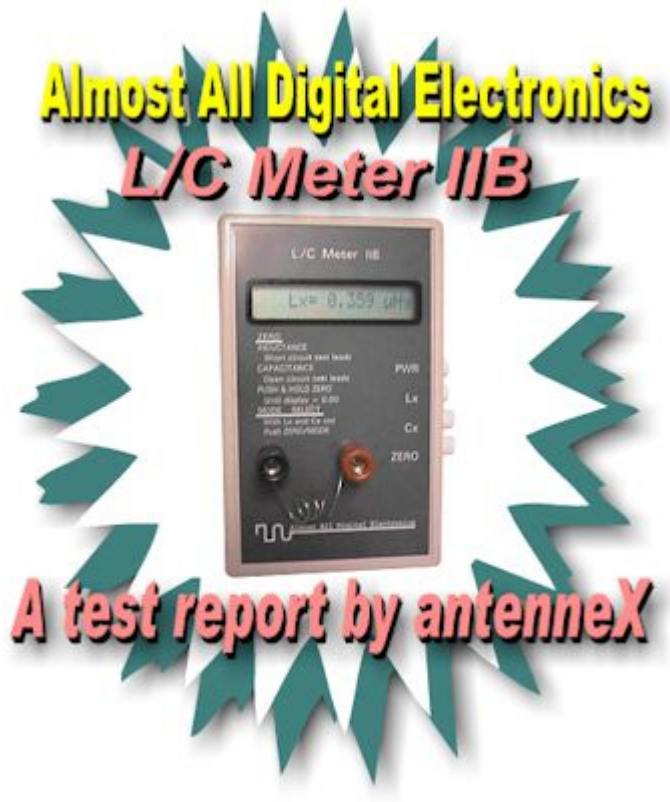


The Almost All Digital Electronics L/C Meter IIB
By Richard Morrow, K5CNF

I do not know how many times in the past 40+ years I have looked for capacitors and inductors in my junk box and hoped what I found was going to be the correct value for what I wanted to do. There was many times when I had purchased boxes of surplus capacitors and inductors from junkyards that obtained the parts as military surplus at the local Naval Base. Many times these had the values on them printed in some unknown language or cryptographic symbols. Never a clue was to be found as to the value on the wrapping, packing, or anywhere on the part itself. But for only five cents a pound, I was certainly not going to let the stuff go to waste!

GUESS BY GOSH
Sometimes, a part at random worked well in whatever project I was undertaking. Sometimes, it took many combinations of series and parallel capacitors to get things working right. But, sometimes things exploded because the part's voltage rating was not high enough. This was especially critical back in the tube days when much higher voltages were common. The anxiety level increased, to say the least, at power up time with parts sans even a vague guess indicator for the parts' value. Waiting for the thing to work, or something to go bang, was nerve wracking-just luck of the draw!

Now many years later, I still have stuff that I am not able to tell what value they are rated at, not even a vague guess indicator can be found on the thing. Nowadays without tubes, the voltages are considerably lower. So, mostly all I need is the capacitance value for capacitors and inductance measurements on the coils. And power supply voltage ratings are very seldom above 12-VDC. But often the actual component values would missing or illegible and I would have borrow a very expensive L/C meter from another local ham. Then he had the audacity to move out of town, taking his instrument with him and leaving me back to guess working!

ALMOST ALL DIGITAL ELECTRONICS TO THE RESCUE!
Once again I had no way to determine the values of all of the different capacitors and inductors. I had to stuff them into a box and hope that someone else would eventually show up with an L/C meter I could borrow. Being a "packrattus electronicas", I ended up with a lot of boxes full of unmarked capacitors and inductors. Not wanting to throw them away as they might be useful later on in the century, I was running out of space. Then, a solution arrived!

One of the ***antenneX*** writers, Jef Verborgt mentioned an L/C meter he was using and urged us to obtain one for testing. It piqued our interest and an email was dispatched to Neal Heckt at ***Almost All Digital Electronics*** expressing our interest in testing their **L/C Meter IIB**. It comes in kit form as well as assembled, but since we did not have the spare time to assemble one, we opted for the assembled unit.

Three days later the assembled unit arrived and a testing frenzy commenced. I decided to pick a wide span of test items from very old to very new to really put the meter through its traces. I dug out an assortment of older capacitors dating back from WW II as well as some capacitors that were not so

old and began testing them. Following this, I tested an bunch of inductors I had wound and some already wound on ceramic forms from an old **ARC-5** transmitter. The results are shown in the following chart. Note that some parts were identified with values and some were not.

Photo 1
Wide Assortment of Old Capacitors

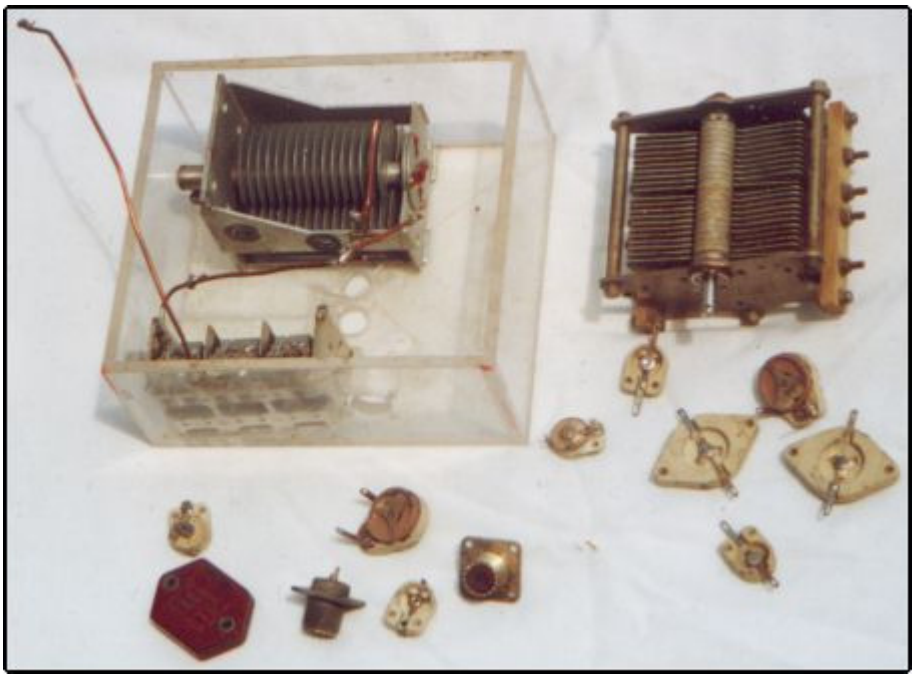
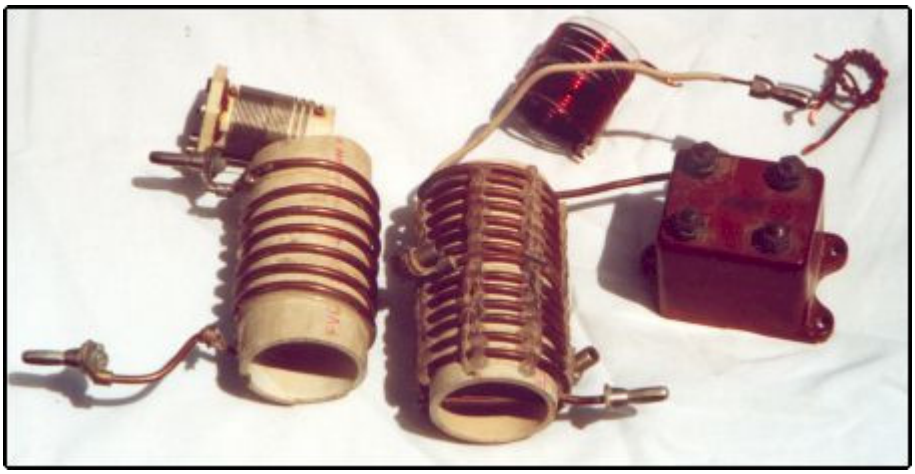


Photo 2
Large Old WWII Mica Capacitor

Capacitor Test Results

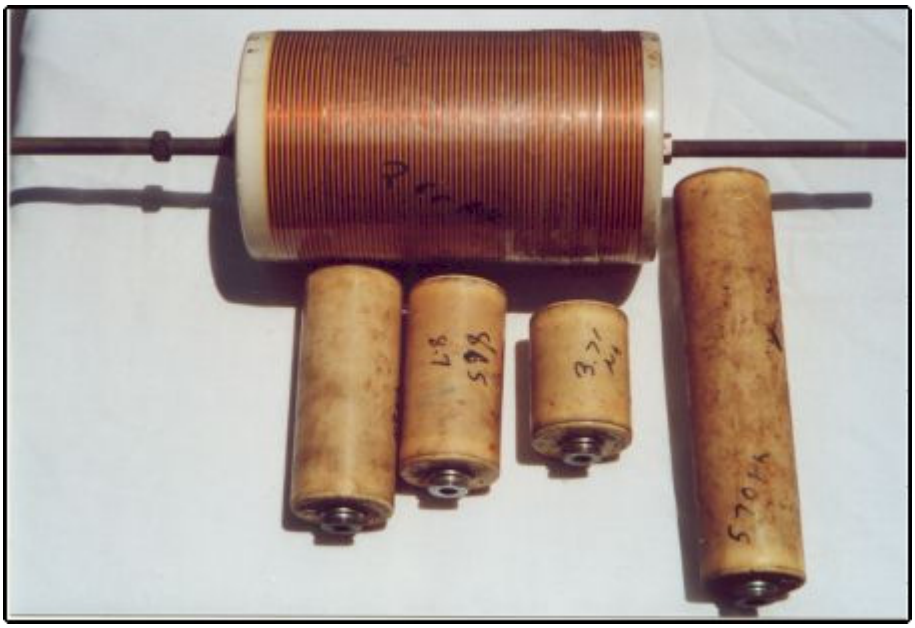
Capacitors	Labled Values	Readings
Oil filled	2mF	1.1mF
NPO ceramic, variable	10-110pF	122pF
NPO ceramic, variable	3-13pF	1.64-16.81pF
NPO Ceramic, variable	No label	5.5-117pF
SO-239 old connector	No info	3.8pF
SO-239 new connector, Teflon Insulation	No info	5.48pF
Vacuum variable	7.2-500pF	15-517pF
RG-58 old cable, old connectors	No values	48.36pF
RG-58 new, Teflon connectors	No values	58.2pF
Toroid windings	Between wind	87.41pF
Air variable	No values	30 - 491pF
ARC-5 trans, variable	No values	29- 150pF
3 gang b.c variable, 3 section parallel	No values	64- 617pF
Air core bifilar toroid (meas between windings)	No values	40.24pF
Large size mica	400pF per sect	486.2pF
Medium size mica	50pF	49.82pF
Huge air variable	No info	20 pF-360pF

Photo 3
Assortment of Capacitors & Conductors



Inductors	Measured value	Comments
Toroid	272.5μH	Unmarked
RF choke	17.5μH	marked as 18μH
Air wound bifilar toroid	219μH & 208μH	both windings
Air wound coil	7.5μH	I.75in dia plastic form
Air wound coil	8.948μH	I.75in dia plastic form
Mobile matching coil	5.9μH	2 in. PVC form
Mobile matching coil	1.961μH	2 in. PVC form
ARC-5 oscillator coil	13.07μH	ceramic form
ARC-5 feedback coil	5.173μH	ceramic form
Mobile antenna coil	3.7μH	air wound 10meter
Mobile antenna coil	8.7μH	air wound 20meter
Mobile antenna coil	40μH	air wound 40meter
Mobile antenna coil	570μH	air wound 160meter
Mobile antenna coil	268μH	home made 160meter

Photo 4
Various Old Coils



Magnet mount antennas

Larsen 2 meter, NMO magnet mount	6.8pF
Anli AT-2 duo band NMO magnet mount	168.5pF
Large CB single magnet	286.5 & 670.2pF

Now for an analysis of the results:

I started right off with a tough test. The first capacitor was an oil-filled filter capacitor that the L/C meter was not supposed to able to measure. The instructions say the meter will not accurately measure power supply type capacitors. However, it did not do too bad saying that the capacitor was 1.1mF. The value on the side of it said that it was a 2mF and I will go along with either value. Moving on down the list, I measured a bunch of NPO ceramic capacitors, which all very were close to the values printed on them. A high-grade vacuum variable was high on the low range by about 8pF and 17pF high on the high end.

Several other air variables were also measured. These air variables had no values on them so I was glad to finally find out what their tuning ranges were supposed to be. Several old style high power mica capacitors were checked and the printed values were lower than they actually measured. One REALLY huge air variable with 1/4-inch spacing measured from 20pF to 360pF, which was just what I was looking for to build a big loop tuning capacitor!

I was also able to measure the capacity of several SO-239 connectors and the older one had less internal capacity than a new one with TEFLON insulation. The same results of less internal capacity occurred with two identical lengths of RG-58 that had both new and old style connectors. Another thing that I did was to measure the inter-winding capacity of an air wound toroid that had "Formvar" insulation.

Then I moved over to some inductors and this is where the meter's ability was more than a blessing. I measured a wide assortment of toroids, RF chokes, air-wound coils, coils in an ancient ARC-5 transmitter, center-loading coils for my mobile antenna and a homemade 160-meter base-loading coil.

Photo 5
Mobile Matching Coil

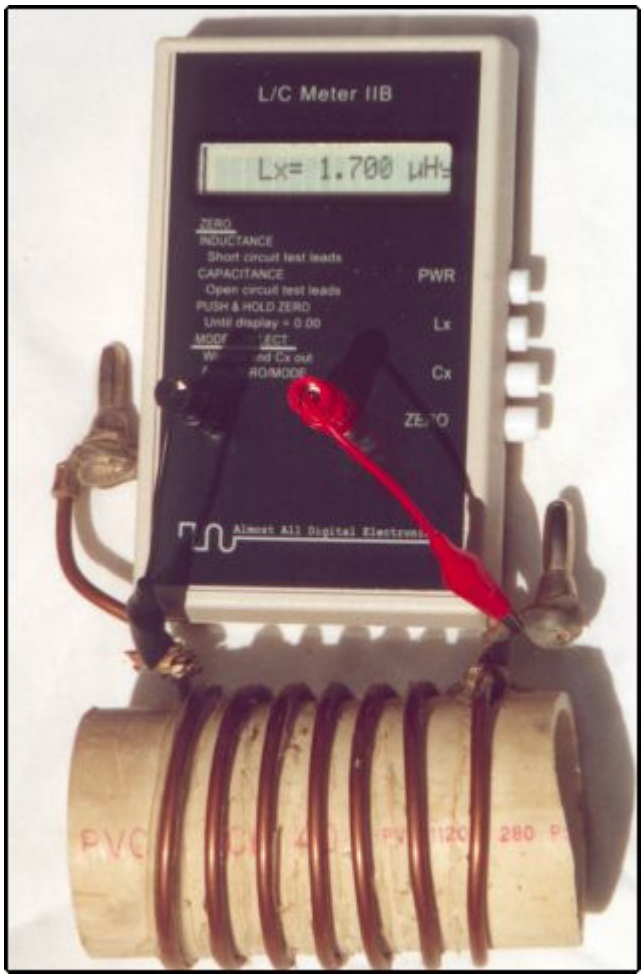


Photo 6
40-Meter Mobile Coil

MOBILE ANTENNAS

The next items I measured were some magnet mount antennas for mobile use. One of these was a Larsen mount using an NMO base with a Larsen 2-meter antenna attached. It was measured only on the roof of the car and had a very short length of coax that would limit the total amount of coupling to the rooftop only.

Another mobile antenna measured was a Larsen magnet mount with an ANLI AT-2 duo-bander 144/440. It had considerably higher capacity as compared to the NMO 2 meter mount. It also had a much longer length of coax. Measurements of this one were made while on the car's trunk and again on the roof.

After that I conducted tests of a large CB-type magnet mount that was measured only on the trunk. This mount had been modified with an added ground wire, which allowed me to ground the mount to the car body directly. It was made of a length of braid that had been inserted and soldered to the coax braid in the mount. An interesting aspect is that the mount had more capacity to the trunk lid than when the ground was connected to the car body and not quite sure why.

The last mount I measured is the homebrew "monster" magnet mount (described in earlier articles) and it had the largest capacity to the trunk lid. The smaller value listed is the amount of capacity from the ball mount to the trunk lid ground. Now these values will change somewhat with the coaxial cable position on the car, but not enough to matter.

Photo 7, 8 & 9
Various Magnet Mounts
2-Meter & Dual-Banders

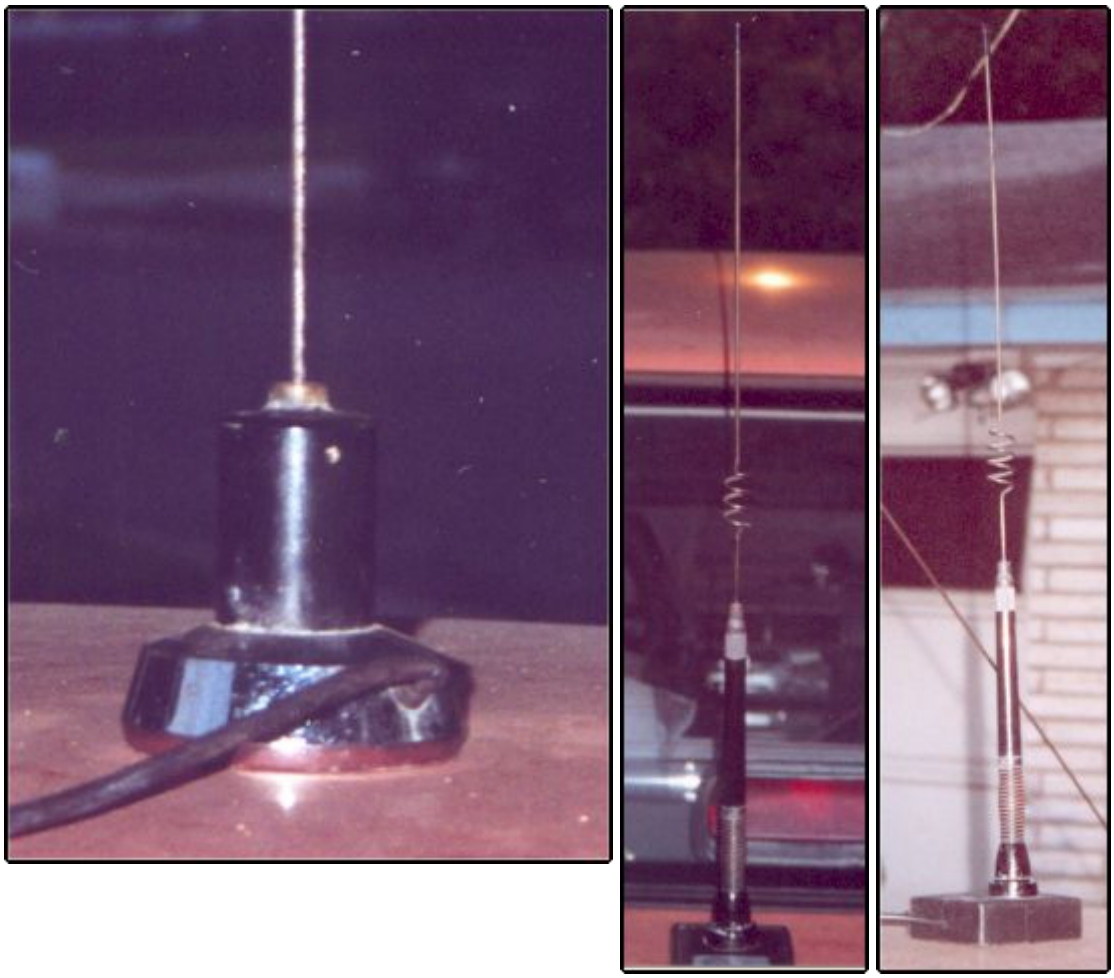
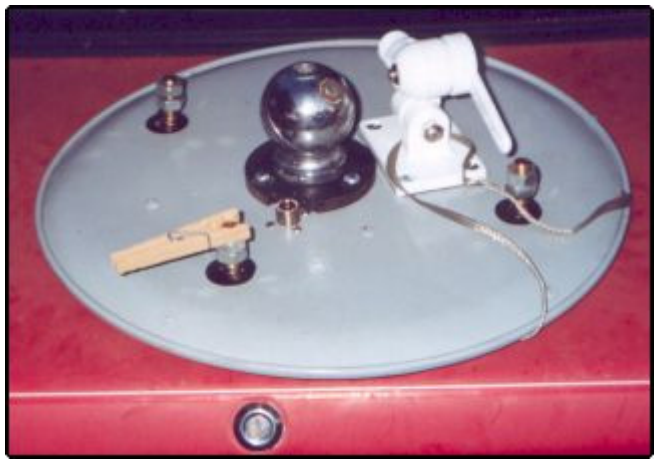


Photo 10 (Monster Magnet Mount)



HOUSE ROOF MOUNTS
WARNING: To avoid possible damage to the meter, be sure to GROUND the antenna first to drain off any static charges that may have built up on the antenna!

I measured the capacity of several antennas mounted on the roof of my house. These are a 20-meter ground plane, one for 17 meters and a 40-meter inverted V. By connecting the shield and center conductor of the RG-58 feed lines to one lead connector on the meter and the other meter lead to the ground connection I was able to get some very interesting readings.

On the 20 and 17-meter ground plane, the readings fluctuated between 225 and 300 pF because the

wind was blowing the antennas around somewhat. These antennas were 14 feet above ground level and had radials spread out over the roof, which meant there was a large conductor area for capacitive coupling to the ground below and the wiring in the attic. Thus, the meter told me what the actual readings were and the amount of fluctuation caused by the windage that I had not known before. Now, that was interesting new information to me!

The inverted V did not show any readings at all on the meter apparently because, being 45 feet tall, the antenna was simply too high for the meter to measure and it had exceeded its capacity.

VARIOUS AND SUNDRY
Later, I took the meter over to another ham's house and we measured another variety of components, both new and old. The results were equally good and we determined that the tolerances shown were the same for newer components as they were for those of a half-century vintage. It was found to be difficult when measuring the surface-mounting components because they were so tiny to work with. Eventually, we devised a method using pins and that enabled us to carry out the measurements. Admittedly, these are items most folks wouldn't both to measure.

ANTENNA EXPERIMENTING
One of our regular writers (and fellow GARDS' member) Jef Verborgt speaks highly of the meter's precision. Jef is an avid antenna experimenter and was using a similar L/C meter made by AADE on a number of small antenna projects. Each time he measured inductances and capacitances, the calculated resonance point was spot on with the point observed on the radio receiver. Jef concluded that the picofarad and microhenries range is precise up to 1pF and 0.01 microhenries. Most of those measurements were done without leads and in order to make the measurements even more "pure", Jef removed the terminal screws from the meter in order to make a direct contact.

Jef goes on to say that the meter is so easy to use especially now that he is working on some balun projects. He uses the meter to positively identify the ends of the bifilar or trifilar windings—no need to get out the ohmmeter! And, when building coaxial traps or choke baluns, Jef says the L/C meter tells the exact values for L and C. He found that he could measure the inductance of a bifilar winding for a choke balun and then calculate the total choke reactance.

In this connection, Jef suggested we mention these useful formulas for calculating resonance:

F = root of 25330/LxC
L = 25330/fxfxC
C = 25330/fxfxL

And, as a caveat, don't forget before measuring power capacitors they should first be discharged!

I am impressed with this little meter. It works well and is very well built. The power is a 9V battery that is the type commonly used in small transistor radios. The case is an attractive case, with the front panel labeled in easy to read instructions. The meter has five different modes:

"READY MEASURE n" measures Lx and Cx and displays the result in "nano mode" Lx=99nHy, Cx=12.34nF.

"READY MEASURE μ" Lx and Cx are displayed in "micro mode" Lx= .099 μHy or Cx = .01234μF.

"READY MATCH μ MODE" used to match components to a reference component and the values are displayed in the "micro mode".

"READY MATCH n MODE" same type of operation as above except the values

are displayed in the "nano mode".

"READY MATCH % MODE" displays the percent difference between the reference component and the measured ones.

The above modes are all very useful functions and are not found in most of the more expensive meters I have used in the past.

The manual is only five pages and is most informative as it clearly explains the way the meter works and provides a mathematical analysis for the different functions that the meter has available. The meter will not measure "in circuit" components, so don't even try it for that purpose. All things considered, this is a very worthwhile addition to any test equipment collection. There are many more components this meter is capable of measuring and I will be thinking about how much more could be done with this meter as time passes.

The ham buddy that help test more components asked me if I thought a resistance measurement function could be added. Well I am sure it could be for more money, but with DVM prices so low, why bother?

NOW IN BELGIUM
This particular L/C test meter is now in Belgium and being put to more tests while helping with some more antenna projects being conducted for us by writer/GARDS' member, Pascal Veecksman, ON4CFC. Such current projects include a 6-meter Quad from L.B. Cebik's Quad books (in the **BookShelf**) and another one for a DDRR mobile mount. Those articles are coming up future issues of ***antenneX***.

Here's what Pascal has to say about the meter so far:

In Flemish
Wel Jef je kan Jack vertellen dat dit het prachtigste toestel is op mijn MFJ na, gewoon fantastisch het is nu kinderspel om coils te meten en om gelijke coils te maken want met de functie Match kan je zien hoeveel het verschil is in waarde en met de functie Match % mode kan je zien hoeveel procent de ene coil afwijkt van de andere, gewoon prachtig. Sinds ik hem in mijn bezit heb ligt hier al een stapel coils... it's fun now to make coils!

And English translation by Jef
This piece of equipment is second only to my MFJ 259 analyzer. Just fantastic, making coils and calibrating them has become a piece of cake. Using the function " Match" and the function " Match % " one can compare coils and get immediately the differences in inductance as well as the percentage of difference. Just amazing and with this tool it has become real fun to make coils and take the guessing out of it.

Many thanks to Neil at ***Almost All Digital Electronics*** for providing the test unit. He has reasons to be proud of this product and we liked it so much we decided to place it on our own shelves here on this website in the **Shopping Shack** for the convenience of our readers. Take a look at this oustanding instrument and see the additional testimomies that have come in since. **-30-**

ABOUT THE AUTHOR
Richard Morrow, K5CNF

RICHARD MORROW, K5CNF has an Associate Degree In Electronic Engineering, attended many classes and seminars conducted by *Motorola, RCA, General Electric, Furuno*. Has been a licensed radio amateur since September 1955 and holds an Advanced Class. Held license as a 2nd Class Commercial Radio Telephone operator

w/shipboard Radar endorsement since 1957, upgraded to 1st Class radiotelephone operator in 1960. Has been a broadcast engineer for AM, FM and TV. Was a electronics instructor for *United Electronic Institute* in Dallas, Texas, Over 100 published articles in *73 Amateur Radio, Radioscan*, and of course, *antenneX* where he has been Editor-in-Chief since its creation in 1988.

Spent three years as a radio operator (1962-1965) in the US Army, assigned to Headquarters Company, 1st Battalion, 23rd Infantry, 2nd Inf. Div., Ft. Benning, Georgia. Worked in two way radio industry as field technician for years. Previous jobs include *Texas Instruments, Collins, Dresser Atlas, S.W. Bell Telephone*, and several broadcast stations as chief engineer.

Has three patents issued on electronic devices and is an eternal experimenter. Built many transmitters, amplifiers, and numerous other ham devices as needed. Work DX when it shows up. Best DX, Pitcarin Island on 10 meters with the HTX-100 and a converted Cushcraft 1/2 wave CB vertical propped up against the garage. Other DX includes ZL on 75 meter SSB with 60 watts, Senegal on 75 meters SSB, 60 watts again, antenna was a dipole at 35 ft. Current activity is on 160 meters sometimes, 40 meters, two meters and 440 MHz. Favorite antennas are: Phased arrays, magnetic antennas, directional arrays, and anything that radiates well.

Current rigs are TS-430S, TS-700 multi-mode, Kenwood two FM meter rig, Icom 440 ht. Radio Shack HTX-100, Radio Shack 440 ht, 2 Atlas 210x, Johnson 275 watt Matchbox, Johnson Thunderbolt, several older SGC SSB marine rigs, three Heathkits.

Interests include; antennas, astronomy, music, both radio and optical, reading, photography, motorcycles, archeology, cars, Cosmology, Science in general, Nature, animals and aviation.

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Send mail to webmaster@antennex.com with questions or comments.

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