CAPACITANCE-INDUCTANCE METER KIT

Ramsey Electronics Model No. LC1

CLEAR THAT JUNK BOX OF ALL THOSE MYSTERIOUS INDUCTORS AND CAPACITORS. DID YOU KNOW THAT SOME CAPACITORS HAVE TOLERANCES AS HIGH AS 80%? IT'S NO WONDER THAT THAT TUNED OSCILLATOR OR FILTER DIDN'T WORK! NOW YOU CAN BE SURE OF THE PART - BEFORE YOU USE IT!

- **Measure both capacitors and inductors**
- **4 ranges measures coils from 10µH to 10mH, capacitors from 1pF to 2µF**
- **Convenient 9 volt battery operation**
- **Handy test connector for fast measurements**
- **Works with any multimeter, values read out directly on meter**
- **Informative manual answers questions on theory, hook-ups and uses**
- **Add our case for a finished 'Pro' look. Cases match all Ramsey products**
- **Clear, concise assembly instructions carefully guide you to a finished kit that works FIRST time!**

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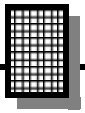

KIT ASSEMBLY
AND INSTRUCTION MANUAL FOR

CAPACITANCE-INDUCTANCE METER KIT

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INTRODUCTION:

If your workbench is anything like many hobbyist's benches, there is a large clutter of unknown parts lying around that could possibly be put to use if their value was known. This is where the Ramsey Capacitance -Inductance meter comes in handy. This simple to build kit helps you to track down coils for your latest project, and check those crucial values of capacitors that may be off in value much more than 80%. Not only that, it will assist you in winding your own coils, whether for RF or for speaker cross over network.

FEATURES

- Measures both capacitance and inductance
- Four Ranges for testing small values to large values
- Measures coils from 10µH to 10mH
- Measures capacitors from 1pF to 2µF
- 9 volt operation

Not only will you find this kit useful, but also easy to build - whether you are a beginner or an experienced kit builder.

NOTE TO NEWCOMERS: If you are a first time kit builder you may find this manual easier to understand than expected. Each part is checked off as you go along, while a detailed description of each part is given. If you follow each step in the manual in order, and practice good soldering and kit building skills, the kit is almost fail-safe. If there is a problem, the manual will lead you through it in the troubleshooting section until you zero in on the problem and are able to correct it.

HOW THE KIT IS USED:

Once calibrated, the operation of the Capacitance - Inductance meter is straightforward. It simply plugs into any VOM or DMM, and the voltage reading from the kit corresponds directly with the part being tested. If there is no clear and concise reading on the meter, simply press the high\low switch to get a good reading. Calibrating the unit can be quite simple. When the calibration section of the manual is followed, a couple of calibration values are all that are required to lead to accurate results.

CIRCUIT DESCRIPTION:

The basis on which this circuit operates is really quite simple. Resistors have resistance which is present whether AC or DC is flowing through, while inductors and capacitors have reactance. Reactance is nothing more than resistance which is dependant upon frequency. We put this property to work in

our circuit by inducing a known frequency across the device being measured and, in effect, measure its resistance.

The capacitance section is completely separate from the inductance section of the circuit, but they both run on very similar principles. Both sections take advantage of the schmitt triggering action of the 74HC14 Hex Schmitt Trigger IC chip. A schmitt trigger is a device which will change states quickly and cleanly when its input voltage exceeds a set point. This is also a characteristic of a comparator and for our sake we will call these stages comparators.

CAPACITANCE SECTION:

The capacitance section uses the comparison of the two comparator sections. One section has a standard known capacitance on the PC board, C5, and the other section has a capacitance under test. U1, section F forms a simple oscillator that operates around 400 Hz. R2 adjusts this frequency, and also sets the Low capacitance calibration. To see how we measure a capacitor, let's look at measuring a Low value capacitor.

In the Low range, R7 and R8 are switched out of the circuit and the oscillator's circuit is coupled to the unknown capacitance through R6 and D1. Diodes D1 and D2 can be ignored in this discussion since their functions cancel. Two voltage dividers are being used; one is formed between resistor R6 and the capacitor under test and the other being R9, R10 and C5. When the voltage across C5 reaches the trigger point of U1:D, it switches - since C5 is constant. U1:D will always switch at the same point so we'll call it the Standard comparator.

A similar situation exists for U1:E, but in this case, the capacitor is under test. You can see that it will switch at a different time depending upon when its input reaches the set trigger point voltage. When the outputs of the standard comparator and the test comparator are compared, there is an average DC voltage difference between the two, and this average voltage difference is what will show on your meter. The larger the capacitance value connected to the test jack, the longer it will take until the test comparator switches. This presents an even lower average DC voltage on the test comparators' output, resulting in a larger difference between the two comparators. The DC voltage average in C2 provides a stable reading on your DMM.

INDUCTANCE SECTION:

The inductance section of your kit works on the same principle, but requires no comparison between two individual sections. Instead there is a simple oscillator formed by U1:A, C7, C9, and R12, R13, R16, and R17. Two separate frequencies are available in this section, a higher frequency for smaller inductance values and a smaller frequency for larger inductance values. The output of this buffer runs into a buffer stage using U1:B, and is fed through a current limiting resistor R18. This resistor and the coil under test are what present a voltage divider on the input of the next comparator stage. When an inductance is small, it presents very little voltage drop across the tested coil, and a very short voltage pulse read by the next stage consisting of U1:C. The average DC value of these pulses is what is read by your multimeter on the output. A large value of inductance presents a longer duration pulse on U1:C, resulting in a higher average DC output.

To zero this section, a very small DC offset is needed to compensate for the 74HC14 voltage drop. This is accomplished by D3 which gives a 0.7 volt drop, and this drop is divided again in the potentiometer R11, where it can also be adjusted.

PARTS SUPPLIED WITH THE LC1 KIT:

CAPACITORS AND INDUCTORS:

- ❒ 1 390pF disc capacitor [marked 390 or 391] (C5)
- ❒ 1 .001µF disc capacitor [marked .001 or 102 or 1000] (C7)
- ❒ 4 .01µF disc capacitors [marked .01 or 103 or 10nF] (C6,C8,C9,C10)
- ❒ 1 .047µF disc capacitors [marked .047 or 473] (C1)
- ❒ 1 1µF electrolytic capacitor [C2]
- ❒ 2 10µF electrolytic capacitor [C3,C4]

Calibration components, no part designators

- ❒ 1 .001µF disc calibration capacitor [marked .001 or 102 or 1000]
- ❒ 1 .1µF calibration capacitor [marked .1 or 104]
- ❒ 1 100µH axial inductor [looks like a resistor with brown-black-brown-gold bands]
- ❒ 1 1800µH calibration inductor [large green case marked 182]

RESISTORS:

- ❒ 1 100 ohms [brown-black-brown] (R20)
- ❒ 1 270 ohms [red-violet-brown] (R7,R18)
- ❒ 3 10K ohms [brown-black-orange] (R3,R4,R19)
- ❒ 3 22K ohms [red-red-orange] (R9,R12,R16)
- ❒ 1 33K ohm [orange-orange-orange] (R14)
- ❒ 1 47K ohms [yellow-violet-orange] (R1)
- ❒ 2 100K ohms [brown-black-yellow] (R12,13)
- ❒ 1 1M ohm [brown-black-green] (R6)
- ❒ 1 2.2K laydown potentiometer (R8)
- ❒ 4 25K ohm standup potentiometer (R10,R11,R13,R17)
- ❒ 1 250K ohm standup potentiometer (R2)

SEMICONDUCTORS:

- ❒ 1 74HC14 Hex inverting buffer with schmitt triggering (U1)
- ❒ 1 7805 5 volt regulator (VR1)
- ❒ 3 1N4148 type diode [black band, glass body] (D1,D2,D3)

HARDWARE AND MISC.:

- ❒ 1 DPDT switch (S3)
- ❒ 1 Switch array (S1,S2)
- ❒ 1 Battery holder
- ❒ 1 Battery clip
- ❒ 1 6 pin test connector (J3)
- ❒ 2 Banana jacks (J1,J2)
- ❒ 1 12” hookup wire

"LEARN-AS-YOU-BUILD" ASSEMBLY STRATEGY:

As you can see in examining the circuit board and parts, there are many tall components such as the potentiometer, capacitors, and switches, along with a lot of small parts. Since you are building on a relatively small PC board and the parts are close together, we will start with the small components first to allow for more “finger-room”. So that you don't spend extra time "troubleshooting" we strongly recommend you follow the assembly strategy and step-by-step procedures we are providing.

To help you learn just exactly what is going on we'll discuss the purpose of most of the components or groups of components as we go along. Since we are trying to keep assembly of the board simple, we will not be able to fully describe each individual component’s function as you build, but Ramsey's "Learn-As-You-Build" kit assembly philosophy still stands.

Be sure to read through all steps, and check the steps as you go along to be sure that you didn’t miss anything important. Before you energize the circuit be sure that all of the diodes and polarized capacitors are correctly oriented.

TIPS AND NOTES:

Use a good soldering technique - let your soldering iron tip gently heat the traces to which you are soldering, heating both wires and pads simultaneously. Apply the solder to the iron and the pad when the pad is hot enough to melt the solder. The finished joint should look like a drop of water on paper, somewhat soaked in.

Mount all electrical parts on the top side of the board provided. This is the side that has no traces or pads on it.

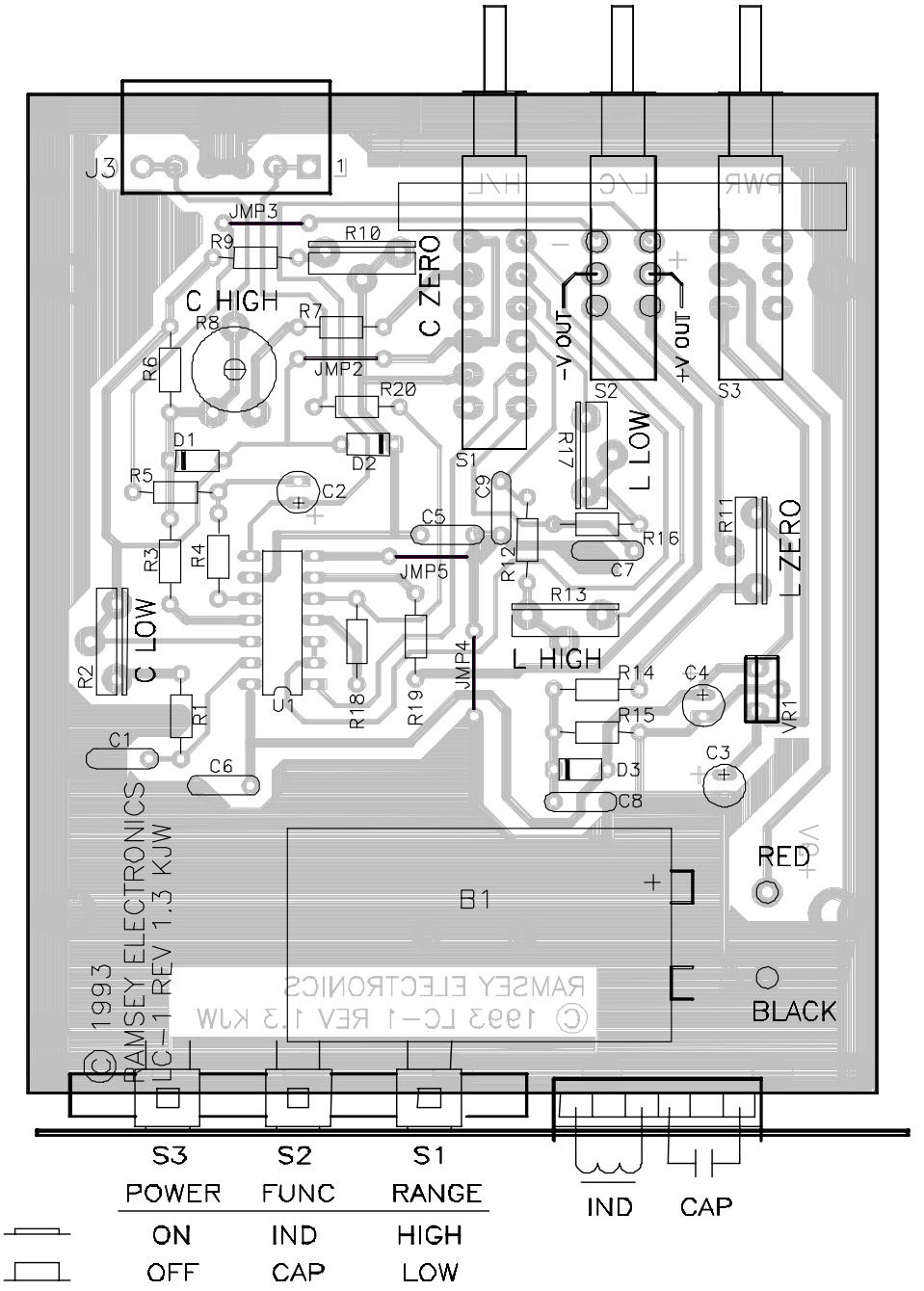
Electrical part installation - when parts are installed, the part is placed flat to the board, and the leads are bent on the backside of the board to prevent the part from falling out before soldering. The part is soldered securely to the board, and the remaining lead length is then clipped off. The clipped off leads should be saved for later use as jumper wires.
Part orientation - all parts in this kit are mounted at 90 degree angles, meaning that parts are either parallel or perpendicular to the sides of the board. If you find yourself locating a part at on odd angle, it’s probably in the wrong holes. There is a parts layout diagram provided for a pictorial reference on page 11.

FOR EACH PART OUR WORD "INSTALL" ALWAYS MEANS THESE STEPS:

1. Pick the correct part value to start with.
2. Insert it into the correct PC board location.
3. Orient it correctly, which means: Please follow the PC board and the written directions for all parts where there's a right way and a wrong way to solder it in. (Diode bands, electrolytic capacitor polarity, transistor shapes, dotted or notched ends of IC's, and so forth).
4. Solder all connections unless directed otherwise. Use enough heat and solder flow for clean, shiny, completed connections. Don't be afraid to use any pencil-style soldering iron as they don’t have enough heat to damage components.

Trim or "nip" excess wire lengths after soldering.

LC1 PARTS LAYOUT DIAGRAM:



ASSEMBLY INSTRUCTIONS:

- ❑ 1. Install J3,the test jack. This is the white six pin jack, and must be mounted so that it hooks onto the board for mechanical stability. This is where you will insert your component to be tested.
- ❑ 2. Install R9, 22K ohms (red-red-orange)
- ❑ 3. Install JMP3 on the board. Jumpers act as electrical bridges bringing signals over the PC board traces.Use a piece of excess lead wire clipped from a previously installed component.
- ❑ 4. Install R7, 270 ohms (red-violet-brown).
- ❑ 5. Install R6, 1M ohm (brown-black-green).
- ❑ 6. Install potentiometer R8, the black lay-down potentiometer. This is the high range capacitance adjustment.
- ❑ 7. Install JMP2.
- ❑ 8. Install R20, 100 ohm (brown-black-brown).
- ❑ 9. Install D2, 1N4148 diode. This diode has a small glass body with a black stripe on the end. Make sure that the black banded end (cathode or negative) is correctly oriented.The dark band must face as shown on the parts layout diagram.
- ❑ 10. Install D1, 1N4148 same as above. D1 and D2 are protection diodes for the 74HC14, to prevent a charged test capacitor from damaging the chip.
- ❑ 11. Install R5, 100K ohms (brown-black-yellow). This resistor creates a high resistance on the output to prevent short circuits damaging the circuit.
- ❑ 12. Install C2, a 1µF electrolytic capacitor. Electrolytic capacitors have polarity markings on them and must be installed correctly. Generally, the capacitor has its negative lead marked while the PC board has its positive hole marked. This capacitor averages the DC voltage developed between the two comparators used for measuring capacitance.

- ❑ 13. Install R3, 10K resistor (brown-black-orange). This resistor is used to protect U1 from damage due to external capacitance discharge.
- ❑ 14. Install R4, 10K ohms (brown-black-orange).
- ❑ 15. Install U1, 74HC14. Observe placement of the notch or dot. Before you solder make sure that all pins are through their holes and not bent over. If you have a socket , install that instead, waiting until all else is finished before you install the IC.
- ❑ 16. Install R1, 47K ohms (yellow- violet-orange).
- ❑ 17. Install C1, .047µF ceramic disc capacitor (marked .047 or 473). This part along with R1 and R3 determine the operating test frequency for the capacitor section.
- ❑ 18. Install C6, .01µF ceramic disc capacitor (marked .01 or 103 or 10nF). This is a bypass capacitor for the power source. It helps eliminate circuit noise from the power supply.
- ❑ 19. Install R18, 270 ohms [red-violet-brown]. This resistor along with R20 and the inductor under test form a voltage divider whose output is a measure of the inductance value.
- ❑ 20. Install R19, a 10K ohm resistor [brown-black-orange]. This prevents damage to U1 should the output be shorted.
- ❑ 21. Install JMP4 and JMP5.
- ❑ 22. Install C5, a 390pF ceramic disc capacitor (marked 390 or 391). This part compensates one comparator section so that its time delay is identical to the other.
- ❑ 23. Install C9, a .01µF ceramic disc capacitor (marked 103 or .01 or 10nF). This part along with R12 and R13 determine the operating frequency for the high range inductance test.
- ❑ 24. Install C7, a .001µF ceramic disc capacitor(marked .001 or 102). C7 along with R16 and R17 determine the test frequency for the low range of inductance.
- ❑ 25. Install R12, a 22K ohm resistor (red-red-orange).
- ❑ 26. Install R16, 22K ohms (red-red-orange).

- ❑ 27. Install S1and S2, the switch array and S3 the DPDT switch. They control the range, component type, and power. Make sure that the switches are as close and flat as possible to the board. This will properly align them with the holes on the matching Ramsey case.
- ❑ 28. Install R10, a 25K ohm trimmer potentiometer. This is one of the standup components. It controls the capacitance zero calibration.
- ❑ 29. Install R2, a 250K ohm potentiometer. This is the low capacitance range adjustment. In the circuit it adjusts the frequency at which the capacitance section operates.
- ❑ 30. Install R17, a 25K ohm potentiometer. This controls the calibration of the low range inductance section.
- ❑ 31. Install R13, a 25K ohm potentiometer. This controls the calibration of the high range of inductance.
- ❑ 32. Install R14, a 33K ohm resistor [orange-orange-orange]. This is part of a voltage divider that controls the inductance section. A voltage divider does simply that, divides voltage. The amount a voltage is divided depends on the resistance ratio of the voltage divider resistors.
- ❑ 33. Install R15, 100K ohms (brown-black-yellow).
- ❑ 34. Install D3, 1N4148 style diode. Make sure that the banded end (cathode) is oriented correctly.
- ❑ 35. Install C8, a .01µF ceramic disc capacitor (marked .01 or 103 or 10nF). This is a bypass capacitor to insure a clean and clear DC voltage from the zero adjust inductance voltage divider.
- ❑ 36. Install C4, a 10µF electrolytic capacitor. Observe correct polarity before soldering.
- ❑ 37. Install VR1, 7805 voltage regulator. Install with metal side facing C4. This part converts the nine volts from the battery to a regulated five volts for the CMOS logic in the 74HC14 IC chip.
- ❑ 38.Install C3, 10µF electrolytic capacitor. Watch the polarity.

- ❑ 39. Install R11, a 25K ohm potentiometer. This component varies the divider voltage for zeroing the meter reading on inductance ranges.
- ❑ 40. Install the battery connector. The black lead is the negative and the red wire is the positive. Place the correct lead in the proper hole.
- ❑ 41. Install the battery clip which is provided with your kit. To secure this to the board you may either glue it or use a small scrap wire bent to fit the holes in the board and soldered in place.
- ❑ 42. Locate the hookup wire and cut it in half. Strip back the insulation about a quarter of an inch on each end and lightly tin with solder. These wires will connect from S2 to the output banana jacks.
- ❑ 43. The top of S2,center 2 pins is where the output banana jacks connect. Orient the board as shown in the parts layout and looking at the board from the top component side, examine switch S2. You will see a “-V OUT” on the center left pin of S2 and “+ V OUT” on the center right pin. Solder one wire , as prepared above, to each of the indicated pins.
- ❑ 44. Mount banana jacks, J1, J2 in your matching Ramsey case set or other enclosure. Solder the wires from S2 to the proper banana jack: Red “+ V OUT” and black for “- V OUT”.
- ❑ 45. Solder C10, a .01µF ceramic disc capacitor (marked .01 or 103 or 10nF) across the banana jacks. This parts function is to eliminate any test circuit noise that could cause erroneous readings.

At this point you are almost ready for setup and calibration. Don’t get impatient though, it’s important that you go back through and check the orientation of polarized capacitors, diodes ,and the proper placement of U1 and VR1. Also, look for any solder bridges or cold solder joints. A cold solder joint will appear to be a dull grey as opposed to a shiny silver. A little time spent now could save you a lot later.

SETUP AND CALIBRATION:

We're now ready to test our masterpiece of construction and tame all those mystery caps and chokes lurking in the junk box. Lets begin:

- ❑ 1. Make sure that the power switch, S1 is off.
- ❑ 2. Connect a fresh 9 volt battery.
- ❑ 3. Connect a digital multimeter to the output banana jacks on your kit. The meter must be a digital type or an analog type with at least 1M ohm input impedance.
- ❑ 4. Using a small screwdriver, rotate all adjustments to their center position.
- ❑ 5. Set your multimeter to a range of 2 volts.
- ❑ 6. Turn on the power, select the capacitance function (S2 in the out position) and note the reading on the meter. It should be close to zero volts. Adjust R10 until it is zero. You may switch to a more sensitive range on your multimeter if desired. If you cannot get a reading of zero volts , stop now and consult the troubleshooting hints.
- ❑ 7. Select the inductance function (S2 in the IN position), the reading should be around 2.5 volts. This is not crucial, but it lets you know if the circuit is running.
- ❑ 8. Place a wire jumper across the inductance measure pins of J3. Adjust R11 until a reading of zero volts is observed. This wire simulates an inductor of very small value - thus the zero reading. Remove the jumper.
- ❑ 9. Switch back the capacitance function (S2 OUT), select the low range (S1 IN), And insert a .001µF capacitor (marked .001 or 102).
- ❑ 10. Adjust R2 until a reading of 1.00 volts is observed.
- ❑ 11. Select the high range (S1 OUT), insert a .1µF capacitor (marked .1 or 104).
- ❑ 12. Adjust R8 until a reading of .10 volts is observed.
- ❑ 13. Switching to the inductance range, leaving the high range, insert 1800uH inductor (round green component marked 182).
- ❑ 14. Adjust R13 until a reading of .180 volts is observed.
- ❑ 15. Switch into the low range, insert the 100µH coil (brown-black-brown-gold bands).
- ❑ 16. Adjust R17 until a reading of .10 volts is observed.
- ❑ 17. Feel the top of the IC to see if it is warm. It should be cool.

Now your kit is ready for use and fully calibrated. When measuring capacitors and inductors remember that a large tolerance is typical. In fact, many disc capacitors of the bypass variety have a -10% to +10% range. It is better to trust your LC1 than the value printed on the part.

USING YOUR LC1 METER:

This doesn't need very much explanation, but here are some brief tips on how to get accurate measurements, and to keep your LC meter running smoothly.

First you should write down the multiplication factors of the readings on your multimeter for the range you are using. Notice that the high and low ranges of the capacitance and inductance sections are different, so each range has a different multiplication factor. Here are some multiplication factors for your meter:

Inductance high range:	1mV = 10µH
Inductance low range:	1mV = 1µH
Capacitance high range:	1mV = 1nF (1000pF or .001µF)
Capacitance low range:	1mV = 1pF

Available ranges:

	Low	High
Inductance	10µH - 800µH	100µH - 10mH
Capacitance	1pF - 2000pF	1000pF - 2µF

To test a capacitor, simply short the leads together before inserting it into the LC meter. Switch your voltmeter to a range for reading 2 volts and insert the cap in the jack on the front of the case, the negative side of the cap in the hole marked GND and the positive side in the hole marked CAP. Switch the LC meter to the appropriate range, and take a reading on the voltmeter.

For example you may have inserted a .01µF capacitor, and on high range you get a reading of 11mV. Use this voltage reading for the multiplication factor above:

11mV = 11nF, which is .011µF

Testing of the inductor is done the same way, using the multiplication factors above to get the actual values. Simply place the coil between the jacks marked IND and GND, set your meter on the 2 volt scale, multiply your answer and you're done.

PART TESTING NOTES:

Before you begin, lets look at some basic rules as to how more than one inductor, and more than one capacitor interact. There are two ways in which two components can be connected, one is in parallel, the other is in series. The name for each may be descriptive enough, but for newcomers, both leads of one component are connected to both leads of another. Connections are made at the jointed end of each set of leads. Series means that one lead of one component is connected to one lead of another component. Connections in this case are made at the ends of the components that are not connected together.

In the case of inductors, when two coils are connected in series, the total value adds together. When two coils are in parallel, their total value is given in the following formula:

Total Parallel Inductance = (Inductance #1 × Inductance #2) /

(Inductance #1 + Inductance #2)

or mathematically: $L = (L1 \times L2) / (L1 + L2)$

Capacitors are just the opposite of inductors in how their values react. When two capacitors are in series, their total value is given in this formula:

Total Series Capacitance = (Capacitance # 1 × Capacitance #2)/
(Capacitance #1 + Capacitance #2)

or mathematically: $C = (C1 \times C2) / (C1 + C2)$

When two capacitors are connected in parallel their values simply add.

These formulas are useful in measuring small and large values of various components. For example if you wanted to measure a 2µH coil, and your kit won't respond to that small of an inductance, take a larger value like a 100µH coil, measure it, then connect the 2uH coil in series with it and measure. The difference between the two readings is the value of the added coil (2µH).

The same can be done with capacitors in series. For example if you want to measure a 10µF capacitor, which is higher than your kit will measure, it's a simple process. First take the measurement of another value, like a 1µF capacitor, then connect your larger value in series, and take another reading. Rearrange the formula to find the unknown capacitor in series:

Cap ? = 1 / ((1 / reading 2) - (1 / reading 1))

Plugging in the numbers, the answer will be equal to the larger value. The

same method can be used for coils in parallel.

Using creativity and these formulas, you can effectively extend the range of any capacitance and inductance meter.

We hope you enjoyed building and learning about this Ramsey kit and welcome any ideas or suggestions you may have. The Ramsey kit catalog is loaded with other neat kits from Stereo FM transmitters to Radio Direction finders, call or write for your copy today!

TROUBLESHOOTING TIPS:

PROBLEM: One of the ranges doesn't work
SOLUTION: Check all of your solder joints in that range, and if need be, use a continuity meter. Normally this is not necessary since the joints may just need to be re-soldered.

PROBLEM: Readings are erratic, not very stable on all ranges, no readings, or reading won't go very high.
SOLUTION: Try a new battery.

PROBLEM: Readings are all in the negative range.
SOLUTION: Check the wiring to the meter, see if the positive output is connected to the positive input of your meter. If not, switch them.

PROBLEM: Meter will not zero in on a capacitance range, stays at a couple of millivolts.
SOLUTION: This is normal for low cost (less than $250.00) capacitance meters. The reason for this is the various stray capacitances and variations in PC board materials.

PROBLEM: Meter suddenly quits upon testing of a large capacitor, or a charged capacitor.
SOLUTION: Check to see if the different sections are still oscillating, if not, check to see if the voltage on pin 14 is still observed. If not send in for repair, or order new 74HC14. These IC's are very sensitive to voltages higher than 7 volts, so make sure you short the leads of the capacitor before testing them.

PROBLEM: Meter won't work no matter what I do.
SOLUTION: See the warranty section of this manual.

INSTRUCTIONS FOR USING THE RAMSEY CASE AND KNOB SET:

- ❑ 1. Place the provided buttons onto the switches. If not a snug fit, rotate a quarter of a turn and then push on.
- ❑ 2. Slide the front panel into the slot on one end of the bottom part of the case.
- ❑ 3. Place the assembled PC board into the bottom of the case aligning the switches with their respective holes.
- ❑ 4. Screw the board to the bottom of the case with the machine screws provided, aligning the holes in the board with the ones on the case.
- ❑ 5. Mount the banana jacks in the rear panel, tightening carefully.
- ❑ 6. Slide the rear panel into its slot.
- ❑ 7. Solder C10 across the banana jacks inside the case.
- ❑ 8. Mount one piece of wire, cut to the appropriate length from the probe center pin of S2, + V OUT, to the positive banana jack. Mount the other wire, cut to the appropriate length for the - V OUT center pin of S2 to the negative banana jack.

The Ramsey Kit Warranty

Please read carefully BEFORE calling or writing in about your kit. Most problems can be solved without contacting the factory.

Notice that this is not a "fine print" warranty. We want you to understand your rights and ours to! All Ramsey kits will work if assembled properly. The very fact that your kit includes this new manual is your assurance that a team of knowledgeable people have field-tested several "copies" of this kit straight from the Ramsey Inventory. If you need help, please read through your manual carefully, all information required to properly build and test your kit is contained within the pages!

1. DEFECTIVE PARTS: It's always easy to blame a part for a problem in your kit, Before you conclude that a part may be bad, thoroughly check your work. Today's semiconductors and passive components have reached incredibly high reliability levels, and it's sad to say that our human construction skills have not! But on rare occasion a sour component can slip through. All our kit parts carry the Ramsey Electronics Warranty that they are free from defects for a full ninety (90) days from the date of purchase. Defective parts will be replaced promptly at our expense. If you suspect any part to be defective, please mail it to our factory for testing and replacement. Please send only the defective part(s), not the entire kit. The part(s) MUST be returned to us in suitable condition for testing. Please be aware that testing can usually determine if the part was truly defective or damaged by assembly or usage. Don't be afraid of telling us that you 'blew-it', we're all human and in most cases, replacement parts are very reasonably priced.

2. MISSING PARTS: Before assuming a part value is incorrect, check the parts listing carefully to see if it is a critical value such as a specific coil or IC, or whether a RANGE of values is suitable (such as "100 to 500 µF"). Often times, common sense will solve a mysterious missing part problem. If you're missing five 10K ohm resistors and received five extra 1K resistors, you can pretty much be assured that the '1K ohm' resistors are actually the 'missing' 10 K parts ("Hum-m-m, I guess the 'red' band really does look orange!") Ramsey Electronics project kits are packed with pride in the USA. If you believe we packed an incorrect part or omitted a part clearly indicated in your assembly manual as supplied with the basic kit by Ramsey, please write or call us with information on the part you need and proof of kit purchase.

3. FACTORY REPAIR OF ASSEMBLED KITS:

To qualify for Ramsey Electronics factory repair, kits MUST:

1. NOT be assembled with acid core solder or flux.
2. NOT be modified in any manner.
3. BE returned in fully-assembled form, not partially assembled.
4. BE accompanied by the proper repair fee. No repair will be undertaken until we have received the MINIMUM repair fee (1/2 hour labor) of $25.00, or authorization to charge it to your credit card account.
5. INCLUDE a description of the problem and legible return address. DO NOT send a separate letter; include all correspondence with the unit. Please do not include your own hardware such as non-Ramsey cabinets, knobs, cables, external battery packs and the like. Ramsey Electronics, Inc., reserves the right to refuse repair on ANY item in which we find excessive problems or damage due to construction methods. To assist customers in such situations, Ramsey Electronics, Inc., reserves the right to solve their needs on a case-by-case basis.

The repair is $50.00 per hour, regardless of the cost of the kit. Please understand that our technicians are not volunteers and that set-up, testing, diagnosis, repair and repacking and paperwork can take nearly an hour of paid employee time on even a simple kit. Of course, if we find that a part was defective in manufacture, there will be no charge to repair your kit (But please realize that our technicians know the difference between a defective part and parts burned out or damaged through improper use or assembly).

4. REFUNDS: You are given ten (10) days to examine our products. If you are not satisfied, you may return your unassembled kit with all the parts and instructions and proof of purchase to the factory for a full refund. The return package should be packed securely. Insurance is recommended. Please do not cause needless delays, read all information carefully.

LC1 INDUCTANCE-CAPACITANCE METER KIT
Quick Reference Page Guide

REQUIRED TOOLS

- Soldering Iron (WLC100)
- Thin Rosin Core Solder (RTS12)
- Needle Nose Pliers (MPP4 or RTS05)

ADDITIONAL SUGGESTED ITEMS

- Helping Hands Holder for PC Board/Parts (HH3)
- Technician's Tool Kit (TK405)
- Desoldering Braid (RTS08)

Price: $5.00
Ramsey Publication No. LC1

Assembly and Instruction manual for:
RAMSEY MODEL NO. LC1 CAPACITANCE-INDUCTANCE METER KIT

TOTAL SOLDER POINTS
145

ESTIMATED ASSEMBLY TIME
Beginner .....3.0 hrs
Intermediate .....2.0 hrs
Advanced .....1.0 hr

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