year warranty is voided on any units operating on any other than the DAETRON PS100 or a unit that has been approved by DAETRON.

1.5 ACCESSORIES INCLUDED

Three test leads are included for use with both the capacitor socket and transistor socket. In both cases the leads are generally used for use with hard to connect parts. the leads are a pin plug assembly with alligator clips designed to be inserted in any socket type receptacle. the insertion into the transistor socket may be a bit stiff at first but will gradually ease up as the unit becomes broken in.

1.6 GETTING STARTED

Despite it's complicated looking appearance the MC400 is very easy to use when initially checking capacitors. the unit is ready to test capacitors when the power switch is turned on. Before placing the capacitor in the capacitor socket make sure to discharge the capacitor. the capacitor socket + and - receptacles have a large wattage resistor connected to it when the power switch is in the "off" position. So if your not sure whether your capacitor is discharged, make sure to short the leads or insert the unit into the socket when the power switch is in the "off" position. Also observe polarity when connecting polarized capacitors.

As you can see there is no "zero" potentiometer. the MC400 will automatically zero any capacitance up to about 150 pF at the input terminals when initially turned on. So if you want to measure small value capacitors make sure to remove them before powering up. When reading capacitors in the pF range always manually zero the MC400 before each reading by pressing the RED zero key.

Because the unit is fully autoranging there is no need to select any particular range as this is done automatically. there is a manual capability that will select a particular range. See MANUAL RANGING . The MC400 also has standard banana jacks if the user wishes to use longer leads. the unit is supplied with 3 small type leads suitable for capacitances as described in section 1.5.

Never apply a voltage to the test jacks or socket, as damage may occur even though it is fuse protected.

When there is no capacitance to be read the display will show either 000.0 or -000. If the user tries to read a capacitor and gets a minus display or a reading then remove the capacitor and press the 'white' ZERO key (see zeroing the MC400).

When taking general readings always make sure to wait a few seconds for the readings to stabilize as the capacitor may have been inserted into the middle of a conversion. this is especially true when operating any of the various features of the MC400. On some features a slight drifting might cause exaggerated drifting when that particular feature is activated due to the rounding and truncating of data during calculations.

The user should be aware that any type of capacitor (ceramic, electrolytic, paper, etc.) can cause marginal, drifting or inconsistant readings if the capacitor is not performing to its rated capability. even many good capacitors will display different readings within a few minutes time. Capacitance will also vary with applied voltage as well as length of time under that voltage, and temperature (unless it is an extremely stable type like a NPO or COG type).

When measuring capacitors between 100 and 10,000 uF sometimes the display will flash 'OUER' for awhile until enough conversions have been accumulated to display a count. This does not necessarily mean that the capacitor is overranged. Be patience when measuring these large capacitors as the MC400 is taking measurements and a valid count will be displayed eventually. A 180,000 uF capacitor for example will take approximately 40 seconds before a display is available. Larger capacitors take correspondingly larger times. When reading capacitors in the pF range, use a battery for best results as an AC adaptor may cause drifting especially with very small values.

1.7 ENTERING IN INFORMATION ON THE KEYPAD

When pressing any key on the keyboard all of the LED lamps will flash and the beeper will sound (on most key entries) to indicate a valid key entry. the microprocessor polls the keyboard in between conver sions. therefore the user must be patient when trying to activate any feature especially when a large value capacitor is being read, as during that charge or discharge period the keyboard is inaccessable. So make sure to keep your finger on the key for a little while until the LeD's flash. There are some symbols on the keyboard that are not utilized as they are reserved for compatibility with future models.

Anytime numerical information with decimal points is being entered, the display may or may not display the initial decimal point on the right of the LSD. Some of the LCD displays that are installed on the MC400 do not have the D.P. while others may have. this depends on the general availability of the various brands of LCD displays available during production runs. If the D.P. doesn't appear initially then it will appear at the 2nd LSD if another number is entered in.

SECTION 2 GENERAL OPERATION

2.1 MEASURING CAPACITANCE

1. Discharge capacitor by shorting leads together.
2. Remove any capacitor from the capacitor socket and turn the unit on.
3. Press the red zero key.
4. Insert the capacitor into the capacitor socket.
5. Read the value from the display and the electrical unit from on of the LeD lamps in pF, nF, uF or mF.

2.2 USING THE FUNCTION HOLD KEY

Used for freezing the display even if the capacitor is removed.
Press the white HOLD key once to freeze the display and again to release the display.
·not available in DA, Zener and Component modes.

2.3 ENTERING A ZERO VALUE FROM THE KEYPAD

1. Enter the value directly on the keypad by pressing any of the numerical red keys.
2. Press the red zero key.
3. Press either the grey pF, nF, or uF keys.

Maximum value is 100 uF.
All subsequent entries will add themselves to whatever zero value is already entered in.

2.4 MANUAL RANGE OPERATION

1. Press the white FUNCTION key.
2. Press the green MANUAL key.
3. Press any green range keys to obtain the desired range.
4. to terminate press the white FUnCtiOn key.
5. and then the green manual key.

Overrange is indicated by the display showing OUEr.

2.5 MEASURING LEAKAGE

1. Select the proper output test voltage by pressing the red LEAKAGE key.
   The display will show AdJt for adjust voltage.
2. Press either the number 1 key for approx. 22 to 25 volts, the number 2 key for approx. 10 to 12 volts or the number 3 key for approx. 6 to 8 volts DC.

The display will show the selected voltage.
(NOTE: the voltages will vary with battery conditions).

4. Press the white FUNCTION key when the displayed voltage is the desired level.
   The display will show teSt.

5. Insert 2 leads into the zener anode and cathode sockets of the transistor sockets.
6. Connect the capacitor with the alligator clips while observing polarity if any (Anode is ground, cathode is +).
7. Press the teSt key and allow the capacitor to charge until it comes to rest.
8. If the capacitor is not leaky it will read "none" to indicate no leakage.
9. If the capacitor is leaky then the display will indicate this leakage in micro-amps.

WARNING - UNDER NO CIRCUMSTANCES SHOULD THE CAPACITOR BE ALLOWED TO DISCHARGE OR ACCIDENTALLY SHORT UNDER THESE CONDITIONS. THE OUTPUT VOLTAGE FROM THE ZENER TEST SOCKET IS NOT FUSED PROTECTED AND ANY DISCHARGE FROM A CAPACITOR WILL CAUSE SERIOUS DAMAGE TO THE UNIT. FOR FURTHER SAFETY NOTES SEE 4.6

10. Remove the capacitor.
11. Press LEAKAGE to display teSt.
12. The unit is now ready to accept another capacitor if the rated voltage is within range of the selected voltage.
13. To terminate press FUNCTION twice.

2.6 SORTING CAPACITORS

A. Entering in low and high setpoints.
Always enter the setpoints while in the normal reading mode or false readings may occur.
There are 2 methods of entering the setpoints.

First method:
1. enter the setpoint value by pressing the numerical red keys on the keypad.
2. Press the grey SEETPOINT key once for the low setpoint or twice for the high setpoint.
3. Press either the grey pF, nF or uF key.

Second method:
1. enter the setpoint value by placing a Capacitor into the capacitor socket.
2. Press the white FUNCTION key.
3. Press the white SORT DISP. ENTRY key.
4. Press the red number 1 for the first setpoint OR the red number 2 for the second setpoint.

B. Sort mode.
1. Press the red SORT key once for the HIGH/GOOD/LOW sorting mode.
2. The display will show HIGH if the value is above the high setpoint. the display will show GOOD if the value is between the high and low setpoints. the display will show LOW if the value is below the low setpoint.

2.6 SORTING CAPACITORS

3. Press the red SORT key again to activate the % deviation mode. If the value is above the high setpoint the display will indicate the % deviation above the high setpoint. If the value is between the high and low setpoints the display will indicate GOOD. If the value is below the low setpoint the display will indicate the % deviation below that setpoint.

4. Press the SORT key again to terminate the sort mode.

During the % deviation mode some values may be so far off tolerance that the display will revert to showing OUER or LOW or HIGH.

Both setpoints must be entered in for this feature to work properly.

If sorting is to commence after cable or time constant measurements have been done and/or the 2 setpoints have not been entered in, then the sorting mode will use whatever values are present for the cable or time constant modes as the same memory is used for both and no error indication will be displayed.

2.7 CABLE MEASUREMENTS

There are 2 methods of entering the value per unit length.

First method:

1. Place a 1 foot or 1 metre sample at the capacitor socket.
2. Press the white FUNCTION key.
3. Press the white CAP/UNIT DISP. ENTRY key. the sample has now been entered in.

Second method:

1. Enter in a value by immediately pressing the red numerical keys.
2. Press the grey Feet/METRES.
3. Press the grey key indicating pF.

Measuring Cable
For metres/kilometres.
1. Press the white function key.
For feet/miles:
2. Press the red CABLE key.
3. The display will indicate feet (or metres if was pressed).
the unit will automatically convert to miles or kilometres when those thresholds are reached.
4. All LED lamps will light up to indicate miles or kilometres.

2.8 DIELECTRIC ABSORPTION

1. Place capacitor in capacitor socket.
2. Press the white FUnCtiOn key.
3. Press the white DA key.
4. The display will now show the symbol DA and is ready to activate.
5. Press the white DA key and the unit will now cycle through soak, dis-charge, and float periods and display a ratio of soakage to recovery voltages as a percentage.
6. During these periods the word "UAit" for wait will be displayed.

7. Press the function key twice to terminate the DA mode.

2.9 COMPONENT TESTS

1. To test unknown bipolar transistors, FETs, triacs, SCRs, UJTs, PUTs (no darlingtons).
1.1 Install the AC adaptor.
1.2 Press the "white" FUNCTION key.
1.3 Press the "white" COMP key.
The display will now show the word COM.
1.4 Place the unknown component in the top 3 receptacles of the transistor socket.
1.5 Press the "white" teSt key.
The unit will now try to analyze the component
1.6 If the display shows the word 'bAd' remove the component and rotate it into another configuration.

NOTE: Any 3 pinned component has a total of six ways to place it in the top 3 receptacles. Keep changing the components configuration until a display other than bad shows up.

1.8 Press the "white" teSt key again until the display shows one of the following symbols indicating the type of device under test:

PnP	-bipolar PnP transistor
nPn	-bipolar nPn transistor
m eP	-MOSFet P channel enhancement transistor
m dP	-MOSFet P channel depletion transistor
m en	-MOSFet n channel enhancement transistor
m dn	-MOSFet n channel depletion transistor
FeP	-Fet P channel enhancement transistor
FdP	-Fet P channel depletion transistor
Fen	-Fet n channel enhancement transistor
Fdn	-Fet n channel depletion transistor
SCr	-silicon controlled rectifier
trAC	-triac
UJt	-unijunction transistor
PUt	-programmable unijunction transistor

1.7 Pressing teSt again will indicate the pin configuration by following the white arrows from the top 3 receptacles of the transistor socket.

For bipolar transistor types the following letters are used to identify the pins.

e	-emitter

C -collector
b -base

example, ebC indicates the left hand pin is the emitter, the middle pin is the base, and the right hand pin is the collector.

For FET transistor types and Triacs the following letters are used to identify the pins:

G = gate
· = source or drain or MT1 or MT2

example, G·· indicates the left hand pin is the gate, the middle pin is either source or drain or MT1 or MT2 and the right hand pin is also either the source or the drain or MT1 or MT2.

In some cases (usually MOSFets) the drain and source can be identified.
d = drain
S = source

For SCRs the following letters are used to identify the respective pins:

G = gate
A = anode
C = cathode

example, CAG indicates the left hand pin is the cathode, the middle pin is the anode and the right hand pin is the gate.

Other components use various combinations of the above symbols to indicate their pinouts.
ex. ebb indicates emitter, base, base on a UJt.

1.8 A component must be considered identifiable and good if any 2 of 6 configurations shows "matching results". For example a component may show 4 "bad" configurations and the 2 remaining configurations identifying it as a PnP transistor or all configurations showing it as a PnP. Less than 2 of 6 indicates a marginal or suspect component. A non-matching result shows a different result for anymore than 1 configuration. For example, one configuration may show nPn and another may show PnP for the same component.

2.10 TESTING POSITIVE AND NEGATIVE 3 PINNED VOLTAGE REGULATORS

2.1 Press the "white" FUNCTION key.
2.2 Press the "white" Reg key.
The display will show the word "Preg" for positive voltage regulators.
2.3 Place the positive voltage regulator with the input pin in the left hand receptacle, the ground pin in the bottom receptacle, and the output pin in the right hand receptacle.
2.4 Press the teSt key and the display will show the voltage that the regulator is out-putting.
2.5 Press the teSt key again and the display will revert to the "Preg" display.
2.7 Press the "white" FUNCTION key to go back to reading capacitance.
2.6 For negative regulators follow the above procedure but press the Reg key twice.
The display will show the word "nreg" to indicate negative regulators.
2.3 Place the negative voltage regulator with the input pin in the bottom receptacle, the ground pin in the top receptacle, and the output pin in the right hand receptacle.
2.4 Press the teSt key and the display will show the voltage that the regulator is out-putting.
2.5 Press the teSt key again and the display will revert to the "nreg" display.

2.7 Continually pressing the Reg key will toggle between the positive and negative modes and pressing the FUNCTION twice key will go back to reading capacitance.

NOTE: This test is for low powered voltage regulators with low quiescent currents of 2 mA or less.

2.11 ZENER DIODES AND RECTIFIER

1. Press the white FUNCTION key.
2. Press the white Zener key.
3. the display will now read ZENR and the socket is ready to accept a rectifier or zener diode.
4. Place the diode in the transistor socket marked with the zener diode symbol observing the proper polarity. If the diode is a non zener type then reverse the polarity.
5. Press the white teSt key.
6. Read the voltage from the display.
7. Press teSt again and the display returns to ZenR and is ready to accept another diode.
8. To terminate press the white FUNCTION key twice.

SECTION 3 OPERATING CONSIDERATIONS AND APPLICATION NOTES

3.1 FREEZING THE DISPLAY WITH THE 'HOLD/FUNCTION' KEY

The display can be frozen when reading capacitors on most of the features that are activated. to do this press the 'white' FUNCTION/HOLD key and the display will freeze. this means that the capacitor can be removed and the display will still show the reading at the time of holding.

The hold can be used when reading normal values, any of the setpoint modes,and cable readings.

3.2 ZEROING THE MC400

The MC400 can be zeroed by 1 of 3 methods. The first method is to simply turn the unit on and most stray capacitance or other capacitance up to about 150 pF will be zeroed. If some residual capacitance is left then manually zero the unit as described below. Caution must be observed if small value capacitors are to be measured. Always zero the unit manually if the display does not show zero when there is no capacitance in the capacitor socket, as described next. The second method is to press the 'red' ZERO button. this is useful for zeroing the capacitance of long leads when using the banana jacks. The ZERO key will zero values up to 100 uF, thereby being able to measure even very small values with very long leads.

A third method is to enter in a zero value through the keypad. This is done pressing the 'red'numbers and then pressing the ZERO key and then pressing 1 of 3 'grey' keys showing the electrical units (pF, nF, uF). This method is useful if it is difficult to measure a 'zero' value at the capacitor socket. Do not enter in a value greater than 100 uF.

3.3 MANUAL RANGE

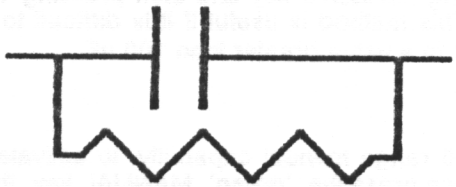
The MC400 also has a 10 range manual capability. to activate this feature press the 'white' FUNCTION/HOLD key and then press the 'green' MANUAL key. the unit will now be in 'manual' mode and will generally be in the lowest range (1000.0 pF). To change the range simply press any of the green range keys all the way up to 1,000.0 mF (1 FARAD). While in the manual range any key that has a 'green' range indicator on it will not allow any other function on that key to be entered, for example entering numbers or selecting any of the 'white' keys. To terminate 'manual' mode, press the 'white' FUNCTION/HOLD key and depress the 'green' MANUAL key.

For maximum accuracy always use autoranging as it selects the most accurate range.

In no way does the manual range feature improve the performance or accuracy or time response of the unit. Its best purpose is learning to compare and distinguish, from different relative electrical units and their relationships.

3.4 LEAKAGE, INSULATION RESISTANCE, CURRENT

Equivalent Circuit for Leakage



The MC400 reads capacitance leakage by charging the capacitor under test through a high resistance unregulated source voltage provided by the Zener diode socket. A leaky capacitor will cause loading to occur and the MC400 converts this information to the equivalent current in uA. the uA LED will light up along with the mF LED. the mF LeD is lit only for necessitating internal hardware functions.

Since this voltage is an unregulated multiplied voltage from the battery it may vary from unit to unit. When using the AC adaptor it is approximately 23 to 25.5 volts. With a battery it will gradually degrade as the battery ages. The accuracy will be reduced slightly as well.

WARNING· Since this voltage is high resistance it presents little danger to the user. But when a large electrolytic capacitor is fully charged by this voltage its internal resistance is much lower than the MC400's source voltage. this may present a danger if it is accidentally discharged while still connected to the MC400. A large 1,000 uF capacitor with a charge of 25 VDC will present quite a large spike to the MC400 and may cause serious damage should it be discharged when con·

nected to the MC400. So it is quite imperative to avoid discharging any capacitance if it is connected to the MC400 through the Zener diode socket.

In many cases 25 volts is higher then the rated voltage of the capacitor under test. In that case the MC400 can provide 3 different levels of voltages for testing purposes. the levels are determined by the condition of the battery if no AC adaptor is used. this is activated by pressing key number 1, 2 or 3 for approx. 25, 12, or 8 volts respectively, when the display is showing the word ADJt.

After pressing the FUNCTION key the display shows the word teSt. Insert the leads into the zener diode socket and place the capacitor in the alligator clips with the '+' side of the capacitor in the right hand side of the socket and the '-' side in the bottom receptacle of the socket. Press the LEAKAGE key and wait for the capacitor to charge. Large capacitors can take an extremely long time to charge. When the capacitance settles out the word "none" will indicate no detectable leakage, otherwise the display will show the leakage in microamps.

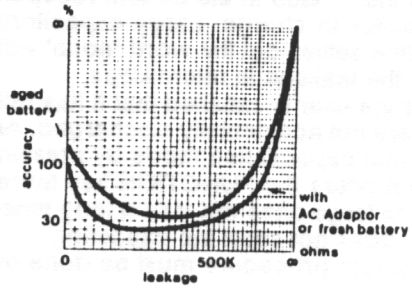
The capacitor may be removed after the user is satisfied that it has fully charged as long as it is done carefully and the capacitor leads are not accidentally discharged. Another way of discharging a capacitance is to go back into normal capacitance mode by pressing the LEAKAGE key so that the word teSt is displayed. And then press the FUNCTION key twice. this last procedure is practical only for small value capacitors as large ones will take a long time to discharge since this procedure only turns the voltage off and does not short the capacitor.

To go back into leakage mode the whole procedure must be done over again.

3.5 ACCURACY AND RANGE OF LEAKAGE MEASUREMENT

The accuracy of the leakage test is limited by the A/D convertor resolution. the worst accuracy is when the capacitor is leaking just a little bit or is approaching extremely low resistance or a short circuit. Also the accuracy decreases as the test voltage becomes lower. This includes lower voltages as a result of battery aging.

The following is a graph approximating the typical accuracy for any given capacitor.



3.6 SORTING CAPACITORS

The MC400 is capable of sorting capacitors in 2 different modes. the different sorting modes are as follows.

1 SORTING IN HIGH/GOOD/UNDER METHOD BY DEFINING A DEADBAND
2 SORTING IN % DEVIATION AROUND A USER DEFINED SETPOINT

Before sorting can commence 2 setpoints must be chosen. Always enter the setpoints while in the normal reading modes or false readings may occur. there are two methods of entering in setpoints. If sorting is to commence after cable or time constant measurements have been done and/or the 2 setpoints have not been entered in, then the sorting mode will use whatever values are present for the cable or time constant modes as the same memory is used for both and no error indication will be displayed. So make sure to enter in the setpoints. The range of this feature is limited to 100 uF. If an 80 uF capacitor is off tolerance and is actually 110 uF then the MC400 will not detect that particular value under this feature.

To enter in the low setpoint enter the value on the 'red' numbers on the keypad. Press the 'grey' SetPOint key once. Pressing the key a second time will allow the high setpoint to be entered. After pressing the 'grey' SetPOint key once or twice then the electrical unit is chosen by pressing 1 of 3 grey keys marked pF, nF or uF.

The second method of entering in setpoints is to use the SORT DISP. ENTRY key. Depress the white FUNCTION and depress the SORT DISP. ENTRY key and the value currently being displayed

will be entered in as a setpoint. To chose the setpoint now depress the 'red' number 1 for the first setpoint and number 2 for the second setpoint.

The display will now continue to read normal value. To activate the HIGH/GOOD/LOW setpoint press the 'red' SORT key. If the value is above the high setpoint then the display will indicate 'HIGH'. If the value is between the high and low setpoints then the display will indicate 'GOOD'. If the value is below the low setpoint then the display will indicate 'LOW'.

To activate the % deviation mode press the 'red' SORT key again. If the value is above the high setpoint the display will indicate the % deviation above the high setpoint. If the value is between the high and low setpoints then the display will indicate 'GOOD'. If the value is below the low setpoint then the display will indicate the % deviation below that setpoint. If the % deviation is to be sorted about a single setpoint then simply make the low setpoint equal in value to the high setpoint. During the % deviation mode some values may be so far off tolerance that the display will revert to showing OVER or LOW or HIGH.

3.7 CABLE MEASUREMENTS

The MC400 can measure the lengths of cables up to a theoretical 9,999 miles or kilometres. The cable must have at least two or more wires, and be completely uniform in composition. That is to say the cable can't start off with two wires and then somewhere along the way several other strands are added. The cable must also be open circuited at the end of the cable. If a multiconductor cable is measured, only two of the strands need be utilized to measure its length. Make sure

the two strands in this multiconducted cable are as short as possible and protrude from one of the ends and not a few inches from it.

The accuracy of the measurement depends on the quality of the data supplied to the MC400. The unit calculates the length of the cable under test by dividing the value of the capacitance at the terminals by the value per unit length supplied by the operator. The more accurate the value per unit length is the more accurate the reading is. Also the cable itself must have a relatively uniform capacitance over the whole length of the cable. In other words the quality of the cable itself as far as the capacitance per unit length is concerned, has an important contribution to the accuracy of the final measurement. For example, in measuring a cable that is 4,000 feet long, the first 1,000 feet is 15 pF per foot and the last 3,000 feet is 16 pF per foot, the accuracy will obviously be affected no matter what value has been entered as the capacitance per unit length. Another factor affecting accuracy is the value of the additional capacitance if the cable is measured rolled up on a spool, as opposed to it being strung out. If this capacitance is known then it can be nulled out by entering this value and depressing the 'red' ZERO key. The user must also be aware that this value changes if the spool is only half filled with the cable that is to be measured.

There are two ways of entering the value per unit length. The first is to place a 1 foot or 1 metre sample at the capacitor socket. If using test leads with the banana jacks, make sure to null out the value of these test leads. Press the FUNCTION/HOLD key and then Press the 'white' CAP/UNIT DISP. ENTRY key. the sample has now been entered in.

The second way to enter in a sample is to simply enter in the capacitance value on the keypad, press the 'grey' Feet/METRES key and then the 'grey' key indicating pF. enter in no more than one decimal point figures. At this point it is not necessary to indicate whether you are entering feet or

metres as this is decided later on. now cable measurements can be read. Press the 'red' CABLE key to read in feet.

The MC400 will automatically read in feet or miles if the cable is over 5,280 feet. If the reading is in feet the red LED lamps will not light up. If in miles the LED lamps will all light up.

To read in metric press the 'white' FUNCTION/HOLD key from normal reading mode and then press the 'red' CABLE key. the display will now show readings in metres or kilometres and will be indicated by the LED lamps being on or off respectively.

To get out of this mode press the CABLE key.

NOTE: the unit cannot toggle back and forth between mile and kilometres or feet and metres.

3.8 LOCATING BREAKS IN CABLES

One of the more useful applications of the MC400 is the ability to locate breaks in cables. A cable with a break in it will measure the length up to that break. Measuring the length of a broken buried cable requires a slightly different technique. There is an additional capacitance in a buried cable, that is the capacitance to ground. Because of this the capacitance per unit length will be different. If the user is fortunate to already now this value then the procedure is to connect the unbroken conductor to earth ground and then to the minus terminal of the unit and the other conductor to the positive terminal. Another problem arises when the buried cable is strung out over many miles with many junction boxes with the break occuring between just 2 of them. One way is to calculate the percentage capacitance between thetwo ends because the capacitance is proportional

to length. The percentage of capacitance on one end of the cable is the same as the percentage of the length from that end to the break. The length is caluiated in the following way:

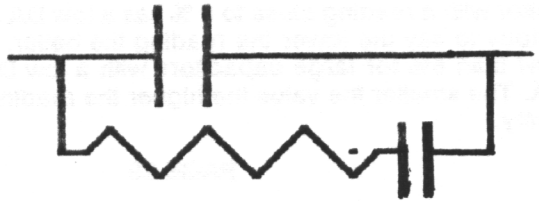
$$\text{LENGTH OF BROKEN CABLE FROM 1ST END} = \frac{\text{CAPACITANCE OF 1ST END}}{\text{CAP. OF 1ST END + CAP.OF 2ND END}} \times \text{TOTAL LENGTH}$$

COAXIAL CABLE

Make sure to connect the shield of the cable (braid or outer conductor) to the minus side of the MC400.

3.9 DIELECTRIC ABSORPTION (DA)

Equivalent DA Circuit



to length. The percentage of capacitance on one end of the cable is the same as the percentage

Due to the internal leakage of the MC400 circuitry the effective range of this feature is usually from 1 uF and up. Smaller values can be measured but a correspondingly high value of DA will be displayed which is useful for comparative purposes.

Some capacitors don't completely discharge unless they are shorted for a very long time. This ability to remember a voltage is known as dielectric absorption. The effect is the same has having a secondary capacitor in series with a large resistor, parallel to the main capacitor. The value is expressed as a ratio of the voltage across a fully charged capacitor to the voltage across that same capacitor when it has been discharged and left to recover or a certain period of time. This is the technique used in the MC400 to measure DA. The cycle is broken down into three time periods. The first is a period of soakage, followed by a discharge period and then a recover period. To enter into the DA mode press the FUNCTION/HOLD key and the 'white' DA key. The display will read DA. To continue with the test press the same key again. The MC400 will cycle the capacitor through three predetermined time periods of approximately 5 minutes charge (soakage),5 seconds discharge,60 seconds recover times. These times conform to MIL spec MIL-C-19978D the display will then show the ratio of the charge voltage to that of the recovered voltage as a percentage. During these cycles the keyboard is inaccessable and the display will indicate to wait by displaying UAit for wait.

A capacitor with a reading close to 0 % has a low DA and one close to 100% has a high reading. It is obvious to say the lower the reading the better. Readings using this MC400 method are typically lower than 5% for large capacitors with a low DA and 30% for smaller value capacitors with a low DA. The smaller the value the higher the reading because of the internal leakage of the MC400 circuitry.

Due to the internal leakage of the MC400 circuitry the effective range of this feature is usually

One of the characteristics of a capacitor having DA is that the value under normal readings will be higher and will gradually decrease as the secondary capacitance is charged. After this secondary capacitance is charged then the true value of the capacitor is displayed. The time it takes for this secondary capacitance to charge depends on the dielectric and may take as little as a few seconds or as much as a few hours.

For measuring the DA of small value capacitors it is best to disregard the DA feature of the MC400 and take normal readings.

For example, take a reading of a good capacitor and then take a reading of a suspect capacitor. When this is done take a reading of both capacitors together. If there is no DA then the displayed reading will indicate an almost exact sum of the two otherwise the 2 values will not add accurately.

3.10 ZENER DIODES AND RECTIFIERS

The MC400 has the ability to measure the zener breakdown voltage of a zener diode from 0.0 volts up to 25.5 volts. This of course depends on the condition of the battery as the test voltage for this feature is not regulated. With a fresh battery this can be about 20 to 22 volts. If an AC battery adaptor is used then the complete operating voltage is always maintained (see AC ADAPTOR). The bottom receptable in the transistor socket (zener anode) is ground and the open circuit output voltage of the extreme right hand socket is approx. 24 volts (zener cathode).

3.11 ZENER DIODES

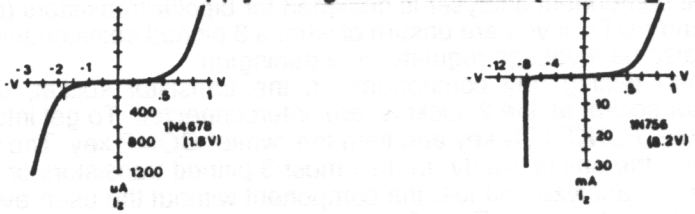
To properly operate this feature it is recommended that the manufacturers test current for a particular zener diode should be known. This will greatly increase the chances of getting an accurate reading. For example a 1N4678 diode is rated at 1.8 V breakdown voltage at a test current of 50 uA. On the other hand a 1N756 uses a test current of 20 mA for a 8.2 V breakdown voltage.

The maximum output current of the zener diode feature of the MC400 is approximately 1.6 mA. The accuracy of reading zener diodes rated with a test current higher than this depends on the characteristic curve of that particular diode. Some high current diodes will barely start to breakdown at 1.5 mA giving a reading lower than normal.

To operate this feature press the FUNCTION/HOLD key and then press the 'white' ZeneR key. The unit is automatically placed in the 1.5 mA output current range. Make sure there is no capacitor connected to the terminal inputs as they have a common connection to the transistor socket where the zener diode is tested. The display will show the word ZenR indicating the diode is ready to be installed. Place the zener according to the zener diode symbol at the transistor socket. Press the 'white' ZeneR key and the display will show the zenering voltage. Press the ZeneR key again and the display goes back to the word ZenR and ready to accept another diode. If the diode is defec-

tive or open circuited then the full 25.6 volts of the zener supply voltage will be shown (Assuming AC adaptor power).

The following 2 graphs show 2 different characteristic curves. One is for the 1N756 and the other 1N4678.



3.14 RECTIFIERS

Follow the same procedure as the above zener diode procedure but take two readings, one for forward voltage and another for reverse voltage. If there is no diode in the transistor socket then the full open circuit 25.5 voltage will be displayed. If a diode is reverse biased then it will read the same. If the diode is forward biased then it will read from about 000.3 to 001.0 volts.

NOTE: It is assumed that the unit is being operated with the AC adaptor. Operation with a 9 volt battery may show a much lower reversed bias voltage.

To deactivate this feature press the 'white' FUNCTION key twice when the display is showing ZENER.

3.15 ANALYZING AND TESTING SEMICONDUCTOR COMPONENTS

Be ready to test any 3 pinned component in all 6 configurations for a complete test.
For bipolar transistor types the following letters are used to identify the pins.

E -emitter
C -collector
b -base

example, EbC indicates the left hand pin is the emitter, the middle pin is the base, and the right hand pin is the collector.

For FET transistor types the following letters are used to identify the pins:

G =gate
\- =source or drain

example, G-- indicates the left hand pin is the gate, the middle pin is either source or drain or MT1 or MT2 and the right hand pin is also either the source or the drain.

In some cases (usually MOSFETS) the drain and source can be identified.

d =drain
S =source

In general the component analyzer works by scanning the component through the transistor socket and looking for specific patterns that are characteristic of the device under test. If no patterns match then the display will indicate bad. If 2 or more patterns are found then the display shows the word rotA for rotate. If a single pattern is found then the device is identified and displayed.

Try to remember when a pattern is correctly identified. Then next time use that same pin configuration so that no time is wasted in rotating the component.

Most components can be identified with the MC400, but with the millions of types in existance there may be some good units that still can't be identified.

3.14 VOLTAGE REGULATORS

The MC400 can test voltage regulators with a quiescent current of approx. 2 mA. The quiescent current is the current under no load or standby conditions. Since the MC400 presents a slight load to the voltage regulator it is virtually in its quiescent state. If a regulator appears to have a voltage much higher (or much lower in the case of negative regulators) it may be a bad regulator or its quiescent current may be too high which will give a much higher indication than normal. The only way to over come this is to know before hand what to expect from any certain regulator whose quiescent current is known to be higher. In general most regulators of the 78LXX or 79LXX have lower quies-

d =drain
S =source

lower quiescent currents.
Typical pinnouts of 78LXX or 79LXX type regulators:

3.15 POWER

The MC400 is powered by a 9 volt battery (see INSTALLING THE BATTERY). When the battery is low the display will indicate the word BAtt and the unit will become inoperable. The MC400 can also be used with an optional AC battery adaptor (DAETRON MODEL PS100) which can be used as an ordinary battery eliminator. THE MC400 WARRANTY IS VOID IF THE UNIT IS DAMAGED BY A LEAKY BATTERY.

NOTE: As some adaptors may destroy the power circuitry the AC adaptor used must be DAETRON'S PS100 or one approved by DAETRON or the warranty is void.

3.16 TIPS ON SAVING POWER

Obviously these tips apply only when using a battery. the largest power consumption is used when reading very large capacitors. So it is wise not to leave these units running for very long as they may quickly drain the battery. Another time when there is large power consumption is when checking forward biased diodes. Also see the section on predicting battery failure.

lower quiescent currents.

SECTION 4 MAINTENANCE AND CALIBRATION

4.1 CALIBRATION

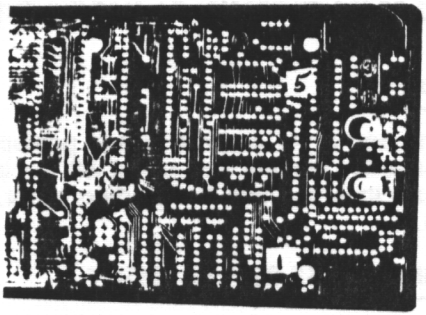
Be careful when calibrating as any damage done to the instrument will void the warranty. The MC400 Digital Capacitance Meter is accurately calibrated at the factory with the temperature not deviating more than 70 degress to 77 degrees F. Recalibration is not considered necessary unless repair has been made to those parts which affect calibration or if there is any reason to suspect that the meter accuracy is off. All that is required is a small screwdriver to adjust The single potentiometer and a single capacitor of approximately 900.0 nF

To within at least 0.5% accuracy. Also the battery must be in good condition otherwise the unit won't work. The leads of the calibration capacitors must be very clean to prevent false readings. If There is access to an accurate capacitance bridge or meter then there is no need to obtain premium tolerance capacitors. Also the electrolytic capacitor used should have as little leakage as possible to calibrate that range.

To get at the calibration potentiometer inside the case use the following procedure to remove the back cover. Unscrew the jack nut from the battery adaptor jack. Peel off the four rubber feet covering the case screws. Remove the four screws using a phillips screwdriver. Separate the front and back cover very slightly while pulling down on the front cover. When the cover is off the unit is now ready to calibrate.

STEP 1.

The screwdriver used should be plastic or non conductive, if not, be absolutely sure to avoid accidentaly shorting out other components when adjusting the potentiometers. The following diagram shows the locations of the various potentiometers.



STEP 2.

Turn the unit on and press the 'red' ZERO key to eliminate any stray capacitance. Insert the 900 nF capacitor in the capacitor sockets. take a reading of this capacitor. If the value varies from the known value of the test capacitor then adjust P1 until it is the same. Zero the unit again and adjust P1 again. Keep doing this until there is very little adjustment left to do.

STEP 1

4.2 ZENER DIODE CALIBRATION

Go into Zener diode mode. Place a zener diode (approx. 8V will do fine) in the zener diode socket. take a reading of the voltage across the zener diode with a multimeter and adjust P6 until the MC400 display agrees with the readinng on the multimeter (to read the display remember to press the ZENER key).

4.3 MAINTENANCE - INPUT PROTECTION

The MC400 incorporates diode clamping and a 1/4 ampere fuse to protect against charged capacitors. This protection however is no guarantee that the instrument will not be damaged if the user forgets to discharge the capacitor before inserting into the binding posts. So remember to ALWAYS DISCHARGE YOUR CAPACITORS.

4.4 IF YOUR INSTRUMENT STOPS WORKING - FUSE REPLACEMENT

The 1/4 ampere fuse is located under the lid of the battery compartment. If the fuse is suspected to be open circuited remove it carefully from its holder. To check the fuse don't trust your eyes, check it out with an ohmeter. If it's defective remove a good fuse from the spare fuse holder and insert it in the fuse holder. Replace the fuse only with a 1/4 ampere, 250 V, AgC regular blow fuse. Using a fuse with a higher current rating may result in damage to the instrument.

SECTION 5 SPECIFICATIONS

RANGE
FULLY AUTORANGING FROM 000.1 PF TO 999.9 MF (1 FARAD)
MANUAL RANGE CAPABILITY IN 10 RANGES

0.0 pF tO 1,000.0 pF	10.000 uF TO 100.00 uF
1,000.0 pF TO 10,000 pF	100.00 uF TO 1,000.0 uF
10.000 nF TO 100.00 nF	1,000.0 uF TO 10,000 uF
100.00 nF TO 1.0000 uF	1.0000 mF TO 100.00 mF
1.0000 uF TO 10.000 uF	100.00 mF TO 1,000.0 mF

ACCURACY¦ 0.5 % OF FULL SCALE FROM 0.1 PF TO 3.000 UF
¦ 1.0 % OF FULL SCALE FROM 3.000 UF TO 140 UF
¦ 5.0 % OF FULL SCALE FROM 140 UF TO 1 FARAD
ACCURACY IS VALID FOR BOTH AUTO AND MANUAL RANGING

LEAKAGE
CALCULATES LEAKAGE CURRENT OF CAPACITOR IF
CAPACITOR IS LEAKY. ACCURACY OF LEAKAGE READING IS
+20 % TO +30 % DEPENDING ON THE CIRCUMSTANCES, WHEN THIS FEATURE IS ACTIVATED

DIELECTRIC ABSORPTION
CYCLES CAPACITOR THROUGH 3 PREDETERMINED TIMED PERIODS OF SOAKAGE, DISCHARGE AND RECOVER AFTER WHICH THE DISPLAY READS A RATIO OF FULLY CHARGED VOLTAGE TO RECOVER VOLTAGE
THIS PROCEDURE CONFORMS TO MIL SPEC MIL-C-19978D

ZEROING
ALLOWS ZEROING OF ANY CAPACITANCE VALUE UP TO 100.0 UF BY 3 DIFFERENT METHODS
1. POWER ON METHOD - AUTO ZEROS ANY VALUE AT TERMINALS UP TO 100.0 PF
2. DEPRESSING ZERO KEY - ANY VALUE AT TERMINALS UP TO 100.0 UF IS ZEROED
3. ENTER THE ZERO VALUE THROUGH THE KEYBOARD

SORTING CAPACITORS
2 BASIC CONFIGURATIONS
1. SORTING IN HIGH/GOOD/UNDER METHOD BY DEFINING A DEADBAND
2. SORTING IN % DEVIATION AROUND A USER DEFINED SETPONT

CABLE MEASUREMENTS
AUTOMATICALLY CALCULATES LENGTHS OF CABLES IN FEET, METRES, MILES, KILOMETRES (THEORETICAL RANGE OF 10,000 MILES).
SAMPLE CAPACITANCE IS ENTERED IN IN 2 DIFFERENT WAYS
1. VALUE IS ENTERED IN THROUGH THE KEYPAD
2. PLACING A 1 FOOT OR 1 METRE SAMPLE AT THE INPUT TERMINALS AND DEPRESSING THE 'CAP/UNIT' KEY

HOLD FUNCTION
FREEZES THE DISPLAY WHEN MEASURING:
VALUE, TRUE CAPACITANCE, TIME CONSTANT, LEAKAGE, EXTENDED RESOLUTION, ANY SORTING MODE AND CABLE MEASURMENT

INPUT
DIODE CLAMPING AND FUSE PROTECTED UNPUTS AT BOTH INPUT SOCKETS AND BANANA JACKS. DISCHARGE RESISTOR IN OFF POSITION OF POWER SWITCH AT TERMINAL SOCKETS AND BANANA JACKS

ZENER DIODE AND RECTIFIER TESTS
READS ANY ZENER DIODE VALUE UP TO 25.5V AND DISPLAYS VOLTAGE ON THE DISPLAY.

POWER
NEEDS ONLY A SINGLE 9V BATTERY DISPLAY INDICATES LOW BATTERY CONDITIONS BY DISPLAYING BATT

CASE
HI-IMPACT ABS PLASTIC CASE WITH METAL TILT STAND
DIMENSIONS 180 MM X 98 MM X 44 MM

ACCESSORIES
INCLUDES INSTRUCTION MANUAL WITH CALIBRATION PROCEDURE AND SPARE FUSE, AND 3 ALLIGATOR CLIP LEADS SUITABLE FOR BOTH THE CAPACITOR AND TRANSISTOR SOCKETS

OPTIONS
CC100 CARRYING CASE, PS100 AC BATTERY ADAPTOR

SECTION 6 WARRANTY

Daetron warrants to the original purchaser that the MC400 is free from defects in workmanship and materials for a period of 1 year plus delivery time, from the date of purchase. DAETRON will repair or replace at its option, without charge a defective unit upon delivery by mail (prepaid and insured) to the following address.

DAETRON
P.O. BOX 641, STATION U
935 THE QUEENSWAY
TORONTO ONTARIO CANADA M8Z 5Y9

NOTE: do not ship to the above address by courier as the post office will refuse it.
NOTE: if returning this unit from a country other than CANADA, please attach proper documentation to indicate the unit is being returned for repair as any charges inccured by DAETRON because of improper documentation will be charged to the customer.

Do not send by courier, send by mail only. Please pack carefully to avoid breakage in transit. This warranty does not apply if the unit has been misused, altered, abused, damaged (accidental or otherwise), miscalibrated or if the serial number is altered, defaced or removed. The above also applies to any damage in transit. DAETRON will not be liable for any consequential, incidental, or special damages resulting from the use, misuse or loss of use of this instrument.