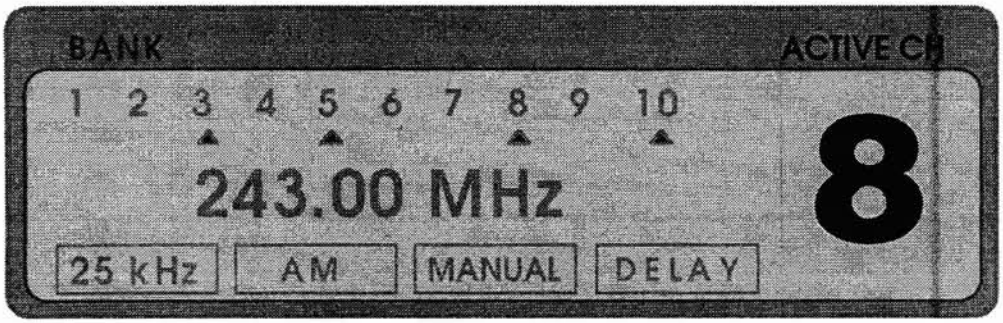


COMPUTER INTERFACES

If it's an Ultimate Scanner, it's wired to a computer...

NO LONGER A LUXURY

It's as obvious as tomato juice on a white shag carpet that scanners with lots of channels *need* automated computer programming. The Cosmic Light will inspire you the first time you punch in 400 channels only to discover an error on #47.

If you've done my 1,600 to 25,600 channel Extended Memory Mods, that Light will sear your retinas.

GENESIS OF COMPUTER INTERFACES

Would you believe that computer interfacing of a scanner is nothing new? Years ago, an ad in *Monitoring Times* offered plans for a Commodore 64/128/PRO-2004 interface.

I mentioned this to Lin Burke, a digital guru, who whipped up a functional interface for the Radio Shack Color Computer II. He went on to modify it and its associated BASIC program for my Apple IIe of the time. Then came a design by Miles Abernathy for the Macintosh computer. We converted that design and its BASIC control program for my Apple IIe. They all programmed a scanner's memory by automated means.

Next came a commercial, universal interface kit from RW Systems, and an MS/DOS-specific interface package including software from Datametrics, Inc. The kit from RW Systems held a lot of promise because (1) it was universal for most computers and (2) computer-specific software was not required to run it. It needed only a serial communications port and a plain telecom program – and it worked. Unfortunately, RW Systems either didn't sell as many interfaces as they expected, or else they weren't patient enough to wait around for the idea to catch on. RW Systems went out of business (to the best of my knowledge), though their interface did a good job with a variety of computers and software.

EVOLUTION

The Datametrics Interface package is still available at this writing, probably because it comes complete, ready to install in any MS/DOS-based computer with 640k RAM and a parallel port. The

Datametrics interface works only in IBM/clones and is driven by proprietary software. The interface is easy to install and virtually foolproof in operation.

The RW Systems kit supports any of the PRO-2004/5/6 series, while Datametrics specifies theirs to be for the PRO-2006 only. After looking it over, I think it is a safe bet that it will work just fine in the PRO-2005. and can be easily adapted to the PRO-2004, but Datametrics actively supports only the PRO-2006.

Enter "Professor Peabody," occasional columnist for the monthly *World Scanner Report.* That fine fellow and his able assistant, "Sherman," concocted a do-it-yourself computer interface for the PRO-2004/5/6 and presented it in great detail in still-available back issues, V2N2-V2N6.

Professor Peabody's "FatMan" interface was distinguished by its ability to work from most any computer with unsophisticated software, and it controlled every function of the PRO-2004/5/6. People are still building the "FatMan" today.

Rather than take space to repeat it here, I refer interested builders to those issues of the *World Scanner Report* where the instructions reside in all their splendor and glory and where the ol' Professor still helps those who need tech support.

Shortly after the "FatMan" appeared, HB Technologies *(now defunct)* and COMMtronics Engineering *(alive and well)* introduced the potent and awesome HB-232 Scanner/Computer Interface.

COMMtronics Engineering further evolved the interface into the CE-232, which is presented in the pages ahead as a do-it-yourself, no charge, no royalty, honest-to-goodness, "gimme." The CE-232 project is offered as the center of your Ultimate Scanner, and you paid for the right to build it when you bought this book. But there are other options...

Most recently, Optoelectronics, Inc. introduced their OptoScan 456 Interface for the PRO-2005 and PRO-2006. Its basic principle is to replace the scanner's CPU in controlling the receiver's PLL circuits.

Installation is reported to be fairly easy, with not too many snags. The OptoScan 456 comes complete, albeit with a somewhat minimal software control package, which led to the emergence of third-party software products that are available to properly complete the project.

WHAT'S OUT THERE TODAY

For more information about commercially available interfaces, contact:

```
Datametrics, Inc.
2575 South Bayshore Drive, Suite 8A
Coconut Grove, FL 33133
   (no phone available at this time)

Optoelectronics, Inc.
5821 NE 14th Ave.
Fort Lauderdale, FL 33334
800-327-5912

COMMtronics Engineering
POB 262478
San Diego, CA 92196
BBS and FAX: 619-578-9247
   5:30pm-1:30pm Pacific Time, only
```

WHAT A PROPER INTERFACE DOES

Before you even think about buying an interface, or rolling your own, you should know more about scanner/computer interfaces in general.

Focus nowadays is correctly on a TWO-WAY interface, one that not only can program the scanner's memory banks and control the scanner remotely from the PC, but that can also acquire and pass data from the scanner to the computer for logging and processing of active frequencies, duration of transmissions, dates, times, and much more. This means data acquisition *and* control.

A well-designed two-way interface between scanner and computer can perform great deeds, and you don't even have to be there!

The most important function of an interface is probably to program memory banks, sparing us drudgery and opportunity for error.

An important secondary function is data logging and processing, which produces a database of your specific area of interest.

Half the fun of scanning is listening to what's going on; the other half is the accumulation of knowledge and understanding.

An interface that can pass data from the scanner to the computer for logging, processing, and storage produces a long-term benefit with long-term implications. In comparison, actual monitoring is relatively short-term fun.

Therefore, both sides of a scanner/computer interface are important and useful, but some interfaces go only one way. Be demanding!

CAPTURING SCANNER DATA

There are perhaps one or two ways to obtain data *from* the scanner. The CE-232 Interface introduced the only practical technique for the casual hacker: decoding the data that flows from the scanner's CPU to the Liquid Crystal Display (LCD).

That data stream contains most everything pertinent to scanning with the exception of time/date, and the computer can provide that. The system decodes data that flows from the scanner's CPU to the LCD, but some of that data is superfluous and has to be removed. The required data going to the LCD includes the following:

Frequency digits	**Manual (On/Off)**
Channel number	**Search step (5, 12.5, 30, and 50kHz)**
Mode (AM/NFM/WFM)	**Search direction (up/down)**
Delay (On/Off)	**Bank (0-9)**
LockOut (On/Off)	**Priority (On/Off)**

Missing – but useful – are time, date, duration of transmissions, and squelch status. There are other potentially important data that would be nice to have captured by an interface with an S-meter, such as center-tuning or frequency errors, and the status of other mods you may have done, such as Extended Memory Blocks, Extended Delay, Automatic Tape Recorder Switch, and more.

The ideal interface, then, will capture and send to the computer not only the normal data that appears in the display, but also a variety of other data that relates to the scanner, and to the session.

SCANNERS ARE NON-ERGONOMIC!

The design of one of the most user-friendly scanners I've ever seen has not been replicated to date: the PRO-2004. Whether or not it's deliberate, it's a fact that scanners seem *designed* to be operated and monitored from a distance. The keyboards are densely congested and designed for fingers about the size of toothpicks. An ideal interface will allow full operation and control of the scanner from the computer's keyboard where even pickles for fingers can hit the right keys at the right time.

Scanner displays don't seem designed for human eyes. Readouts are small, poorly illuminated, and often must be viewed from very narrow angles. A good interface presents an image of the scanner's display on the computer's monitor, so you can see all the information, from a distance.

MY PRESCRIPTION

Let's talk about either rolling your own high-performance scanner/computer interface or acquiring one for the least possible effort and cost. Many CE-232 Scanner/Computer Interfaces (and its predecessor, the HB-232) have been successfully tested and used by hobbyists and commercial interests for several years.

The following project offers a lot to most owners of the PRO-2004/5/6, and of certain other scanners such as the PRO-2035, PRO-2022, PRO-43, PRO-39, PRO-37, and PRO-34.

Now, with the PRO-2004/5/6 scanner series passing into history, I am literally giving you the design of the CE-232 *–it's here, complete, in this book.* It's too powerful and wonderful a tool to keep as a strictly commercial venture.

If you have knowledge of electronics and general hacking skills, you can build the CE-232 for yourself at modest cost.

LEGALESE

Of course, there are a few catches to this deal...

CATCH 2: The CE-232 Scanner/Computer Interface requires software expressly designed for it. This software is not simple or easy to show in print, and it will not appear in this book. If you desire to build the interface but not write your own software, for the cost of disk duplication and shipping I'll send you an IBM/PC-compatible control program, plus supporting programs and files for the CE-232. If you elect to write your own software, I'll help by *giving* you the Developer's Kit, but cannot take responsibility for, or directly assist, your work.

The materials that I provide are *"copyrighted freeware,"* which means the package is freely available for individual, non-commercial use for only my cost of duplicating and shipping.

This software package is "complete" and powerful, so there is little reason or need for you to develop your own software unless you enjoy that sort of thing.

This complete software package is available for $9.95, ppd (USA), only on a high density, 3.5" floppy disk in MS-DOS 3.1 and up format and compatibility. Add $5 special handling for 5.25" disk. Payment in US Funds, check, money order, MC/VISA, to: COMMtronics Engineering, PO Box 262478, San Diego, CA 92196 or (619) 578-9247 (1:30-5:30pm, Pacific Time). Foreign shipping and handling add US$10.

CATCH 3: The CE-232 as presented herein is strictly for the PRO-2004/5/6 scanner series. Other scanners are supported, but you must contact me privately or on my BBS for that information.

CATCH 4: The CE-232 is known to work with virtually all modifications that can be made to the PRO-2004/5/6 with one important exception: It will NOT work with scanners that have been speeded up by means of a faster crystal. The standard diode speedups are okay, however.

All other mods of which I am aware will work just fine with the CE-232, though some may require slight alterations regarding where or how they are installed.

CATCH 5: I support strictly IBM/PC compatible computers, but third parties have written software that lets Macintosh computers control the CE-232, so if you need software for the Mac check the resources listed in this chapter or on my BBS. Formats for other computers are not available.

Other third parties that have written shareware or commercial control programs for the CE-232 Interface are identified on my BBS.

READ THIS FIRST

These instructions are geared for PC-compatible computers with MS/DOS 3.1 or higher, and a minimum of 512k RAM, though 640k is recommended. Operation of the CE-232 is possible from a floppy disk, but a hard drive with 2 MB free is better.

This version of the CE-232 Scanner/Computer Interface is expressly for the PRO-2004/5/6 scanner series.

It will work, as shown herein, for certain other scanners at reduced capability (1-way interface), but special add-on software and hardware are required. These other scanners include, but are not limited to, the following: PRO-2035, PRO-2022, PRO-2021, PRO-34, PRO-37, PRO-39, and the PRO-43.

Features and functions of the 2-way CE-232 Interface are:

- ***AutoPrograms*** scanner's 400 memory channels in 8 minutes (typical)
- ***Remote-Controls*** scanner keyboard functions from the PC
- ***AutoLogs*** contents of scanner's display ("hits") to a text file or a printer
- ***AutoLooksUp*** and displays your frequency data when a "hit" occurs
- ***AutoRejects "birdies"*** and undesirable frequencies – *no false stops!*
- ***Script*** feature allows unlimited automated control
- ***User Switches;*** status and control registers for generic purposes: data acquisition and control
- ***Proved technology;*** reliable and effective

CONNECTIONS

The CE-232 Scanner/Computer Interface connects between a PC/XT/AT-compatible computer and the scanner. A standard serial cable connects the CE-232 to the computer's COM1 or COM2 port.

The CE-232 can be installed inside the scanner for a tidy package, or it can be built into a small

project box, with a short cable and plug to mate with a receptacle mounted on the scanner.

External installation allows a CE-232 to be used with more than one scanner. The scanner is not appreciably modified by either approach; rather, approximately 20 wires go from the CE-232 to various points in the scanner.

Absolutely no scanner features or performance are altered or sacrificed to gain the automated features.

FEATURES / FUNCTIONS

From a functional viewpoint there are no compromises whatsoever. The system has the following features and capabilities:

AutoProgram; in about 8 minutes it will insert up to 400 frequencies of your choice into the scanner's memory channels, along with custom settings of DELAY, MODE, and LOCK-OUT.

Try to program 400 channels by hand in under an hour or two... and what if you find a mistake with the channels out of sequence back on Ch-30? The AutoProgrammer uses plain ASCII text files, by the way.

View and control all standard scanner keyboard functions from the computer. The monitor displays a monochrome or color facsimile of the scanner's keyboard and LCD. Whatever shows in the scanner's LCD at any time is simultaneously displayed on the Monitor.

Press M on the computer keyboard for MANUAL, press S for SCAN, or press P for PRGM. All of the control keys of the scanner's keyboard are active at your computer's keyboard.

The scanner operates directly from the computer keyboard exactly as it operates from its front panel. In fact, you can operate from either location alternatively or simultaneously at any time.

AutoLogs to a handy text file the details about every "event" seen by the scanner. For example, the AutoLog mode senses when the SQUELCH breaks (a signal comes in).

It then commands the computer to write and append a line of data to a text file, containing channel number or SEARCH Bank, frequency, MODE setting (NFM, AM, or WFM), DELAY status (On or Off), LOCKOUT status, SEARCH Mode and STEP increment (if applicable), Date, Start Time, and Duration of transmission.

This file is "comma-delimited" to make it easy to load into a database manager for more processing and sorting as desired.

A text editor is provided with the CE-232 Program for a handy way to review and edit your AutoLogged Files. The CE-232 AutoLogger files its data in the same format as needed by the AutoProgrammer.

AutoLogged files of newly found frequencies in a SEARCH mode can be programmed back into the scanner's memory for a SEARCH and STORE function.

This process can be automated to eliminate duplicates and common frequencies. A dot-matrix or daisy-wheel printer can be selected to print AutoLogged data in real time as it is acquired.

The CE-232's **Lookup** function works when the scanner stops on an active frequency. It displays a line of text for that frequency on the monitor from your file. This reference file can be the SAME file used to AutoProgram the scanner. Great for signal identification.

An **Anti-Birdie** function compares a frequency "hit" to the contents of a "REJECT" file, and instantly resumes SCANning or SEARCHing, if that frequency is found in the file. It will not AutoLog these momentary "birdie" stops.

This superb feature is not limited to just "birdies"; you can put up to 32,000 undesired frequencies in the "REJECT" file, such as for pagers, computer data channels, continuous tones, encrypted signals, and other frequencies that you don't want the scanner to stop on or to AutoLog.

There are easy ways to automate the collection of undesirable signals for the REJECT file. The REJECT function can be turned on and off by the user or automatically commanded by a Script function.

The CE-232 has a powerful script or macro function to allow the automation of virtually any process that would normally be done by hand.

A Script can produce a file of what's been programmed into the memory channels (CHANNEL DUMP), or set a time limit for stops on various frequencies or channels, or lock-out every frequency found in a SEARCH session to avoid duplicate log entries.

The CE-232's microprocessor is programmed by your computer every time you run the program.

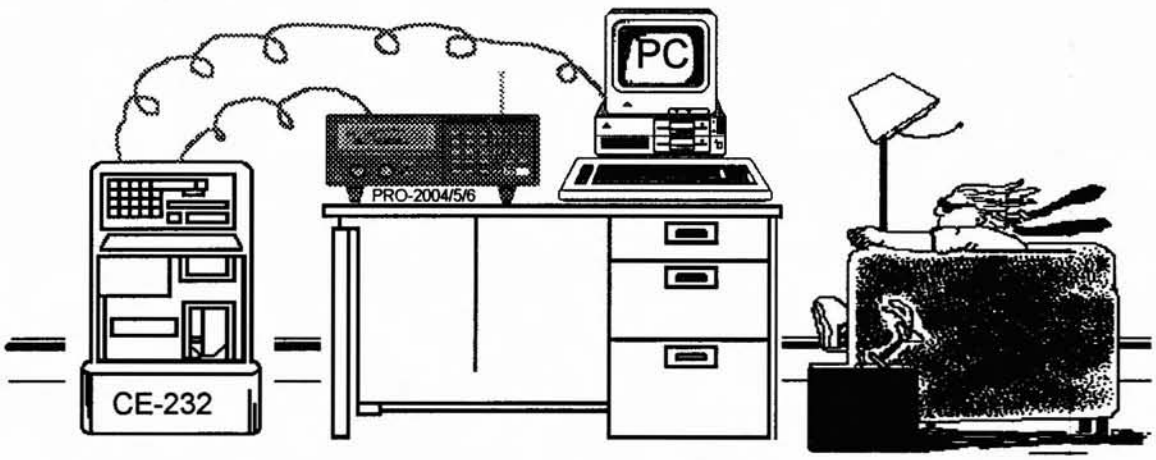
No expensive "hard programming" or firmware on the MPU chip.

Not only can low cost upgrades be done, but the CE-232 has attracted third-party developers who have produced many useful tools for the hacker, including superb support programs, utilities, and hardware.

The next few pages will present an overview followed by graphic details of how to build and install the CE-232 Scanner/Computer Interface. We start with the overview in *Figure 8-1*, and progress into the gory details, stage by stage and step by step.

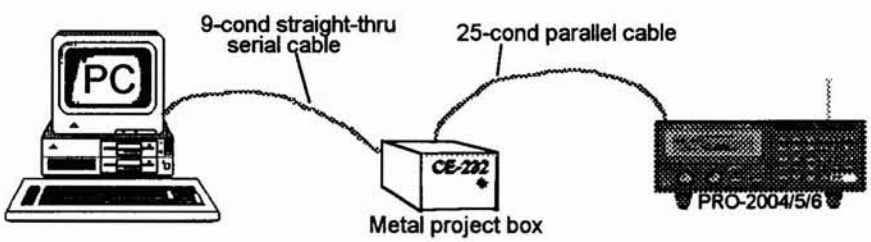
This is the path to the Ultimate Scanner!

Figure 8-1: The big picture!



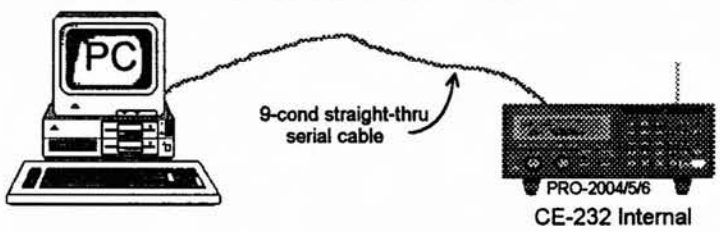
But, just in case you're blown away by all this technology.....

External Installations



And for those who really need to (KISS) Keep It Simple, Stupid, then.....

Internal Installations



HERE'S THE PLAN

Okay, bear with me. Whether you're a new hacker or have been around for many years, this is really important.

This is Chapter 8, and by now you've had to plow through a lot of cautions, caveats, and warnings to "be patient," "have a plan," "lay out the parts and tools," and more. So why should I do it again?

Two reasons. First, if I do it enough, eventually you'll figure out that I *really mean it* – in the most friendly way. Just like a paint job, if you prepare properly the work is a lot easier.

The second reason is that a lot of you will get the book and instantly flip to the chapter that interests you the most. Therefore, I've splattered my warnings quite liberally throughout this book.

Well, here we go again... step-by-step, this time.

1. Examine, assess, and inventory parts, materials, tools, and documents. Make a list of needed parts, materials, and tools that you don't have in stock...

   This will save you time, trouble, and headaches.

2. Acquire, install, and pre-test the CE-232 program and software...

   A confidence builder, and you've got to do it eventually. No sense in building the CE-232 without software.

3. Purchase, acquire, make all needed parts, materials, and tools...

   This more or less ices down the preparatory stages and ensures your readiness to launch.

4. Review documents and procedures...

   Final preparations before the ultimate commitment.

5. Build the CE-232 circuit or acquire one.

6. Install CE-232 board.

   A. Inside scanner *(74HC4050 Buffer optional but recommended).*

   B. In an external metal box. Build and install the 74HC4050 buffer circuit inside the scanner as close to the logic/CPU board as possible.

If (A) above, connect a straight-through serial cable between the computer's COM1 or COM2 serial port and the input to the CE-232.

If (B) above, connect a straight-through serial cable between the computer's COM1 or COM2 serial port and the input to the CE-232, *and* a 25-cond parallel cable between the CE-232 and the scanner.

Inspect and double check all your work, ensuring no mistakes and clean work. To reduce my workload, check it one more time.

Set up and run the CE-232 software.

You're finished!

MANUAL

The formal manual for the commercial CE-232 Kit occupies more than 100 pages.

The following pages present a compromise, with sufficient detail for the technologist and experienced hobbyist.

There is no missing key information. If you are interested in this project but have doubts, the formal *Assembly, Installation, and Operation Manual for the CE-232* is available, as are a printed circuit board, parts, software, and even a packaged kit, ready to assemble for those who want the least hassle.

You can even download the full manual from my BBS, *free.* The end of this chapter will discuss the options available to you.

Table 8-1A is a list of all the materials that you must have on hand *before* you start, and *Table 8-1B* lists the nice-to-have stuff.

Table 8-1A: CE-232 parts, materials, and supplies – mandatory

Qty √	Circuit Symbol	Circuit Description	All parts numbers are DigiKey or Radio Shack unless noted Source and Part #
___1	Program	Current program and files (*from the author, 3rd parties, or your own*)	COMMtronics Eng
___1	DOC	At least this book, ideal to have the full manual	COMMtronics Eng
___1	PCB	Printed Circuit Board, ready to assemble (*author's or yours*)	COMMtronics Eng
___1	XU-3	PLCC 68 pin Leadless Chip Carrier Socket for IC-3	A419-ND
___1	IC-1	MAX232CPE RS-232 Receiver/Transmitter (AD-232 is okay)	MAX232ACPE-ND
___1	IC-2	TL7757C or MC34064P-5 Undervoltage Sensing Integrated Circuit	*
___1	IC-3	MC68HC11F1FN Microprocessor Unit, or XC68HC11F1FN	*
___4	IC-4,5,6,7	74HC4066 Quad Bilateral Switch	MM74HC4066N-ND
___1	IC-8	78L05 Voltage Regulator, +5V @ 100mA	AN78L05- ND
___1	IC-9	74HC4050 Hex Non-inverting buffer	MM74HC4050N-ND
___4	C-1,2,3,4	Capacitor, electrolytic, 22µF/35 WVDC	RS# 272-1026
___6	C-5 thru 10	Capacitor, monolithic, 0.1µF/50 WVDC	RS# 272-109
___1	C-11	Capacitor, electrolytic, 4.7µF/35 WVDC	RS# 272-1024
___2	C-12,15	Capacitor, electrolytic, 1.0µF/35 WVDC	RS# 272-1434
___2	C-13,14	Capacitor, monolithic, 22pF/50 WVDC	RS# 272-806
___8	D-1 thru 8	Diodes, switch, silicon, 1N914 or 1N4148	RS# 276-1620
___1	R-1	Resistor, 10Ω, 1/4-watt	RS# 271-1365
___1	R-2	Resistor, 100Ω, 1/4-watt	RS# 271-1311
___4	R-4 thru 7	Resistor, 47kΩ, 1/4-watt	RS# 271-1342
___2	RN-1,2	Resistor Network, 10 pin w/bus, 10kΩ	Q9-103-ND
___1	RN-3	Resistor Network, 8 pin w/bus, 10kΩ	Q7-103-ND
___1	RN-4	Resistor Network, 6 pin w/bus, 4.7kΩ	Q5-472-ND
___1	X-1	Crystal, quartz, HC-18, 8MHz	CTX-056-ND
___1	PC	PC/compatible, 512k RAM (min), w/9600-baud COM1 or COM2 port and MSDOS 3.1/up	
___1	MAN	Service Manual for your scanner: call Tandy National Parts (800) 442-2425	

**** These parts are hard to find. Try Future Active at (800) 757-9438 or COMMtronics Engineering***

Table 8-1B: CE-232 parts, materials, and supplies – "nice-to-have," or useful

Qty √	Circuit Symbol	Circuit Description	All parts numbers are DigiKey or Radio Shack unless noted Source and Part #
___1	J-1	DB-9 jack, male, mates w/W-1 below	RS#276-1537 or 276-1538
___2	J-2	DB-25 jacks, female, mate w/W-2 below	RS#276-1548
___1	LED-1	Light Emitting Diode (LED), choice of color	RS# 276-1622
___1	R-3	Resistor, 1kΩ, 1/4-watt	RS# 271-1321
___1	W-1	Serial cable, 9 conductor, straight-thru (not null-modem), w/female DB-9 on one end (see text)	
___1	W-2	Parallel cable, 25-conductor, shielded, DB-25 male-todB-25 male	RS#26-249
___1	XU-1	IC Socket, 16 pin, DIP, Low Profile Best is DigiKey	RS# 276-1998 AE-7216
___4	XU-4,5,6,7	IC Socket, 14 pin, DIP, Low Profile RS# 276-1999, Best is DigiKey	AE-7214
___4'	Misc	Wire, insulated, 22 gauge, stranded, best are wires salvaged from cable –>	RS #278-776
___2	Misc	Mounting studs	RS# 276-195
___4	Misc	Pin-line sockets, see Chapter 3	A-208
___1	Misc	Metal project box	RS# 270-253

More hack than factory!
This PRO-2004 has an (early) CE-232 interface, S-meters (analog and LED) 25,600 channels, Data/Tone Squelch, SCA decoder, and much more.

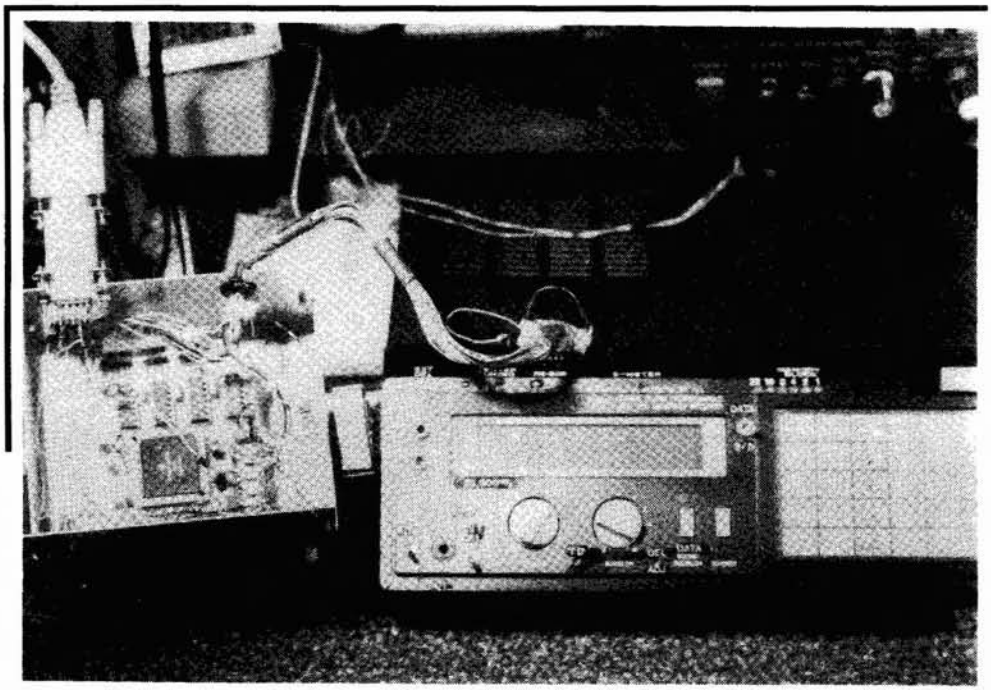


Figure 8-2: CE-232 System Block Diagram

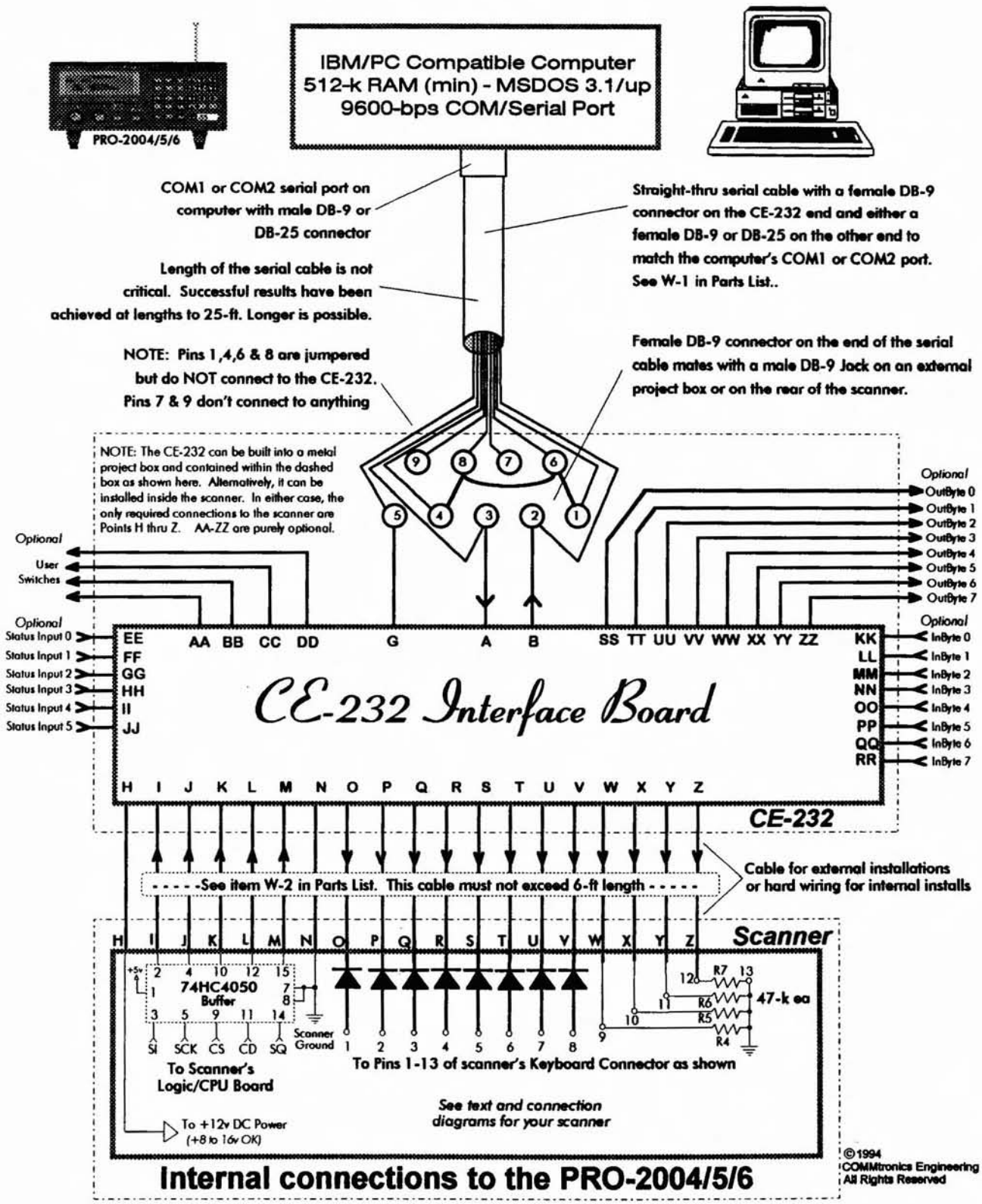


Figure 8-3: CE-232 schematic

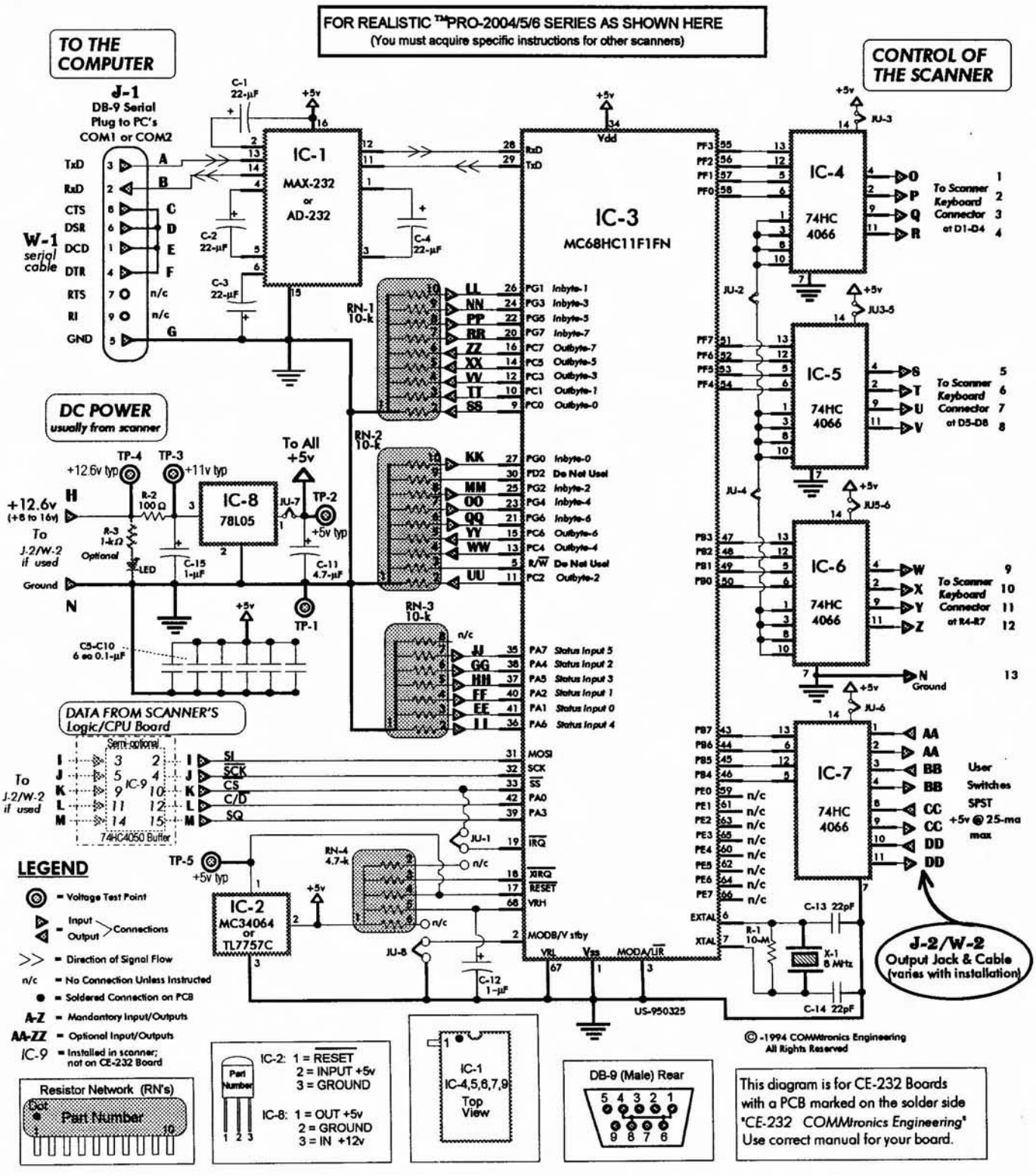
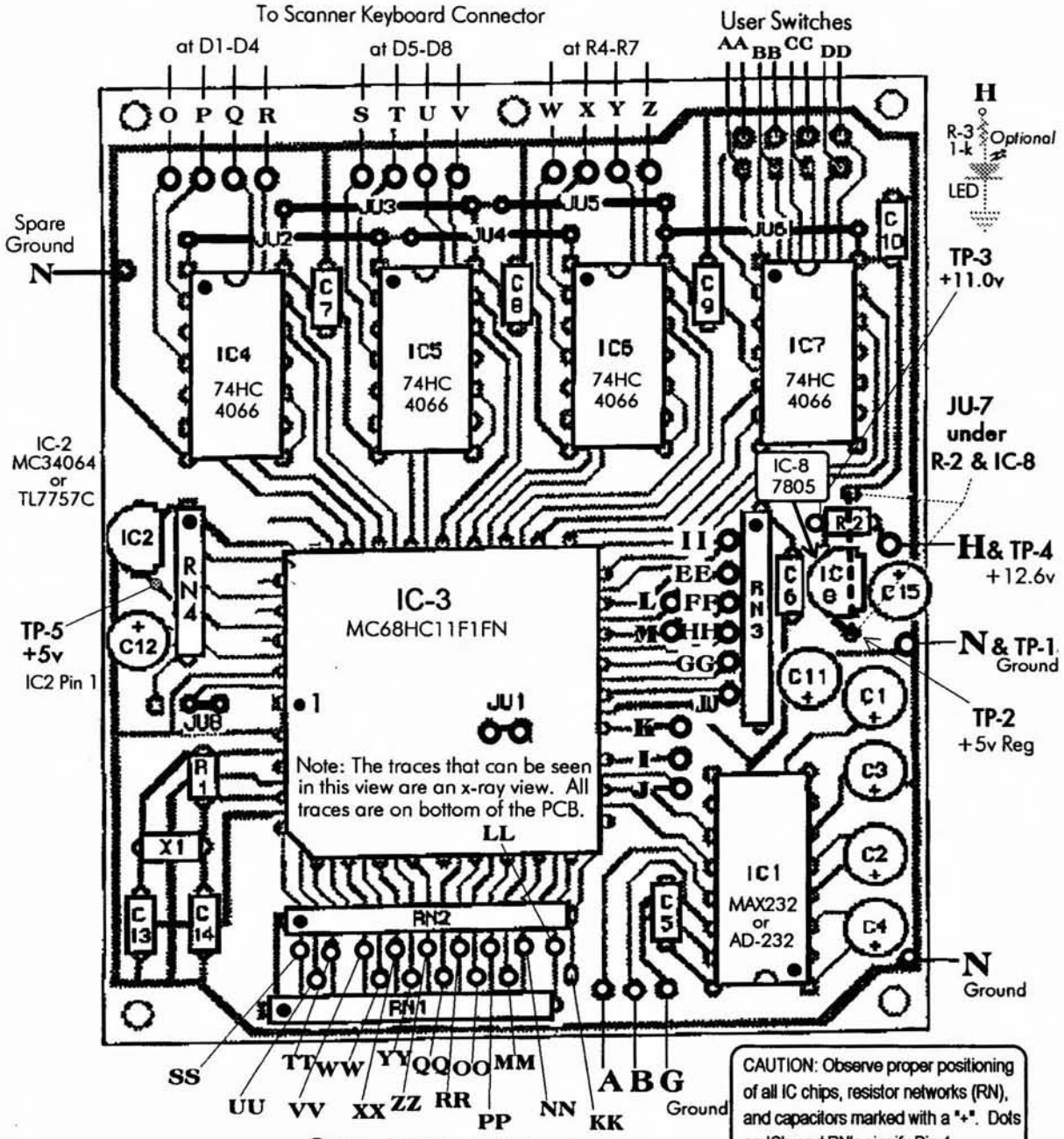


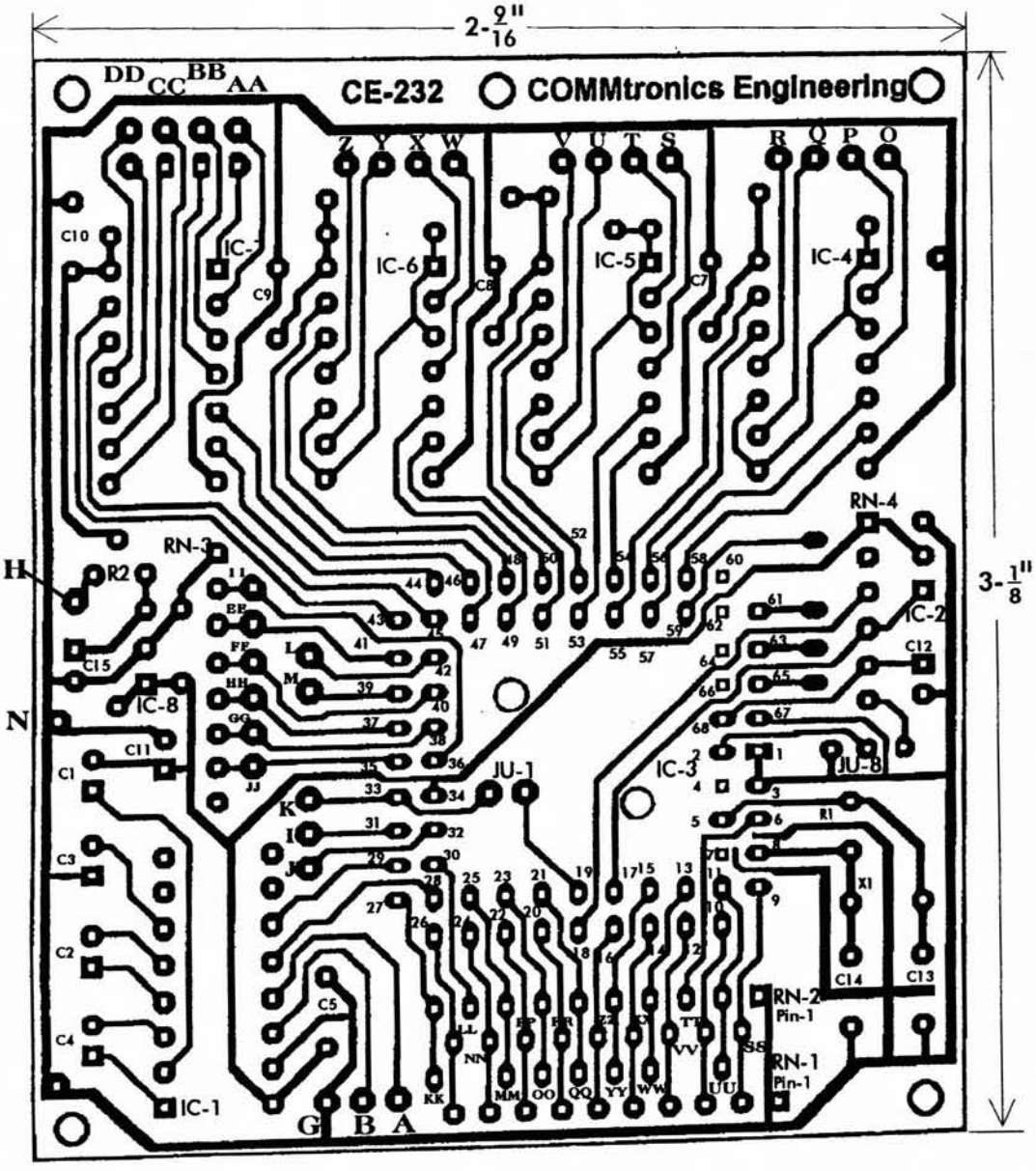
Figure 8-4: CE-232 circuit board – component side



NOTES:

1. Input/Output points are designated by letters A,B,G,H through Z, and AA through ZZ. C thru F are on the DB-9 connector.
2. Input/Output points can be hardwired to their destinations, but use of PinLine Sockets & Plugs is highly recommended.
3. Input/Output points EE thru ZZ are non-essential and can be disregarded during assembly. PinLine Sockets are suggested however.
4. Test Points: TP-1 is ground. TP-2 is regulated +5v. TP-3 is DC input to IC-8. TP4 is +12v In to R2. TP-5 is special +5v to IC-3. Current drain of the CE-232 is calculated by: (((Volts at TP-4) — (Volts at TP-3))÷ R2) = typical: 1.6v/100 = 16 ma (13-18 ma OK)
5. Voltage at TP-5 is critical. If the microprocessor IC3 is ok, expect +5v. If any problems with X-1 or IC-3 circuits, TP-5 will be 0-v.
6. THIS DIAGRAM is for CE-232 boards distributed AFTER 1/1/95. This board is marked on rear: *"CE-232 COMMtronics Engineering"* Previous versions of this board are marked "HB-232" and "9217" on the rear. Use the right manual for your version of the board.

Figure 8-5: CE-232 circuit board – solder-side



NOTES:

1. Square pads are Pin #1 for IC's and RN's and (+) leads of capacitors.
2. IC Pin Spacing in the vertical and horizontal planes is 0.1"
3. Mounting holes and IC-3 access holes are 1/8" dia.
4. CAUTION: This pattern is NOT to scale, but is accurately proportioned. It will be just right if reduced to where IC pin centers are spaced exactly 1/10-inch apart,

FOLLOW INSTRUCTIONS

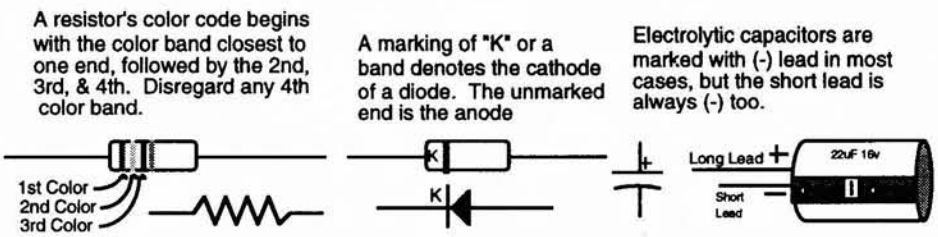
Before we get into the detail of this project, I want to tell you a (true) story. When my daughter, Ali, was a 15-year-old 10th grader, I gave her a draft copy of the Parts Layout with these instructions. With no other special preparation or guidance, she was able to obtain all the correct parts from our component bins and successfully assemble the first production HB-232 board. *It worked the first time out!*

She made no errors, and the only input I gave her was at the end when I insisted on pressing the microprocessor chip into its socket myself (I should have let her do it). The point is that I gave her no real help, and from the few questions that she raised I was able to make these instructions even clearer and to the point.

For a painless assembly of the PCB, you need only follow the diagrams and instructions. The procedure is a proved method and should be clear even to those not highly experienced with this line of work, like my daughter used to be.

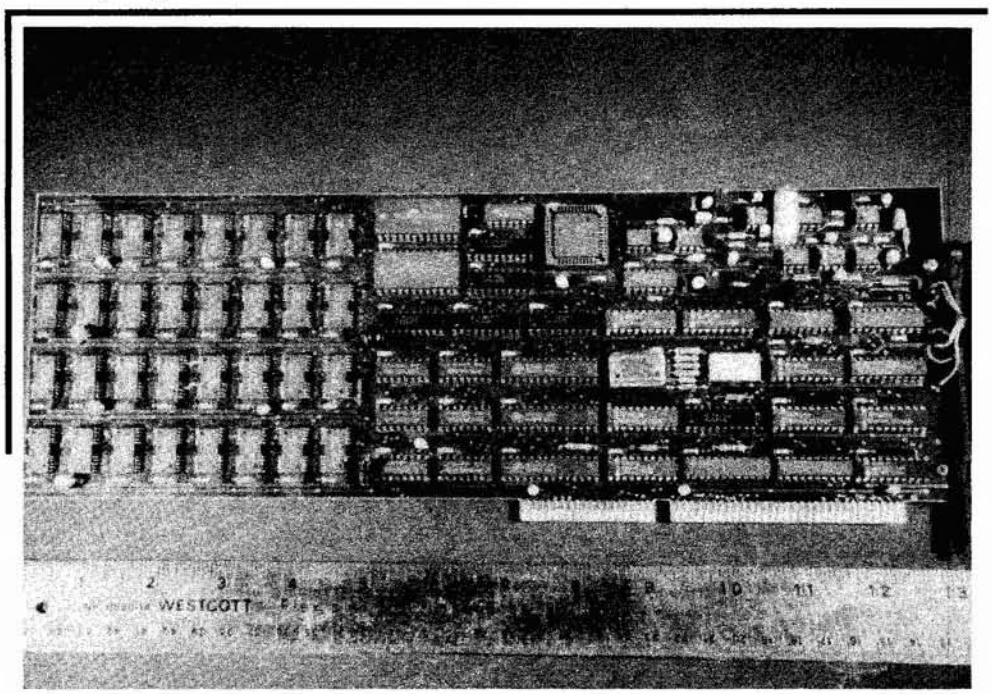
NOTES: A mention of *"No Polarity"* in these assembly instructions means the component can be installed either way. Inspect for solder blobs and bridges after every step. Leave all IC's and the microprocessor chip in their original packing until needed.

Don't forget!



Pushing the limits

Here's the Intercept Technologies Voice Activated Digital Electronic Recorder (VADER) for use with the CE-232 Interface. 16 Mb of audio RAM for 1 hour of continuous recordings, perfectly synchronized with the CE-232 activity log file.



PARTS ID – A REVIEW

The banded end of a diode is the cathode. The unbanded end is the anode. The cathode is schematically represented as the bar while the anode is the triangle.

A 10MΩ resistor is color coded Brown-Black-Blue, a 1kΩ resistor is Brown-Black-Red, a 100Ω resistor is Brown-Black-Brown, and 47KΩ resistors are Yellow-Violet-Orange. Zero through nine goes: black - brown - red - orange - yellow - green - blue - violet - gray - white.

Resistor Networks (RN's) are identified with a dot or a bar at the end where pin 1 resides.

Pin 1 of most IC chips is identified from the top by a dot or hole next to a notch at one end of the chip. Pin numbers increase in a counterclockwise direction around the perimeter of the chip, as viewed from the top.

Capacitors C5-10 and C13-14 are non-polarized and may be installed either way. The eight little *(usually yellow)* capacitors look alike at first glance – it's up to you to keep them apart.

The rest of the capacitors are electrolytics, clearly marked, and must be installed with the proper polarity. The negative (–) lead of these capacitors is marked on the side next to the lead.

PROCEDURE

A. Install and solder the 68-pin Microprocessor Socket, XU-3.

B. Solder all except those few pins that dead-end to no traces or pads. Use a thin-tipped soldering pencil, and position the tip so that entry is from ABOVE the pin, not from the side. This will minimize chances of solder bridges from one point to the next.

   After all pins have been soldered, examine each with a strong light and a magnifier to ensure that each solder joint has "taken" properly and that there are no bridges or blobs between pins.

   Do not skip this Quality Assurance procedure!

C. Install and solder all eight jumper wires on the PC board. Note the short jumper (JU-8) near IC-2.

   JU-1 is on the BOTTOM (solder) side of the PCB. JU-2,3,4,5, and 6 are near the ends of IC4,5,6 and 7. JU-7 is near IC-8 and R-2.

   Use #22 to #30 gauge solid copper wire for jumpers, OR you can use snipped component leads. Make the jumpers neat and clean. Avoid shorts between pads and traces. Snip excess wire from all jumpers.

D. Install IC sockets for IC-1,4,5,6, and 7, observing the proper locations of all pins #1. Insert one socket at a time, and solder the #1 pin of each to its pad.

   Then, pushing down on the socket from above the board, melt the solder at pin 1 so that the socket slips in and seats flush with the top of the board.

E. When all sockets have been seated, solder the remaining pins of each to their respective pads on the bottom of the board. Snip...

   By the way, a strip of 3 pin-line sockets makes a good socket for IC-2 and IC-8. Purists will solder these and all other IC's with exception of IC-7, though. Sockets are best for the novice hacker.

F. Install Resistor Networks, RN-1, 2, 3, and 4. Be sure the #1 pin of each resistor network is properly positioned before inserting into the holes.

   Pin 1 is designated by a dot toward one end of the "chip." *Figure 8-4* shows the proper orientation of each resistor network. Snip...

G. Pin-line strips:

   Install a 6-socket strip in the Input/Output holes for Points EE-JJ next to RN-3.

   Install a 9-socket strip in the Input/Output holes for Points SS, TT, VV, XX, ZZ, RR, PP, NN, and LL next to RN-2.

   Install a 2-socket strip for Points L and M.

   Install a 3-socket strip for J, I, and K.

   Install a 5-socket strip in the Input/Output holes for Points WW, YY, QQ, OO, and MM next to RN-1.

   Install single sockets in the spots for UU and KK next to RN-1.

   Install 4-socket strips in the spots for O-R, S-U, and W-Z.

Install 2-socket pairs for each of AA, BB, CC, and DD.

Install a 3-socket strip for A, B, and G.

Install single sockets for Point H and all Points N.

PIN-LINE NOTES:

1. PIN-LINE sockets are available from DigiKey, (800) 344-4539, Part # A-208. Another source of low-cost pin-line sockets is HOSFELT Electronics, 2700 Sunset Blvd, Steubenville, OH 43952, (800) 524-6464, Part #21-151 (10 pin), #21-128 (16 pin) and #21-161 (20 pin). Hosfelt Electronics may also have other configurations of pin-line sockets.

2. Use of pin-line sockets is optional. You can later hard-wire to all the points if you wish. Pin-line sockets are a touch of class, however, that make future work, such as troubleshooting, a heck of a lot easier.

3. If you are not going to use pin-line sockets, then skip this step altogether. Hard-wiring will come later.

H. Install two capacitors C-13 and 14 (22pF), possibly marked "220" and "A1J" on one side; disregard markings on the other side.

Do not confuse these capacitors with C5-10, which look exactly like them except for the markings. No polarity. Snip...

I. Install six capacitors C5-10 (0.1µF), possibly marked "104" and "C1K" on one side; disregard markings on the other side. No polarity. Snip excess leads.

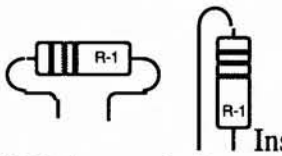
J. Install C-12 (1µF/35V) near pin 6 of RN-4, observing the (+) polarity. The (+) terminal is not marked, but is the LONGER lead of the two. The (–) lead is shorter, identified by a wide stripe with a (–) and a ">" on the stripe.

K. Install C-15 (1µF/35V) near IC-8, observing the (+) polarity. The (+) terminal is not marked, but is the LONGER lead of the two. The (–) lead is shorter and is identified by a wide stripe with a (–) and a ">" on the stripe.

L. Install C-11 (4.7µF/35V) near RN-3, observing the (+) polarity. C-11 looks exactly like C-12 and 15, but is marked differently. Refer to Steps H and I above for the method to distinguish the proper polarity.

M. Install C1, 2, 3, and 4 (22µF/16V), the capacitors near IC-1. Observe (+) polarity using the method in Steps H and I. Snip...

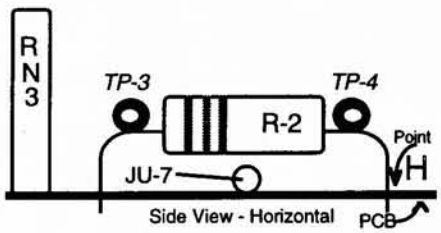
N.



Install R-1 near pin 6 of RN-4, no polarity, standing on end or laid flat with the leads properly bent, as shown in the sketch above. R-1 = 10MΩ (Brown-Black-Blue). Flat is preferred. Snip....

O. Install R-2 near C-15. It MUST go flat and bridge over JU-7. It is okay to raise R-2 above the board a little because each end is a Test Point at which you'll measure voltages. Ease of access to the ends of R-2 is a big consideration here.

One pin-line socket soldered to each end of R2 makes a nice Test Point. Take a look at the drawing below.



P. Install X-1, an 8MHz crystal, no polarity. Partially insert its two leads into the holes provided and then bend X-1 back 90° so that it lies flat on top of C13 and 14.

Pull the leads tight from underneath the board and solder. Snip excess leads.

This method offers minimum vertical clearance but X-1 can also be installed straight into its two holes, flush with the board, otherwise.

The latter method is technically best for the sake of shortest leads, but X-1 is the tallest item on the CE-232 board and could interfere in tight installations.

Q. Install IC-2 near RN-4 (looks like a 3-lead transistor), observing the proper polarity of the 3 leads. (Flat side faces RN-4.) Snip...

Install IC-8 near RN-3 (also looks like a 3-lead transistor), observing the proper polarity of the 3 leads. The rounded side faces RN-3. Snip...

It's decision time now; the moment of reckoning is at hand. You have to decide the course of the rest of your scanner's life: internal or external installation.

I'll help. The next few pages present a standard wiring scheme for *whichever* way you decide. Those pages offer insight to the final steps of the: connection of the CE-232 PC board to the scanner, and either way, the concepts are similar.

Step R waits for you to make up your mind. Just consider these next few pages before jumping.

STANDARDIZED WIRING SCHEMES

The first years of distribution of the CE-232 taught us several lessons, the first of which is that our instructions are good. Most hackers are successful the first time out.

But there have been a few problems that stand out in our notes, and they will be shared with you. These errors occur in the wiring and point-to-point connections.

The first four editions of the Interface and *Manual* left the wiring up to the hacker, and for most that was sufficient but a few had trouble.

This procedure will standardize point-to-point wiring to reduce errors during installation. Regarding the CE-232 Wiring Plan, *Tables 8-2* and *8-3*, you may disregard if you see fit.

If you stick to it and run into trouble, I will be better prepared to assist with remedial measures; call it "both playing to the same sheet of music."

Whether you choose to install your CE-232 inside the scanner or in a metal project box, at leaast 19 wires are to be connected between the scanner and the CE-232 printed circuit board.

That's a lot of wires to keep track of, and to trace down later if/when something doesn't work. Actually, there's not much to say about internal installations except that the color codes I recommend will help keep things consistent – *if* you will adhere to them. If you won't, then wire up one point at a time and one wire at a time, making sure that each wire originates and terminates at the right places. Also, tag each wire (in lieu of color code) so you can troubleshoot if necessary.

When questions are thrown at me, I am much friendlier when I find your compliance with standardized wiring procedure.

USE STANDARD PARTS

External installations can make it tough to track things, which is where our CE-232 Wiring Plan shines. It's standardized.

The first step is to use female DB-25 connectors, one mounted on the rear panel of the scanner and the other on the rear panel of the CE-232 box. This allows interconnection with a cheap and commonly available shielded parallel cable, with male DB-25 connectors on each end, cost of which is about $10 anywhere. Do NOT under any circumstances, use "ribbon cable" for remote installations, and preferably not for internal installations, either.

PROCEDURE

Now that the cable question is out of the way, the rest is a lot easier. Before you physically mount the female DB-25 connectors on the scanner and metal project box, you'll be wise to lay the two loose female connectors side by side and prewire each one so they're exactly alike in color codes.

Each wire bundle can be cut and trimmed to the approximate correct length after mounting the connectors. Then, when you install the DB-25's, mount them so the SPARE unused pins face up and are accessible for future use.

After the DB-25's are installed, then and only then, route and solder the wires to their respective termination points.

ALTERNATIVE ONE

If the idea of installing DB-25 connectors doesn't appeal to you, there is another way to keep things smart and still simple. Buy two shielded 25-conductor parallel cables, one with male DB-25

on each end and the other with female DB-25's on each end. After that, it's almost intuitive.

Lay aside the one with the male DB-25; it will be your interconnecting cable later. Now cut the female cable a certain distance from each end to have enough length to use as "pigtails."

That is, you'll drill a $^3/_8$" hole in the back of the scanner and another in the back of the CE-232 project box.

Now slip a cut female cable into one of the holes, cut off excess cable, strip enough of the insulation for the individual wires to flare out and go to their respective termination points.

Make a note of color codes: one color for each CE-232 Wire or Point, and use the same color code at each end to keep things straight.

I'll show you , and you can choose.

Look at *Table 8-2.*

Figure 8-6: Wiring the computer to the scanner

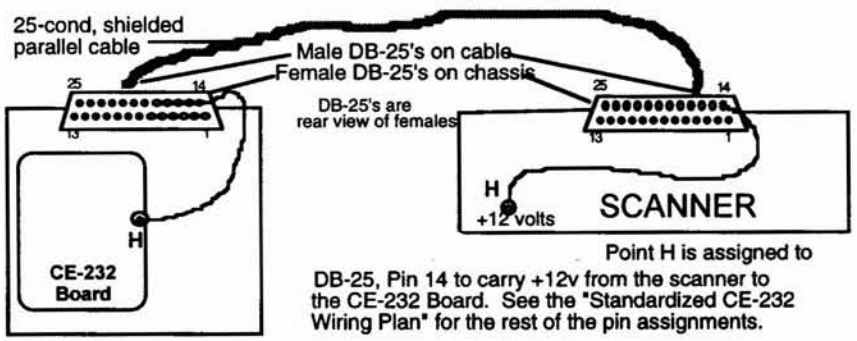


Table 8-2: The* Standardized *CE-232 Wiring Plan

Wiring from CE-232 Box or PC Board to Terminations in Scanner

CE-232 DB-25 Pin No	CE-232 Wire/Point I.D.	Wire Color Codes for Inside CE-232 Box/Scanner	Termination Points Inside the Scanner, or Notes & Function (PRO-2005/6 | PRO-2004 - Pin No)
1	Z	White	Row-4 CN-501 | CN-502 — Pin 12
2	Y	Black/White	Row 3 CN-501 | CN-502 — Pin 11
3	X	Brown/White	Row 2 CN-501 | CN-502 — Pin 10
4	W	Gray/White	Row 1 CN-501 | CN-502 — Pin 9
5	V	Green/White	Column 1 CN-501 | CN-502 — Pin 8
6	U	Blue/White	Column 2 CN-501 | CN-502 — Pin 7
7	T	Violet/White	Column 3 CN-501 | CN-502 — Pin 6
8	S	Tan/Orange	Column 4 CN-501 | CN-502 — Pin 5
9	R	Yellow/Orange	Column 5 CN-501 | CN-502 — Pin 4
10	Q	Orange/White	Column 6 CN-501 | CN-502 — Pin 3
11	P	Pink/White	Column 7 CN-501 | CN-502 — Pin 2
12	K	Tan	CS - Chip Select — *CPU*
13	O	Red/White	Column 8 CN-501 | CN-502 — Pin 1
14	H	Red	+12 to +14 volts, DC
15	_____	_____	*spare*
16	_____	_____	*spare*
17	I	Gray	SI - Serial Data — *CPU*
18	_____	_____	*spare*
19	M	Blue	SQ - Squelch — *CPU*
20	_____	_____	*spare*
21	*DD (1)*	*Yellow (Demo of a User Switch)*	*User Switch 4: Beep Vol: DD(2) ground*
22	*JJ*	*Green (Demo of a Status Input)*	*Status Input 6: Squelch Break Indicator*
23	L	Violet	C/D - Command Data — *CPU*
24	J	Brown	SCK - Serial Clock — *CPU*
25	N	Black/Yellow	GND - Ground CN-501 | CN-502 — Pin 13

Wiring Between the CE-232 DB-9 Input Jack and the CE-232 PC Board

DB-9 Pin #	CE-232 Wire/Point ID	Wiring Color Codes	Notes/Function
1 •	E	Bare Jumper	***No Connect to CE-232***
2>	B	>GREEN	>RxD - Receive Data
3>	A	>PINK	>TxD - Transmit Data
4 •	F	Bare Jumper	***No Connect to CE-232***
5>	G	>Black/Orange	>PC Ground to CE-232
6 •	D	Bare Jumper	***No Connect to CE-232***
7	none	***No Connection***	***No Connect to CE-232***
8 •	C	Bare Jumper	***No Connect to CE-232***
9	none	***No Connection***	***No Connect to CE-232***

NOTES: The unused User Switches (AA, BB, CC) can be wired to any of the above SPARE pins on the DB-25 connector, if and when you need them.

The 8 OUTBYTE, 8 INBYTE and five of the six INPUT STATUS registers are not wired to anything. These functions are up to you to implement and use as desired. See Manual.

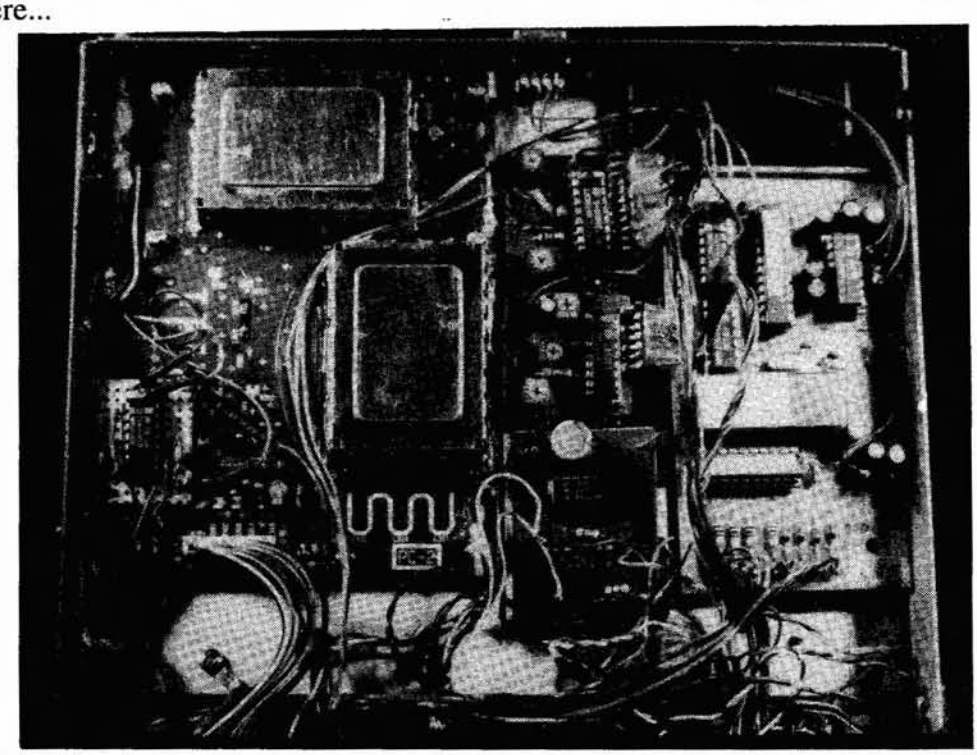
Status Input (JJ) goes to IC-2, Pin 13 in the scanner through a 4.7-kΩ limiter/safety resistor.

User Switch (DD) shown here is used to turn the BEEP on and off. It wires straight thru to the BEEP line: (PRO-2005/6 is CN-3, Pin 8) (PRO-2004 is CN-504, Pin 7). Use CTRL+F4 for On/Off.

- Pins 1,4,6,8 are jumpered, but go nowhere.

Interesting views of cobbled-up scanners. Can you tell which are prototypes (my fault) and which were sent to me for "help?"

A massive assault on a PRO-2006. The bottom are of the 2004/5/7 and the 2035 can be stuffed! Shown here, left to right, are: Remote Control, Extended Delay, LED Center Tune and S-Meter, and a computer interface! Note the DB-9 connector where the AC cord once entered the chassis. And there's still room for more down there...



A PRO-2004 with 6,400-channel Extended Memory and Keyboard Memory Block Controller. Old-style SRAM, but still works!

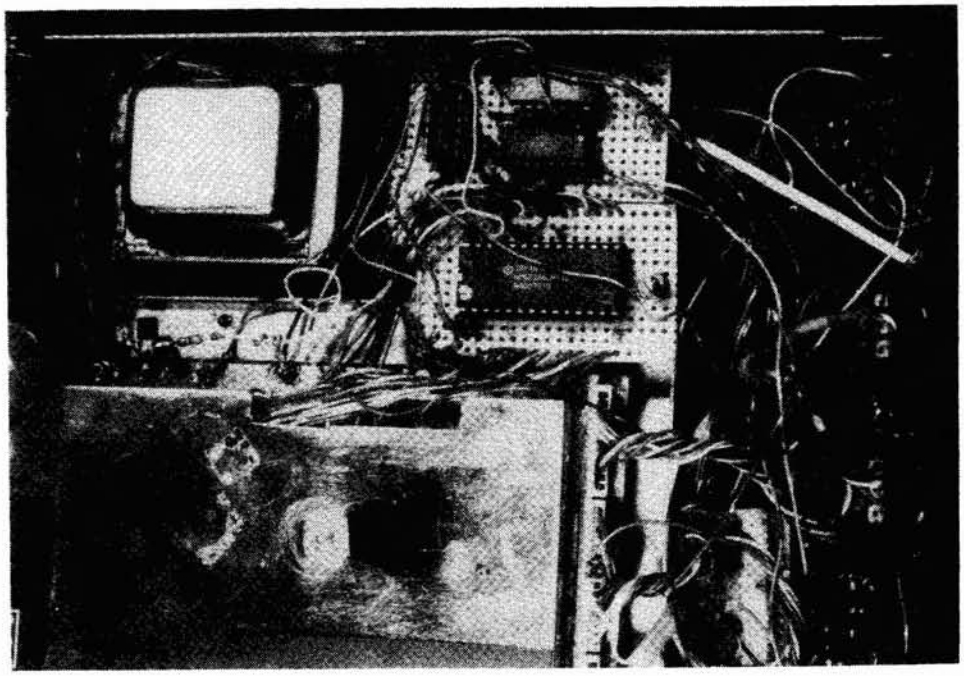


Figure 8-7: Connectors and cables

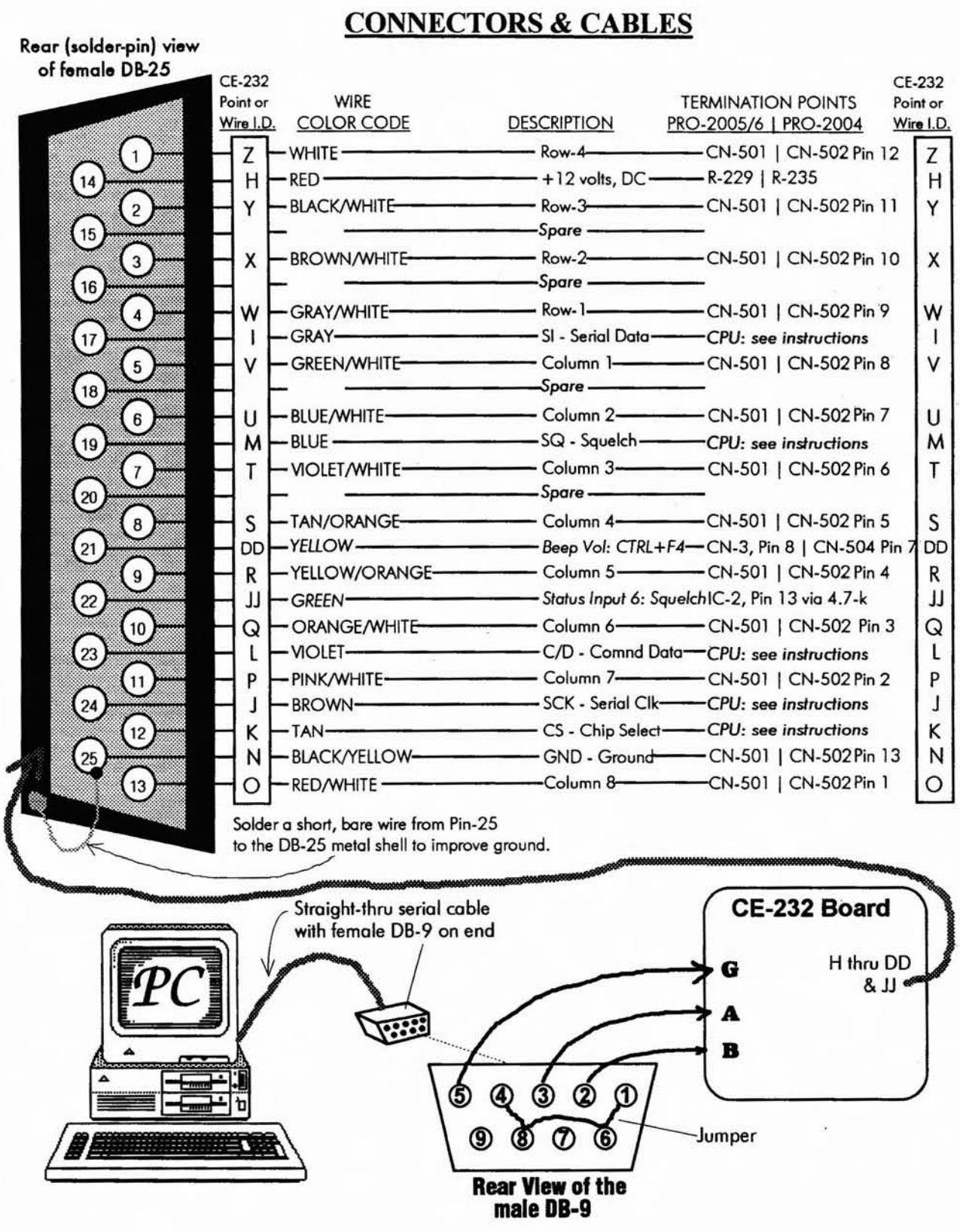
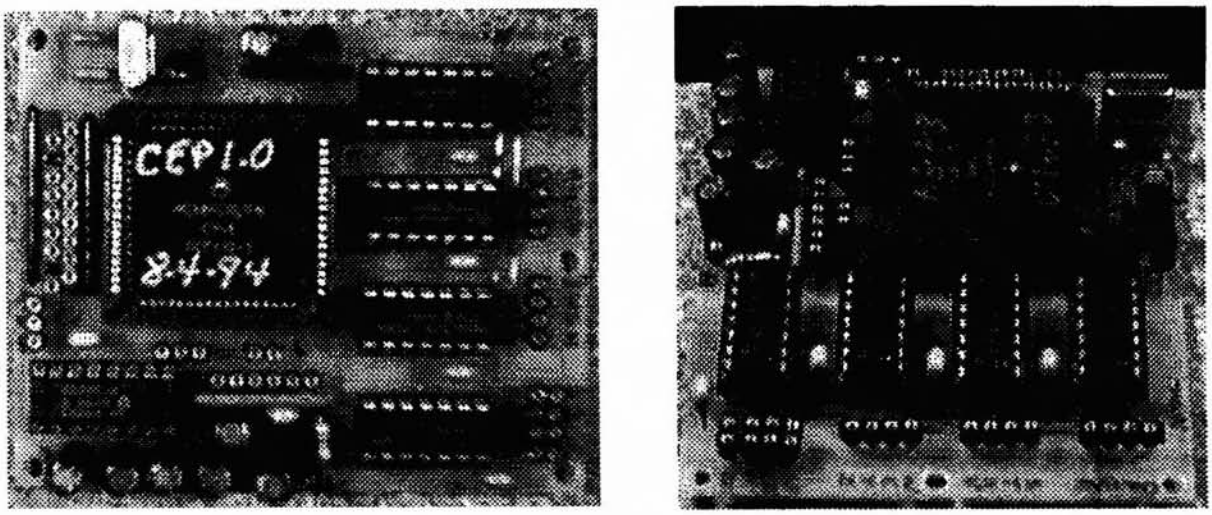


Figure 8-8: CE-232 board, assembled – two views



Examine these illustrations, which show component location and orientation. Note the liberal use of pin-line connections to increase flexibility and permit quick disconnect, etc.

STANDARD CE-232 WIRING PLAN

The final steps of this section help you connect a wiring harness to the CE-232 board. How that's done depends on your choice of installation, internal or external. No matter which way, the preferred starting point is to install a pin-line socket strip at each group of Input/Output Points on the CE-232 board so that the female sockets are exposed.

This facilitates making your own connectors for the CE-232 board using identical pin-line sockets as on the board, with the male plugs exposed and wires soldered to the female sockets. They mate perfectly and allow for quick connects and disconnects. See *Figure 8-7.*

YOUR CHOICE

If you don't understand this concept, or don't want to bother with it, then go ahead and solder wires to each In/Out point. Refer to the wiring guides and diagrams.

The wire length should be kept to a minimum for your choice of installation. For instance, if the CE-232 is installed inside the scanner, the wire bundle from the board to the destination points should be kept short consistent with neatness and ease of routing.

For external installations, the wiring will consist of two phases:

(1) wiring the I/O points on the CE-232 to a DB-25 connector installed on the metal box, and

(2) wiring a DB-25 connector on the back of the scanner to its termination points in the scanner.

In either case, choice of wire is critical. Do not use the stiff, single or multi-strand hookup wire from Radio Shack. Ribbon cable is not recommended. The best choice is to pull the color-coded wires from Radio Shack's "25-conductor LAN cable," #278-776, if you can find some.

WIRING, CONTINUED

Review the wiring layout shown in *Figures 8-4 and 8-6,* and study *Table 8-2* before performing Steps R – Y. The guide provides some alternative ideas, and you must make a commitment one way or the other.

No matter which installation you choose, Steps R–Y are a guide only.

R. Solder wires A, B, and G to their respective termination points or pin-line plugs.

S. Solder wires J, I, and K to their respective termination points or pin-line plugs.

T. Solder wires M and L to their respective termination points or pin-line plugs.

U. Solder wires H and N to their respective termination points or pin-line plugs.

V. Solder wires O, P, Q, and R to their respective termination points or pin-line plugs.

W. Solder wires S, T, U, and V to their respective termination points or pin-line plugs.

X. Solder wires W, X, Y, and Z to their respective termination points or pin-line plugs.

Y. Solder wires AA, BB, CC, and DD to their respective termination points or pin-line plugs.

Z. Solder wire JJ to its respective termination points or pin-line plug.

AA. Install all IC's in their sockets now – IC1 and ICs 4-7 first.

BB. The pins of these IC's are probably spread a little too far apart to fit your sockets. Grasp the ends of each chip's body between your thumbs and forefingers with the pins away from you and lay the chip against a flat, hard surface.

Pushing downward, force the chip body toward the bottom row of pins lying on the flat surface. This will cause the row of pins to flatten a little.

Flip the chip over and repeat the procedure to the other row of pins. Then compare the pin alignment with the pins of its socket. If they match, press the chip into the socket, ensuring proper orientation of pin #1. Repeat this procedure for all five IC's: 1, 4, 5, 6, and 7.

CC. CAREFULLY unwrap the foil packaging from the Microprocessor Chip, IC-3. Avoid touching its pins on the perimeter (sides) of the chip. Hold it between thumb and forefinger on its top and bottom, not the sides.

Facing the TOP side of the chip, look for one of the four corners that has a tiny flat corner instead of a sharp one. This flattened corner must mate with the corresponding flattened corner of the leadless chip carrier socket on the CE-232 board. The flattened corner of the chip will be next to the crystal, X-1.

DD. Carefully lay the microprocessor chip into the open area of the chip socket, but don't force it in, just lay it there so that it rests with the flattened corners aligned. Jiggle the chip a little with something like a small screwdriver so that it settles into the chip carrier socket slightly. It won't actually go all the way in because of back pressure from the pins of both the socket and the chip. Just make it lie in the opening as flat as possible, with all pins aligned.

EE. Now grasp the CE-232 board with the four fingers of each hand on the bottom of the board and your two thumbs resting on the top of the microprocessor chip.

Begin exerting an even pressure on the top of the chip to force it down into the chip carrier socket.

Be gentle at first, ensuring that the chip remains relatively flat. Increase pressure gradually, watching the chip as it is pressed into the socket.

If one edge of the chip suddenly drops in a little more than its opposite side, then exert more pressure on the opposite side to even things up again. Avoid a "bending" pressure on the chip.

FF. In this manner, with careful application of force, the chip will "pop" down into the chip carrier socket. Continue applying increasing pressure until the microprocessor seats solidly into the carrier and can go no farther.

Examine the chip carefully with respect to the carrier.

When properly seated, the top surface of the µP chip will be about 0.5 to 1 mm *below* the top edge of the carrier socket.

GG. Use a good light and magnifier to inspect all pins of the MPU to ensure that none got crumpled or torqued out of alignment.

There are two 1/8" holes on the standard PCB boards, for the purpose of pushing out the MPU chip from the bottom, if ever necessary.

Radio Shack now sells the proper extraction tool: #276-2101, which is a better way to remove the MPU.

This concludes the basic fabrication and assembly of the CE-232 Printed Circuit Board.

At this time, inspect ALL your work, and especially the solder-side of the board, with a strong light and a good magnifier.

Inspect for solder blobs, bridges, and unsanitary-looking solder joints. Correct all problems and investigate all suspicious looking oddities. When you are sure your work is perfect, go have a cup of coffee.

When you come back, check it thoroughly yet one more time, and only then proceed to the following instructions.

INSTALLATION INSTRUCTIONS

Study all the wiring diagrams and illustrations to develop a good understanding of the big picture.

Select a COM (serial) port (COM1 or COM2) on your PC to drive the CE-232. Acquire a standard, straight-thru serial cable with the appropriate connector on one end that mates with your PC's COM port. The other end should have a female DB-9 to mate with the male DB-9 input connector on the CE-232.

Determine whether your CE-232 Installation will be internal or external. We suggest external for a variety of good reasons including ease of maintenance and installation, and the fact that an *external* CE-232 can be used to drive other scanners, too, provided they are appropriately wired. One at a time, of course.

If you choose an internal installation that's fine, but you can be on your own here since the job is mostly mechanical (see Chapter 4). Just follow the wiring diagrams and pictorials and read the remainder of this section, which is geared for external installations, but which will also be applicable in terms of wiring between the CE-232 and scanner.

POWER SUPPLY REVISITED

This is my last chance to convince you to take an important step. It will open space for future modifications, improve scanner reliability, and more. Please do it!

Regardless of how you install the CE-232: *REMOVE THE POWER TRANSFORMER,* T-801, and power your scanner with a source of external DC to the coaxial power plug on the rear of the scanner.

External power will let the scanner run much cooler and thereby preserve its life. If you remove T-801, you'll have plenty of room in which to mount the CE-232. The suggested external power source should be rated at 12V @ 500mA at a minimum with 12V @ 1A preferred. The following Radio Shack power supplies and AC/DC adapters will work just fine with the PRO-2004/5/6: #22-120, #22-127, and 273-1653. WARNING: Radio Shack's #273-1652 has been found to be inadequate, despite its specs.

You could use the A/C power cord and a removed T-801 in the design of your own external power supply. T-801 heats up the rest of the scanner, and that's not good. Do something about it.

PRO-2004 ONLY (Internal)

The CE-232 board can fit in the PRO-2004 quite handily, on the back of the keyboard panel. Velcro strips will hold it there just fine. Another possibility is in the area just forward of the power transformer, on either the top or the bottom of the scanner.

If you insist on retaining an internal supply, it may be useful to move the power transformer, up or down and/or to the REAR slightly, to make more room.

T-801 is mounted to the chassis side wall with two locking nuts and bolts, so drilling two more holes is all that's needed to move it a little.

Again, I suggest you remove T-801 entirely and power the scanner from an external DC supply.

PRO-2005 and PRO-2006 ONLY (Internal)

Space is very limited in these rigs and you need a lot of it for other modifications and gizmos, so I strongly urge an external installation of the CE-232. If you insist on keeping it internal, there are two possibilities.

One is to move T-801 a bit up or down and to the rear to make space for the CE-232 on the side opposite the direction in which you move T-801. T-801 is mounted to the chassis side wall with two locking nuts and bolts, so drilling two more holes is all that's needed to move it somewhat.

Again, we suggest you remove T-801 entirely, and power the scanner with external DC.

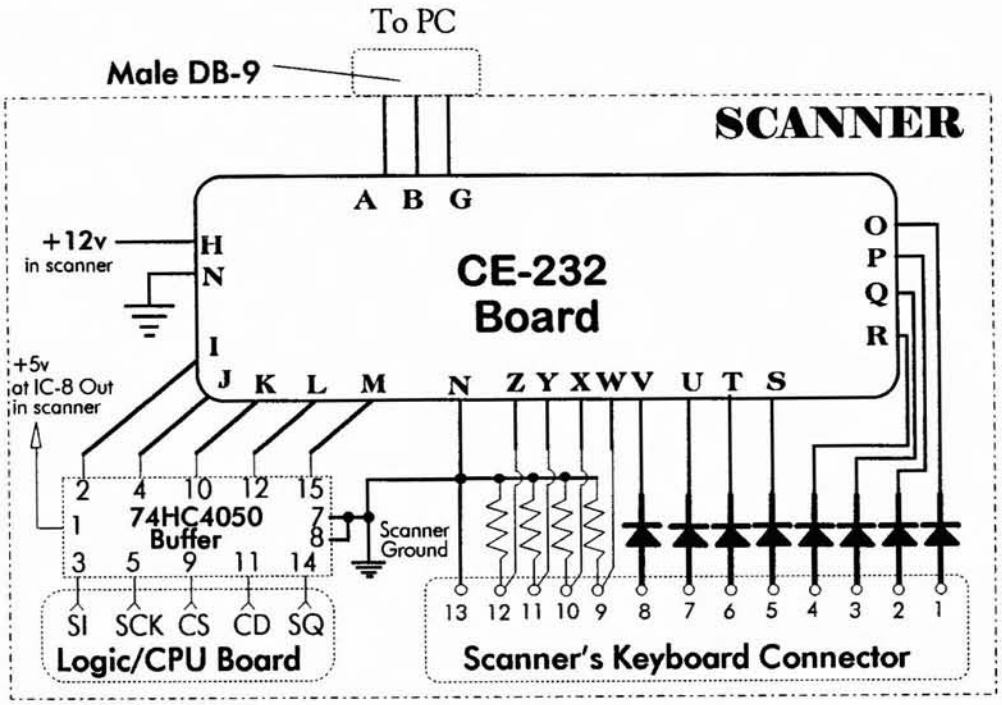
Another possibility is on top of the two small shielded compartments just behind the keyboard on the top right side of the scanner. That's where I install 'em.

A very thin layer of insulation should be placed on the top of these two compartments and/or on the bottom of the CE-232 board. Clear acetate will do, or any thin plastic. *Beware:* snipped solder joints on the bottom of the CE-232 board are very sharp and can penetrate plastic.

I have done many of these, however, and a layer of acetate with Velcro between the CE-232 and the plastic will do nicely. You might also scope the bottom area of the scanner over that large cutout in the metal chassis. As I said, possibilities are limited.

You decide, but keep in mind the likely future need for maintenance, modifications, and general access.

Figure 8-9: CE-232 internal installation guide



See text and connection diagrams for your scanner

INTERNAL INSTALLATIONS

1. Build CE-232 Board
2. Install a male DB-9 on rear of scanner
3. Make a wiring harness for CE-232 Board: A, B, G, H-Z, DD, JJ
4. Install CE-232 Board somewhere in scanner
5. Fabricate and mount the 74HC4050 Buffer circuit
6. Fabricate and mount the diode/resistor group to keyboard connector
7. Connect 5 wires to Points I-M on scanner's Logic/CPU Board
7. Connect Wires I-M from scanner's Logic/CPU Board to Buffer as shown
8. Connect CE-232 Wires O-Z to diode/resistor group as shown
9. Connect CE-232 Wires I-M to Buffer as shown
10. Finish wiring: Buffer +5v, CE-232 +12v, grounds, etc.

CONNECTIONS

If you choose an *internal* installation, a male DB-9 connector should be mounted on the rear of the scanner and wired as previously shown to points A, B, and G on the CE-232. Examine *Figure 8-9.*

The rest of the points on the CE-232 will be terminated within the scanner at places discussed just ahead and in the specific sections for your scanner.

The remainder of the installation involves point to point wiring for the most part. Most of the rest of this discussion will be focused on external installations, but the basic principles – and the actual connections (what point connects to what) – will apply to internals as well.

Fabricate a short multi-conductor wire bundle for the CE-232's Input-Output points. *(You might have done this in Steps P-Y)* A minimum of nineteen (19) wires are needed here.

Cut the cable to desired length for whichever installation you choose: if external, then long enough to go from the CE-232 board to the DB-25 connector; if internal, then long enough to go from the CE-232 board to the termination points in the scanner.

EXTERNAL INSTALLATION

Install the CE-232 in a suitable Project Box –metal (for shielding) is strongly suggested. The CE-232 board can be mounted on two or four metal standoffs in the box.

Install the CE-232's DB-9 connector on the back panel of the Project Box. Install the CE-232's DB-25 connector on the back panel of the Project Box.

Refer to the CE-232 Scanner/Computer Interface Schematic Diagram *(Figure 8-3),* the Component Location Diagram *(Figure 8-4),* and the Wiring Plan from CE-232 board to Scanner *(Figure 8-10)* as guides to the designated wiring points on the CE-232 board.

Use a VOM/DVM (or wire color codes) to keep track of which wire is used at any given point.

Make a record of pin numbers and color codes. Solder or bolt the ground wires N and G on the CE-232 board to the box's chassis.

Install a prewired female DB25 connector on the back panel of the scanner.

PRO-2004 – PRO-2005 – PRO-2006 DIFFERENCES

While the PRO-2004/5/6 are all pretty much the same scanner (electronically), there are mechanical differences among them, notably their logic-display boards.

The PRO-2004's logic-CPU board is all by itself on the bottom of the main chassis, well away from the separate display board tucked inside the front panel. The PRO-2005 and PRO-2006 are alike with a single logic-CPU-display board mounted inside the front panel.

The PRO-2005/6's logic-display board is installed vertically in the front panel, and that can be very intimidating to those who don't know how to get it out. It's not *that* difficult, and I'll guide you through it.

Meanwhile, since the PRO-2004 differs from the PRO-2005/6, they will be discussed separately. Watch for the header titles that apply to your scanner.

PRO-2004, PRO-2005, and PRO-2006

These specific wiring instructions are for the PRO-2005/6, followed by those for the PRO-2004. The instructions for each calls for some splicing, or soldering wires to other wires. This is largely for simplicity of verbiage, and you can (and should) devise your own scheme with pin-line connectors wherever that helps connecting one wire to another.

If you must solder the wires directly use good splicing techniques, including a bit of heat shrink tubing inserted over one of the wires before it is soldered to the other one. The heat shrink tubing is pulled over the solder joint and heated briefly with a heat gun or butane lighter until it shrinks down tightly to insulate the connection. DON'T USE TAPE!

I recommend the mini-connector technique, and one way this can be done is by use of break-apart pin-line sockets. You'll need two strips of 25 to make one 25-pin male/female combination.

You may have better ideas, depending on what's available in your area. Just don't use large jack/plug combinations because space is cramped and you need room not only for the CE-232 but also for other modifications in the future.

Therefore, use proper splicing techniques if other ideas fail you and if you don't like my pin-line socket idea. Splicing is a good technique for all-round use, with the singular liability that quick-disconnects/re-connects are not possible.

PRO-2005 and PRO-2006 ONLY

FRONT PANEL DISASSEMBLY

NOTE: Cable connectors and ground straps should be disconnected from the main circuit board and chassis, ***not*** from the logic/CPU board.

1. Disconnect the PRO-2005/6 from main power. Remove the internal Memory Retention Battery. Remove the top and bottom cases from the chassis.
2. Disconnect all wires and cable bundles that go from the front panel assembly to the main circuit board. There are six (6) cable bundles and connectors to be disconnected from the top side of the scanner, and one cable bundle and connector on the bottom side of the scanner.

   Disconnect the two ground straps that go from the logic/CPU board to the bottom side of the scanner chassis.
3. Remove 4 (2 on each side) countersunk machine screws from the sides of the front panel that secure it to the main chassis. Gently, pull the front panel assembly away from the chassis until it's free.
4. Desolder the bare ground wire from the chrome metal shield that goes to the area by the VOL control and push this wire out of the way towards the VOL and SQUELCH controls.
5. Remove the six small screws that secure the logic/CPU/display board to the front panel.
6. Face the inside of the front panel as it is placed in an upright position, and locate the white, 13-pin connector (CN-501) at the upper left corner of the printed circuit board.

   This connector doesn't have any wires and doesn't look like a connector at first, but that's what it is. Insert a small flat blade screwdriver under the edge of that connector and gently pry upward.

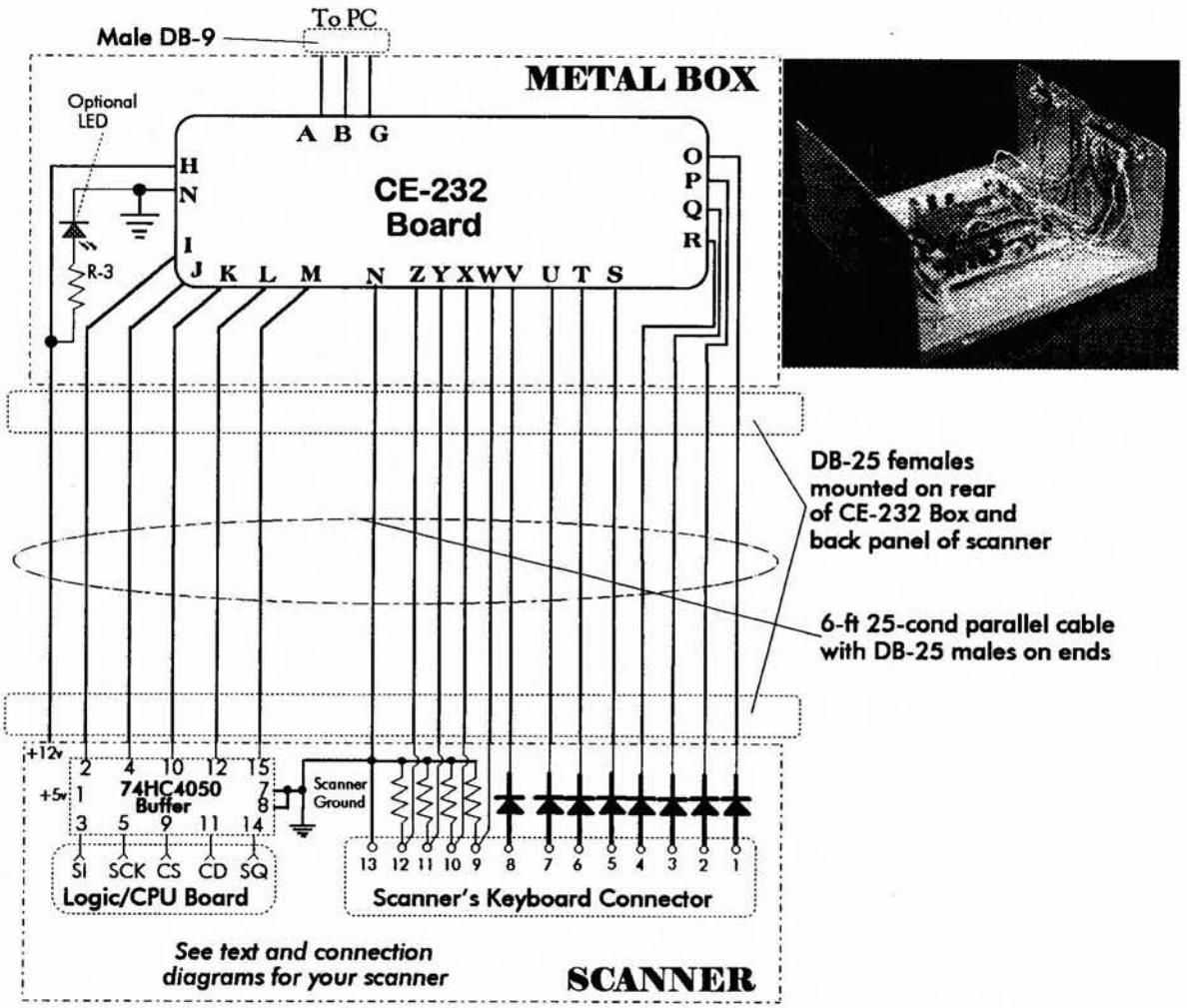
   The entire logic/CPU/display board should then slip up, away from the plastic front panel and come loose in your hands. Handle it by its edges and be very careful, but don't let paranoia make a critical error.

CN-501 is a female connector for 13 long pins (CN-601) that protrude up from the keyboard panel underneath, where you can't see it easily.

Friction grips the CN-601 male pins tightly in CN-501, but the logic/display board separates easily enough from these pins.

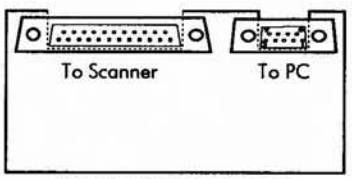
Use caution and protect those connectors!

Figure 8-10: CE-232 external installation

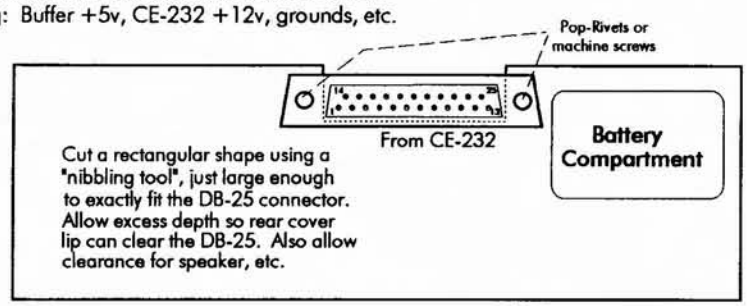


EXTERNAL INSTALLATIONS

1. Build CE-232 Board
2. Install prewired male DB9 and female DB-25 on metal box
3. Connect DB-25 wiring harness to CE-232 Board: A, B, G, H-Z, DD, JJ
4. Mount CE-232 Board in metal box
5. Install prewired female DB-25 on rear of scanner
6. Fabricate and mount the 74HC4050 Buffer circuit in scanner
7. Fabricate and mount the diode/resistor group to keyboard connector
8. Connect 5 wires to Points I-M on scanner's Logic/CPU Board
9. Connect Wires I-M from scanner's Logic/CPU Board to Buffer as shown
10. Connect prewired DB-25 Wires O-Z to diode/resistor group as shown
11. Connect prewired DB-25 Wires I-M to Buffer as shown
12. Finish wiring: Buffer +5v, CE-232 +12v, grounds, etc.

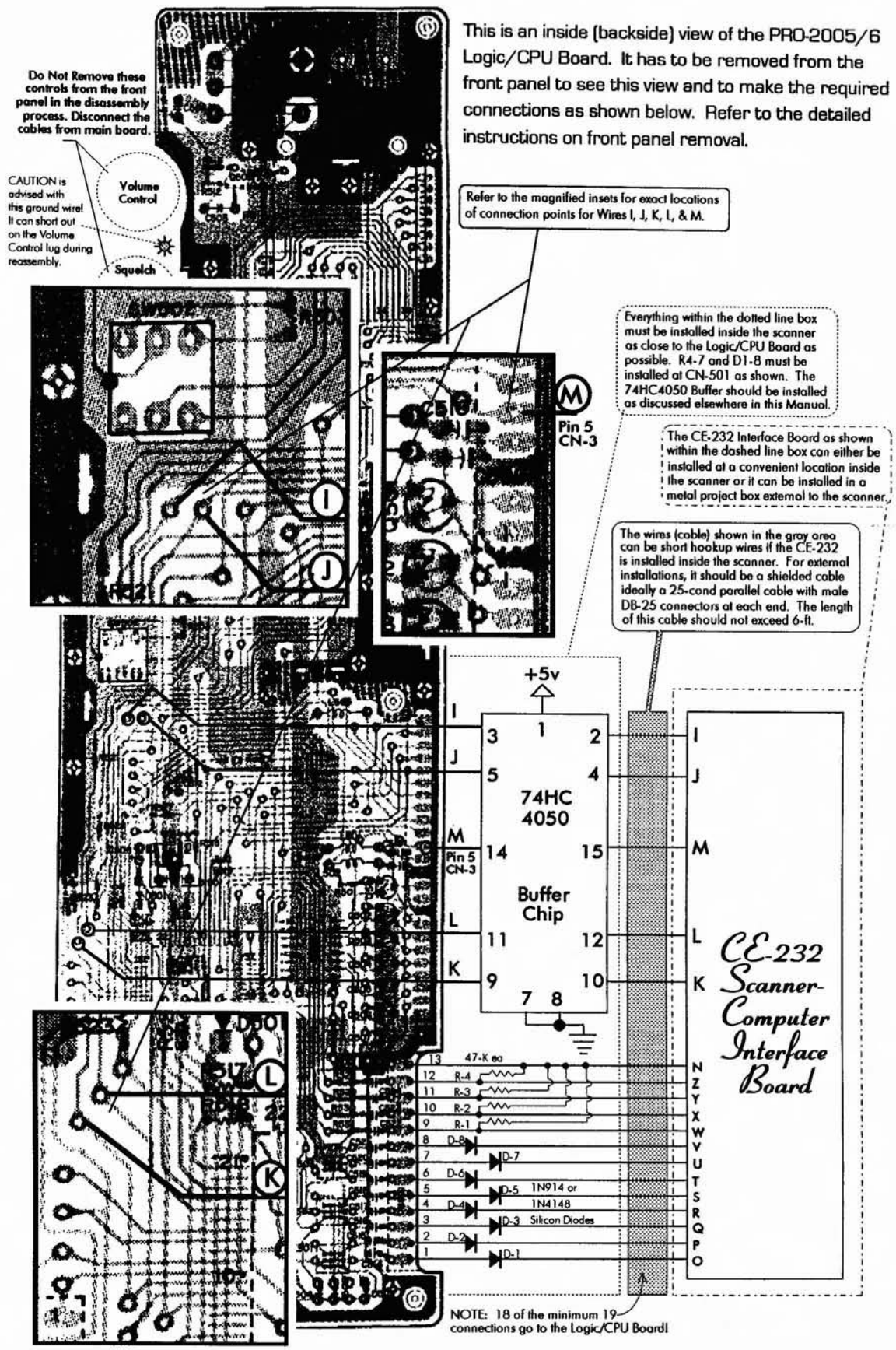


REAR PANEL OF CE-232



REAR PANEL OF PRO-2004/5/6 SCANNER

Figure 8-11: Details of connection points on PRO-2005/6 logic board



HOOKUP TO THE CE-232

7. Refer to the pictorial for the PRO-2005/6 logic-display PCB, *Figure 8-11,* and solder 5 short (6") color-coded wires to the back side of the logic-display board to points I, J, K, L, and M, as shown in the pictorial. Make written notes of which wire goes to what point. You don't want to forget what went where, so a drawing should go into your notebook.

8. Flip the logic-display board over so that the side with the chrome metal shield is exposed. Solder the anodes (unbanded ends) of 8 silicon switching diodes (1N914/1N4148) to the solder pads for pins 1 through 8 of CN-501. Solder a short wire (2") to pins 9, 10, 11, and 12 of CN-501. Dress up the 8 diodes and these 4 wires so they point up and out from the board and clip the ends so that all 8 diodes and 4 wires are of equal length. About 1/4" of cathode lead on the diodes will be about right.

   NOTE: You can solder in a 13-pin strip pin-line socket to the 13 holes just beneath CN-501, so the female side is exposed.

   Then prepare a mating 13-pin male strip to plug into that permanently soldered female strip. The 8 diodes and 4 short wires can be soldered to the removable "plug."

9. Replace the logic-display board back into the front panel, being observant of the 13 male pins on the keyboard that have to be lined with CN-501. Press the logic-display board partly down onto these 13 pins and then dress and route the newly-installed 5 wires over the bottom edge of the board so that they are free and accessible. Press down on CN-501 again until the logic-display board solidly seats in the front panel.

   You might have to jiggle the board a little to work the SOUND SQUELCH and DIMMER/LIGHT switches through their holes in the panel. Replace and tighten the 6 Phillips screws.

10. Resolder the bare ground wire near the VOLUME and SQUELCH controls back to the chrome metal shield, taking great care to see that it does not short against one of the lugs of the VOLUME Control. Reinstall the front panel to the scanner chassis. Plug in all previously removed connectors.

11. Solder the 5 wires I, J , K, L, and M from the logic-display board to their corresponding wires in the parallel cable. Solder Wire N of the parallel cable to the chrome metal shield of the logic-display board (Ground). Solder Wire H to the left end of R-229 as you face the front panel of the PRO-2005/6.

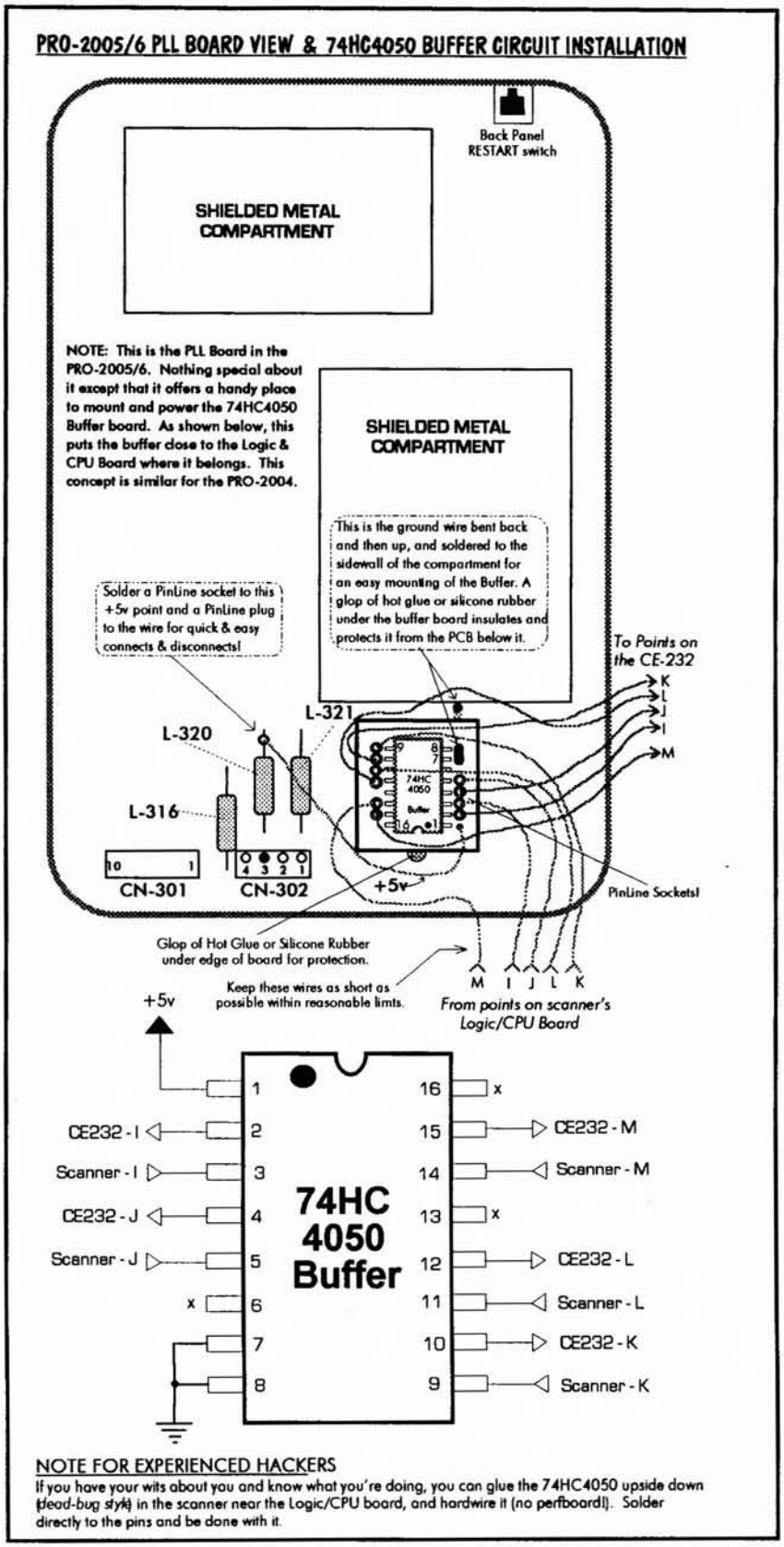
    NOTE: Use of the 74HC4050 buffer is optional but highly recommended for internal installations; it is mandatory for external installations.

12. Identify and separate Wires O through Z from the bundle out the parallel cable. Refer to *Figures 8-10* and *8-11* and solder Wire O to the cathode of D-1 (at pin 1 of CN-501).

    Complete the wiring to the 7 remaining diodes and 4 short wires as shown in the diagrams and pictorials.

    This completes the PRO-2005/6 detail section.

Figure 8-12: PRO-2005/6 74HC4050 buffer connections



PRO-2004/5/6... PROTECTION

I have recommended an external installation because it has so many advantages, but I waited till now to tell you about the single electrical disadvantage. In this case, the pluses outnumber the minus by a huge margin. But, the minus has to be taken care of because it's a potential killer.

The CPU needs an electrically clean environment. If you do an external installation for the CE-232, you need a simple little circuit to protect the scanner's CPU from external noise, spikes, and static generated by nearby or connected hardware.

Since the CE-232 connects directly to the CPU at several points (I, J, K, L, and M), the CPU is susceptible to being zapped.

Provided with my Kit is a 74HC4050 High Speed CMOS Hex Non-Inverting Buffer, a 16-pin DIP standard IC. If you're rolling your own, get one.

The 74HC4050 isolates outputs from inputs and still cleanly transfers signals. Up to six signal lines can be protected with one 74HC4050. You will need a piece of perf board on which to mount the chip and a 16 pin DIP IC socket.

This little board is installed in the scanner near where Wires I-M terminate at the logic/CPU board. The closer the better.

PROCEDURE

Build the protection circuit on a tiny piece of perf board – I use a piece that's 8 holes by 10 holes with pin-line sockets for the chip's inputs and outputs to make connections easier and to aid troubleshooting when required.

Use an IC socket to avoid direct soldering of the chip.

Loop a stiff copper wire (18 gauge) through two holes in one corner nearest pins 7 and 8 of the 74HC4050 and bend/pinch and solder the loop so that it is tight and about 1 inch of the copper wire protrudes away from the perf board.

Solder pins 7 and 8 of the 74HC4050 to this ground wire.

Solder this 1" stiff copper wire to any chassis or PCB ground in the scanner near where Wires I-M from the CE-232 terminate. This wire not only serves as a ground, but also as a mount.

The idea is to install the 74HC4050 buffer circuit close to the scanner's logic/CPU board.

Connect the wire from Point "I" on the scanner's logic/CPU board to pin 3 of the 74HC4050. Connect the Wire "I" that goes out to the CE-232 to pin 2 of the 74HC4050.

Repeat this procedure as shown above for Wires/Points J, K, L, and M as shown in *Figure 8-12*. Connect pin 1 of the 74HC4050 to a source of regulated +5V, as shown in *Figures 8-12* and *8-14*.

PRO-2004 ONLY

You guys have it easier in *some* ways.

Disconnect *just* CN-501 from the left-rear corner of the logic-CPU board. Now, remove the seven screws that hold the logic-CPU board to the main chassis. Gently, flip this subassembly up and over toward the front of the scanner so you can work on the bottom side. *You do not need to remove any other connectors.*

Refer to the Installation Guide just ahead to see where to make your solder connections. 18 of the required 19 wires go to easy spots on this board, so relax and do the job carefully.

Fabricate and mount the simple 74HC4050 Buffer assembly you built onto that small perf board.

Solder 4 short wires from each of the solder pads for CN-505, pins 5, 6, 7, and 9, to the Input pins of the 74HC4050 Buffer, 3, 5, 9, and 11, respectively.

Study this 11-pin connector carefully from the top first, so that you can identify its eleven solder pads. At first glance, pin 1 doesn't look like a pin pad.

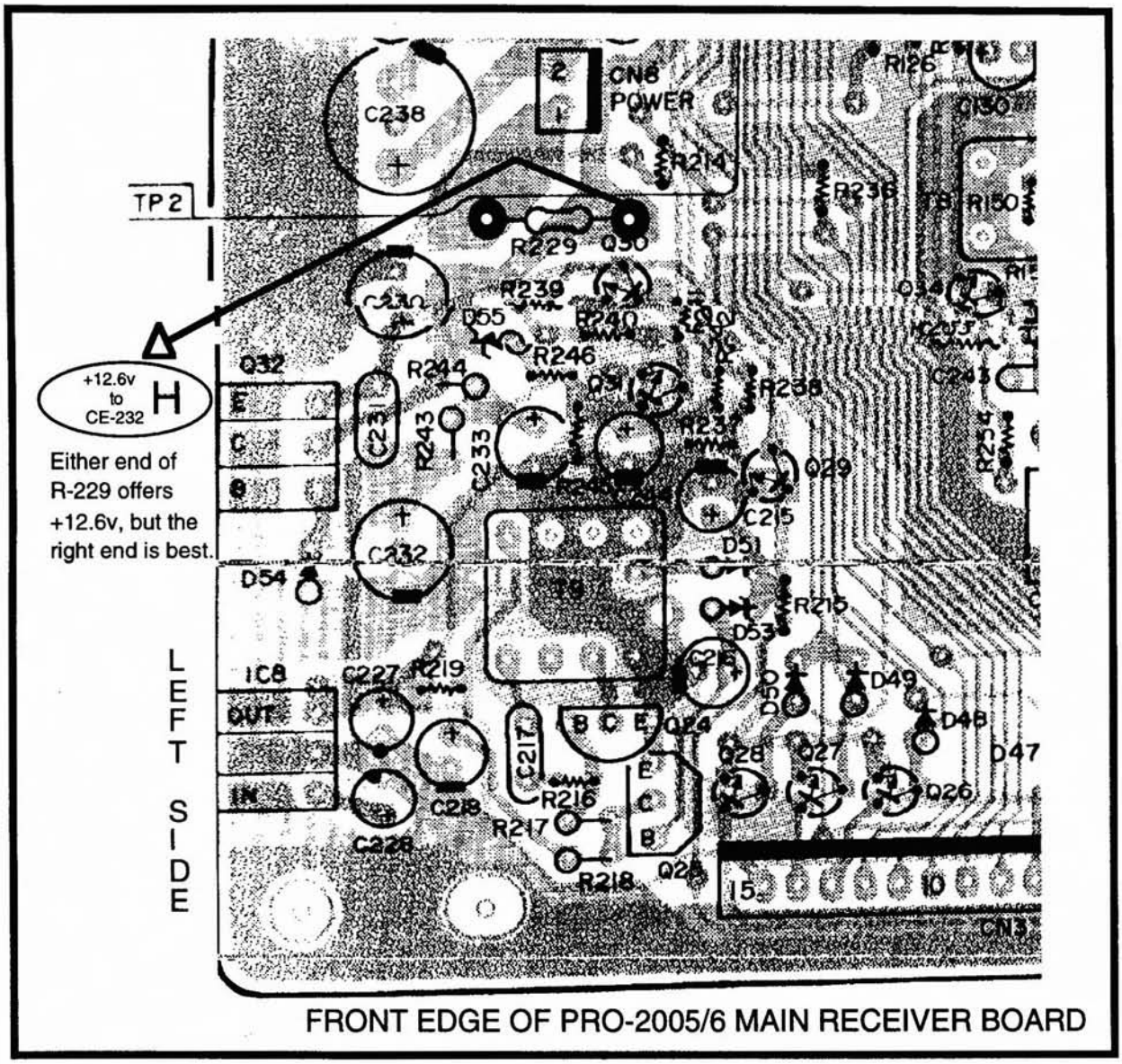
Make sure you can identify pin Pads 5, 6, 7, and 9 before soldering. Pin 1 doesn't look like pin 1 from the bottom, but you can tell by looking from the top.

Solder a short wire from pin 9 of CN-504 to Buffer Input pin 15. Easy enough. Again, make sure you *correctly* identify CN-504, pin 9.

Solder the anodes (unmarked ends) of 8 diodes, D1-D8, to CN-502, pins 1-8. Clip the anode leads to about 1/4" before soldering.

Correctly identify CN-502, pins 1-8. Then solder the four 47kΩ resistors, one each to CN-502, pins 9-12. The free ends of these resistors go to ground.

Figure 8-13: PRO-2005/6 main PCB - source of +12V for CE-232



Solder 5 short wires (2") to CN-502, pins 9-13. Dress up the 8 diodes and these 5 wires so they point out from the board and clip the ends so that all 8 diodes and 5 wires are of equal length. About 1/4" of cathode lead on the diodes will be about right.

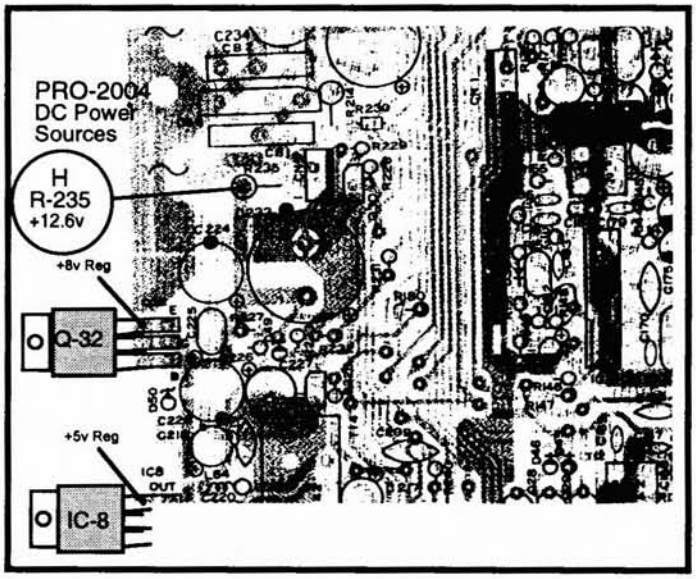
Make a diagram of the pinout or coding of these 19 wires so you don't have to remove this board again, and then reinstall the logic-CPU board back onto the chassis standoffs and replace the 7 screws. Reconnect CN-501.

NOTE: You can be slick at this point and solder in a 13-pin strip pin-line socket to the 13 solder pads of CN-502 so that the female side is exposed.

Then prepare a mating 13-pin male strip to plug into that permanently-soldered female strip. The 8 diodes and 4 short wires can then be soldered to the removable "plug;" a "pro" flourish here.

The socket can be superglued to the board, and hot-glued for strength after checkout.

Figure 8-14: PRO-2004 detail



PRO-2004 CONTINUED

Solder Wire H from the CE-232 board to the exposed end of R-235 on the top-rear of the main board. See *Figure 8-14* for the location of R-235.

It's a good idea to solder or bolt a ground wire from the metal shells of any DB-9 or DB-26 connectors to the chassis/frames of the scanner and any external metal boxes.

Point N on the CE-232 board should also be connected to the chassis or frame in which it is mounted.

Figure 8-15: PRO-2004 key locations – note 74HC4050 buffer

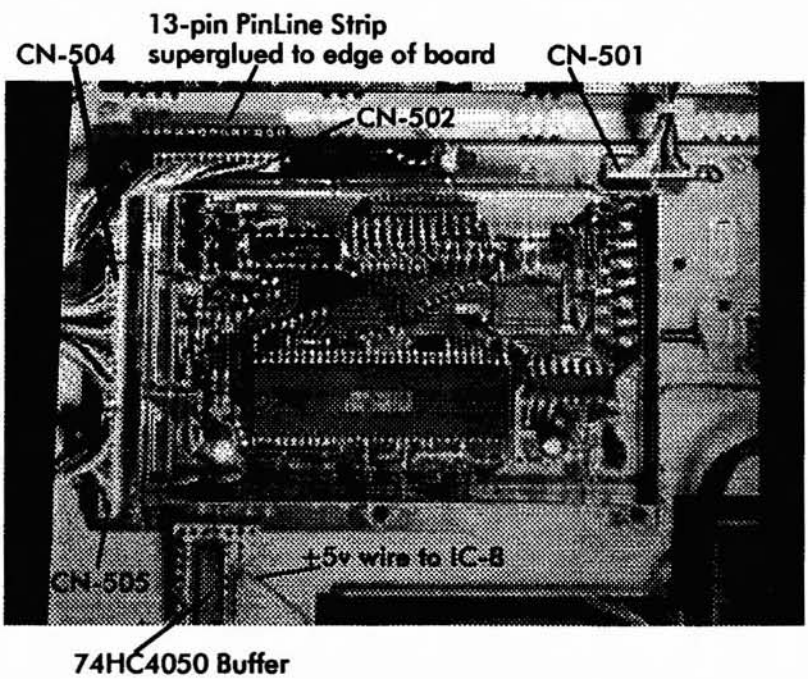
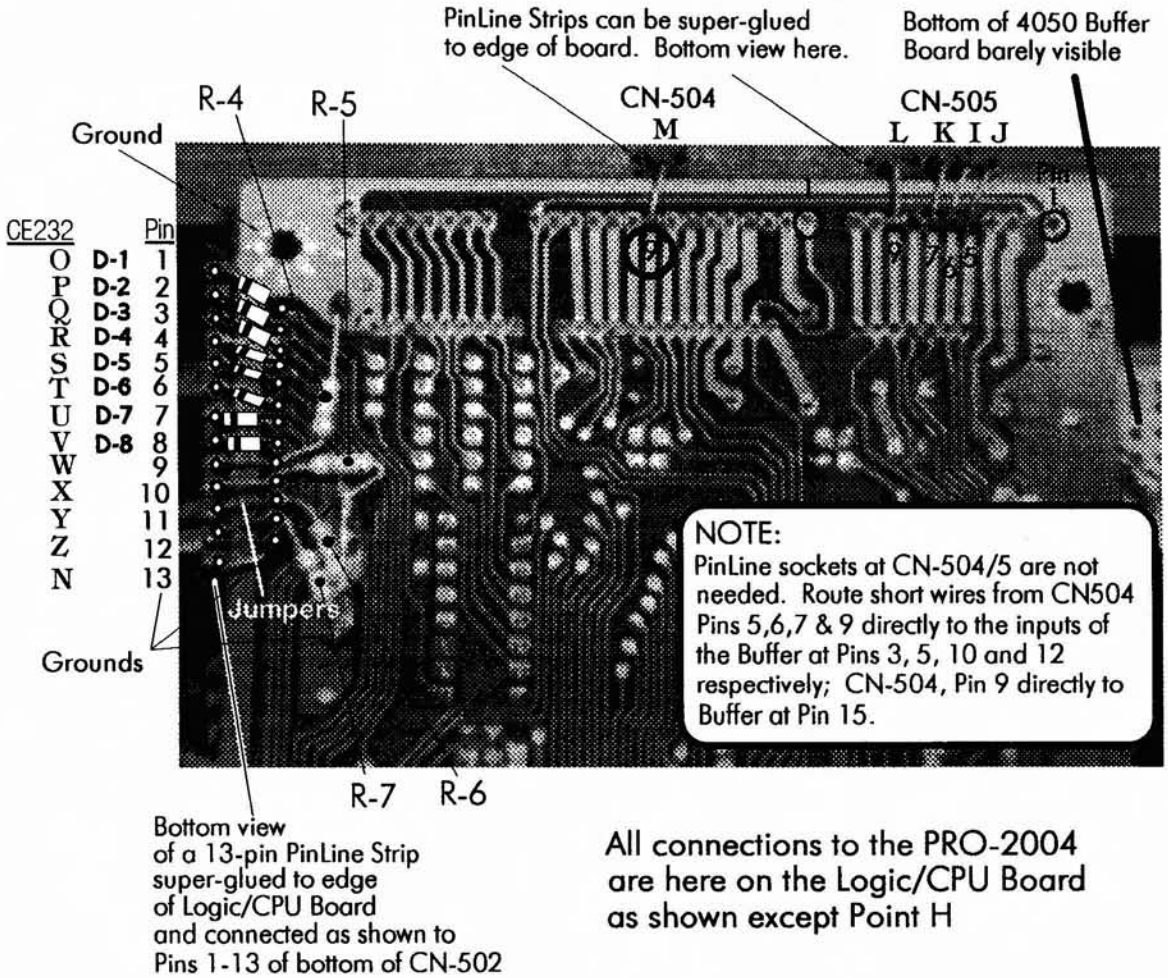


Figure 8-16: Connections to logic/CPU board

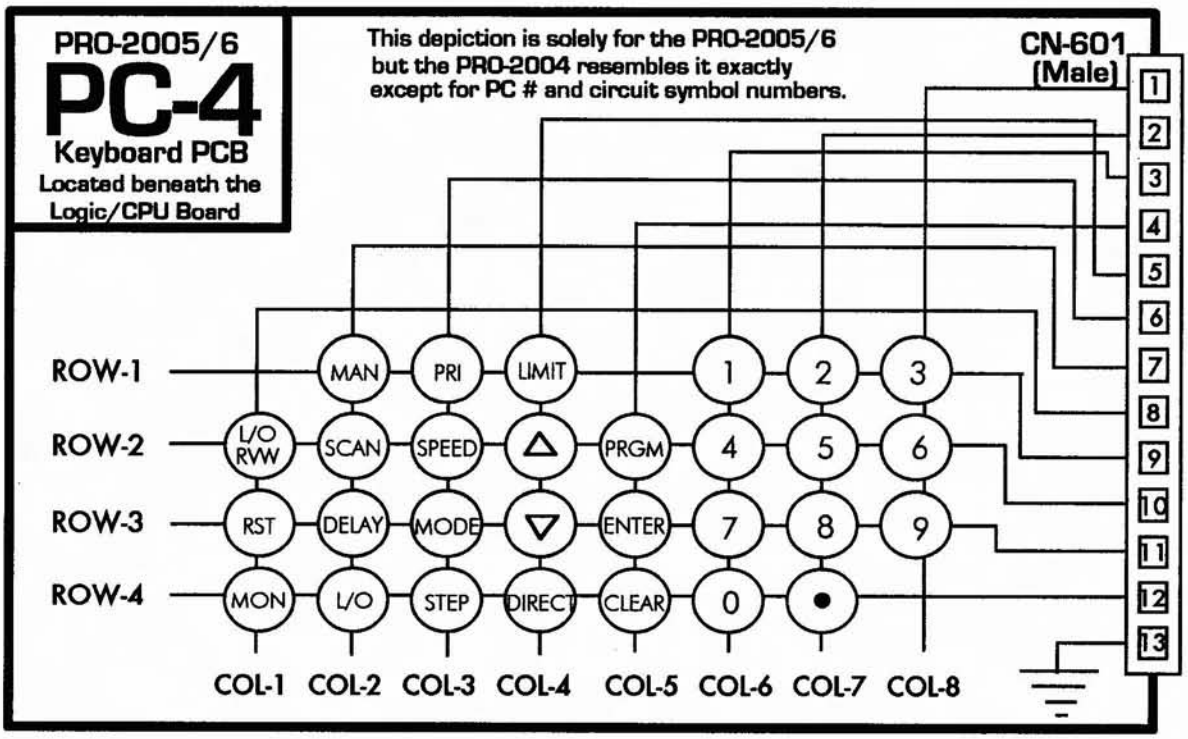


Solder the five Output Points (I, J, K, L, and M) from the Buffer Circuit to their corresponding wires that go to the CE-232 board.

Identify and separate Wires O through Z from the bundle that comes from the CE-232 board. Refer to the diagrams and pictorials and solder Wire O to the cathode of D-1 (at pin 1 of CN-502). Complete the connection of Wires P-Z to the seven remaining diodes and pins 9-12 of CN-502 as shown in the diagrams and pictorials.

This completes the portion of the project that is specific to the PRO-2004.

Figure 8-17: Keyboard matrix wiring



KEYBOARD MATRIX PCB (ALL)

Figure 8-17, above, shows the stock PRO-2005/6 Keyboard Matrix PCB and its associated male connector, CN-601. This information applies to the PRO-2004 also.

The configuration is not easily understood until the logic-display board is removed from the front panel for the work that must be done to it, at which time everything will become clear.

Figure 8-18 shows how to connect the 13 wires from the CE-232 to CN-501.

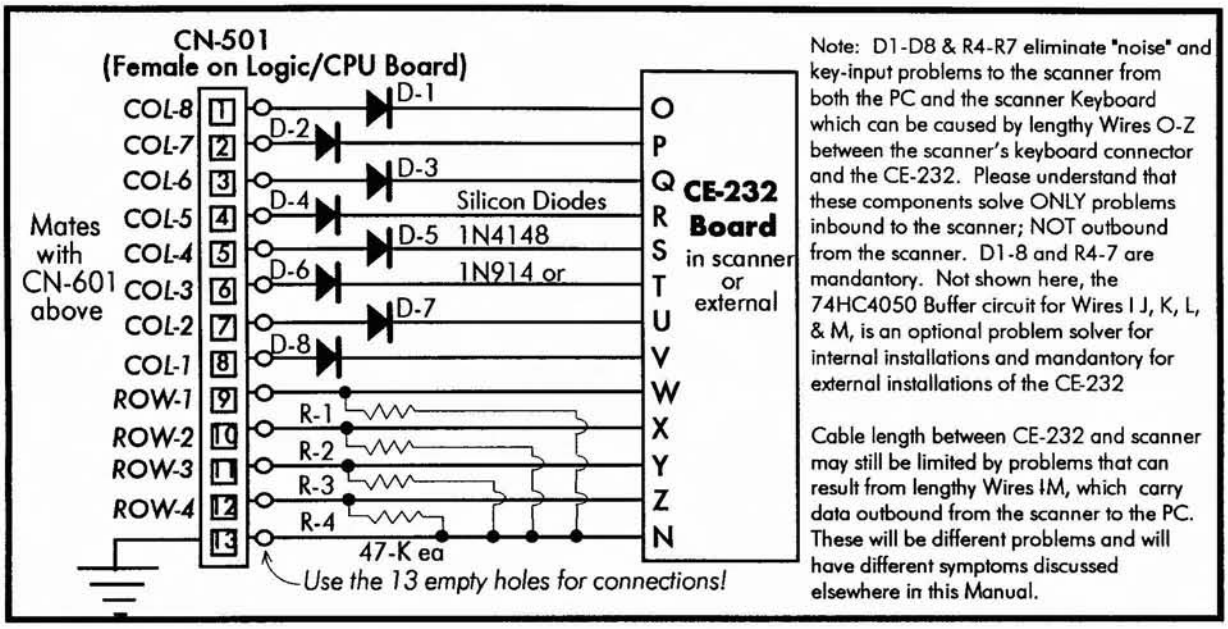
You can fabricate a connector to mechanically mate with CN-501 by soldering a 13-pin strip of pin-line sockets to the 13 plated-thru (unused) holes just behind CN-501.

The males of another 13-pin pin-line strip will then mate with the exposed females of the previously soldered pin-line strip.

The diodes and resistors can be soldered to the removable strip for a convenient quick-disconnect arrangement, and it keeps the board looking neat.

A bit of the chrome metal shield over that end of the logic-display board has to be "nibbled" away to make more room for the new connector. Watch any sharp edges, and look out for metal filings.

Figure 8-18: CE-232 to CN-501 wiring details



WHAT IF YOU RUN INTO TROUBLE?

You won't, if you follow my instructions to the letter. But, to quote CE-232 Murphy... "anything that goes will probably be inaccessible." Keep your dynamite handy.

If you encounter trouble, it will be due either to a failed component or to an error on your part. I'll help with a bit of guidance, and the first thing you need is an understanding of how the CE-232 functions. Let's walk through the circuit...

1. IC-8 accepts a range of +8 to +16V input and generates a regulated, steady +5V to power the CE-232.

2. The computer sends data or control signals to the CE-232 down Wire "A". The CE-232 sends data back to the computer on Wire "B". Wire "G" is the common or ground between the two.

   IC-1 is a dual RS-232 receiver + transmitter that lets your PC and the CE-232's microprocessor, IC-3, "talk" to each other.

3. The CE-232 receives data from the scanner on Wires I-M, with Wire N the common or ground (same as Wire G)

   Wires I-M have nothing to do with data or control signals sent to the scanner.

4. The CE-232's MPU sends data to and/or controls the scanner via IC-4, 5, and 6 and Wires O-Z with Wire N as common or ground. IC-4, 5, and 6 and Wires O-Z have nothing to do with what the scanner sends to the PC.

5. IC-3, the MPU, processes both data from the scanner as well as data or control signals to the scanner.

6. IC-2 won't let the MPU operate until DC power has stabilized after turn-on. The CE-232 will not operate till pins 1 and 2 of IC-2 are stable at +5V, ± 0.15V.

7. IC-7 is the User Switch Bank and is controlled by the MPU independently of everything else.

Whether or not everything works, this information will help you understand the unit. If you do have problems, this will help you define them when you seek help or troubleshoot on your own.

TROUBLESHOOTING

The CE-232 Interface has different circuits and signal flow paths, of which one is the Scanner Control section and another, Data Acquisition.

Trouble is less likely in the data acquisition side than in the control side, but it is important that you understand each physical path to avoid wild goose chases.

DATA ACQUISITION SIDE

Data Acquisition is the opposite of the "scanner control" that electronically presses the scanner's keys, from the AutoProgram or Keyboard Control functions.

Data Acquisition reads and processes the scanner's LCD data for replication on your monitor. It also acquires and processes scanner data for AutoLogging, LookUp, and Birdie Reject functions as well as for portions of the Script function.

The Scanner Control section consists of one half of IC-1, portions of IC-3, and most of IC-4, 5, and 6. Scanner control begins in the computer with signals sent to the CE-232 via Wire/Point "A".

Those signals are coded into MPU format by IC-1 (pin 13) and sent to the MPU from pin 12. The MPU (IC-3) processes control signals and operates IC-4, 5, and 6 to emulate keypresses on the scanner's keyboard via Wires/Points O through Z. The CE-232 Scanner Control section is shown in detail in *Figure 8-16.*

Data Acquisition begins in the scanner with sampling of display, clock, and squelch activity data at Points I, J, K, L, and M on the scanner's logic/CPU board.

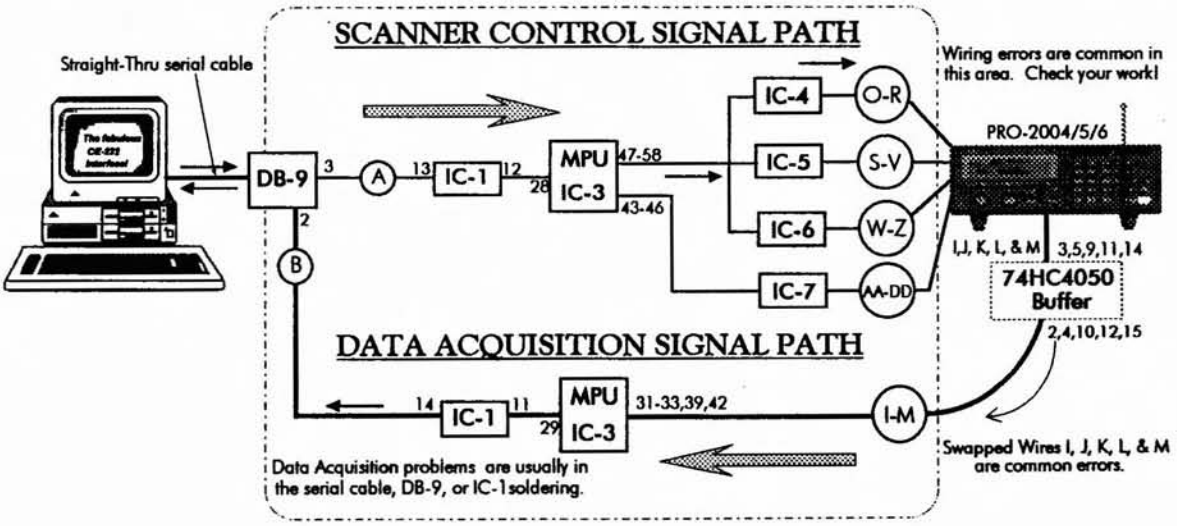
The data are buffered (copied and isolated) and passed through our protective 74HC4050 Buffer and fed directly to the CE-232's MPU at pins 31, 32, 33, 39, and 42.

The MPU continuously processes the scanner data and transfers it out pin 29 to IC-1, pin 11 where the data are encoded into computer format and outputted as RS-232 serial data from pin 14 through Point "B" into the serial cable and on to your computer's COM1 or COM2 ports.

The Data Acquisition section is neither complicated nor trouble-prone and does not need further treatment here.

Figure 8-19 depicts the signal paths that were described above. It is useful to know something about them in the event your CE-232 ever develops problems.

Figure 8-19: Scanner Control section



IN CASE OF (SERIOUS) DIFFICULTY

Many HB-232's and CE-232's have gone into service since August, 1991, when the first few were Beta tested. All bugs and glitches have since been worked out of the design, and the software is quite robust and not buggy.

If your CE-232 fails to perform properly, you will waste a lot of time with an attitude of *"I checked everything three times."* You simply have to check everything a fourth time.

Or more – because the problem is in the execution or in a part failure, but not in the design.

About the only realistic possibility of a problem not within your responsibility will be a defective part.

There are no known instances of this having occurred, but I suppose it could happen.

One fellow told us he replaced X-1 (8MHz crystal) with a new one and it worked. We don't know if he damaged the original or if it was defective from the factory. There have been very few cases of user-damaged parts, so components are not the primary focus for problem resolution.

On the other hand, after providing Technical Support for nearly three years, I do know something of where problems occur in those rare cases when it happens.

Let me give you the benefit of that experience.

PREPARING FOR TROUBLESHOOTING

Resistance and voltage measurements are of limited value when the problem is a wiring error, but voltage measurements at the test points are often informative. You should record these measurements for future reference, whether or not you have a problem at the beginning, and then use that information if a problem comes up in the future. Fill out and retain *Table 8-3.*

Table 8-3: Test results – your record

Attach the BLACK (-) lead of a voltmeter to any PCB ground or TP-1. Measure the voltage at each of the test points and record the results below:

#	Location	Nominal Or Typical	Your Test #1	Your Test #2	Your Test #3	Your Test #4	Your Test #5
A	TP-5	+ 5.0v ±0.1v					
B	TP-4	+12.6v ±3.4v					
C	TP-3	* 11v					
D[1]	B– C	1.6v ±0.3v					
E	TP-2	+5.0v ±0.1v					
F[2]	(D ÷100)(1000)	16-ma ±3-ma					

* *Absolute value is not as important as is the difference from (B) with 1.6v difference being typical. See (D)*

1. Subtract (C) from (B) and record the difference in (D)
2. Divide (D) by R-2 (100-0hms); multiply by 1000 and write the result in (F). This applies Ohm's Law to calculate current drawn by the CE-232. If the calculation is not less than 10-ma, nor more than 20-ma, there will not be a serious problem with the unit. If greater than 25-ma, shut off power immediately and troubleshoot the problem. NOTE: R-2 can burn out under current greater than 50-ma.

Table 8-4: Trouble history – learning from the mistakes of our fellow scannists

The assigned number tells you something about history, and therefore the likelihood of a specific area causing a problem

0 = No problem history at all...
1 = Rare
2 = Occasional
3 = More frequent

PROBLEMS AT THE PC, OR BETWEEN PC and CE-232:	**1 (avg)**
Defective or incorrectly configured COM1 or COM2 port on the PC	1
Defective or incorrect type of serial cable	2
Reversed wires or errors in wires A, B, and/or G	1
Incorrect installation of the software	1
Misunderstanding of how to operate the software	2
PROBLEMS ON THE CE-232 BOARD:	**2 (avg)**
Wires soldered to the wrong spots on the printed circuit board	2
Cold or defective solder joints on the printed circuit board	2
Reversed/swapped parts on the printed circuit board	1
Solder blobs/short circuits/open circuits on printed circuit board	2
Defective part on the printed circuit board due to User error	1
Defective part	0
Reverse installed IC's	2
Reverse installed polarized capacitors or resistor networks (RN1-4)	1
PROBLEMS BETWEEN CE-232 BOARD and SCANNER	**1 (avg)**
Defective or incorrect type of cable	0
Defective wiring of connectors	1
Broken wire	1
PROBLEMS INSIDE THE SCANNER	**3 (avg)**
Keyboard Connector Installation	*2 (avg)*
Reversed polarity diodes, D1-8	1
Defective diodes (if from Radio Shack)	1
R4-7 installation errors	1
Wiring errors, Wires/Points O thru Z	3
Logic/CPU Board Wiring errors	*3 (avg)*
Wires/Points I thru M	3
74HC4050 Buffer errors	1
DC Power	*0*
Wire H error	0
Wire N Error	0
Scanner failures associated with CE-232 Installation (errors)	1
Due to CE-232 (does not impact or alter scanner's performance)	0

TIPS - HINTS - IDEAS FOR TROUBLESHOOTING

Startup problems will usually be caused by one or more of the following. Check each carefully.

- _ solder-blobs and bridges between pins and traces *(short-circuits)*
- _ cold solder joints *(open/intermittent circuits)*
- _ reversed wires, wires soldered to wrong spots
- _ erroneous component installation, location
- _ incorrect polarity (+ and –) of diodes and electrolytic capacitors
- _ improper pin alignment of the integrated circuits, IC sockets, and resistor networks.

Double and triple check for correct soldering and parts locations on both sides of the CE-232 board BEFORE you install it in the metal box or scanner. If you just give the board a casual *"eyeball"* before installing it, then STOP HERE! GO BACK. DO IT RIGHT.

You need a strong light and magnifier to properly check the soldering of the CE-232 board. Solder joints should be bright, shiny, and smooth in appearance. It's easy to get solder bridges between those tightly spaced IC pins. You must not take your work for granted, even if you think you're an expert.

The microprocessor chip socket, if installed wrong, will get the chip in wrong – and it *will* blow! Check all other IC's for proper installation on the board, also. It's easy to get 'em *bass-ackwards.* I know. I'm the guy who has fixed a boatload of these where the only problem was a reversed chip.

LIKELY WIRING ERRORS, AND DIAGNOSTICS

The greatest potential for error will be the wiring of the CE-232 to the scanner. There are at least 19 output wires, and any could be miswired to the wrong spot or cross-wired, either on the CE-232 board, or at the termination points in the scanner.

If some keyboard functions work from the computer, but not others, you will find a pair of reversed wires in the O-Z group, probably one in the O-V group and one in the W-Z group. A quick study of the scanner's Keyboard Matrix Diagram in *Figures 8-17* and *8-18* may disclose which pair(s) may have been reversed.

For instance, if PRGM, ENTER, and CLEAR along with MANUAL, PRIORITY, LIMIT, 1, 2, and 3 don't work, you'll find wires R and W to be reversed.

If all functions "happen," but two or more don't work according to the specified keypresses, then you have one or more miswired pairs in the range of O-V or W-Z, but not both as would be the case if some functions worked and others didn't. For example, if pressing PRGM, ENTER, or CLEAR results in functions L/O RVW, RESET, or MONITOR, it's obvious that wires R and V are reversed.

If there is no computer keyboard control of the scanner but the Monitor gives a faithful reproduction of what's going on in the scanner, then an error or defective solder joint could exist in the vicinity of IC-6.

Also, be sure the INPUTS to the CE-232 are properly connected between the DB-9 connector and the CE-232 board. This includes the jumper between pins 1, 4, 6, and 8 on the DB-9 which do NOT go to the CE-232 board.

Pins 7 and 9 of the DB-9 have no connection at all. Pin 3 goes to Point A, pin 2 goes to Point B, and pin 5 goes to any ground Point G or N on the CE-232.

Other variables include the quality and type of your serial cable and/or your COM port. The serial cable must be the "straight-thru" variety, *not a null-modem cable.* If your cable is a null-modem type, you can invert it back to the straight-thru type with a "null modem adapter," commonly available at all computer outlets and Radio Shack.

A null-modem adapter on a null-modem cable turns it back into a "straight-thru" cable. If all else fails and you're just not sure of what kind of serial cable you have, try a null-modem adapter, just for the hell of it.

Now let's look at your COM port, which could be faulty. Cheaper serial I/O cards and old computers are sometimes only marginally capable of the 9600-bps serial data speed that's required by the CE-232 to keep pace with the scanner.

The bottom line is that your serial port, serial cable, and serial input (DB-9) wiring to the CE-232 must be proper. I would expect COM port

problems to be more common with some of the el-cheapo or older PC/compatibles.

Finally, be sure that you have selected the correct COMport for the CE-232 – don't mistake COM2 for COM1, etc., and forget COM3 and COM4.

WHAT ELSE?

We worked hard to make the CE-232 both foolproof and simple enough to be handled (and operated) by the casual scannist. Yet, the CE-232 is a very sophisticated tool, and that sophistication increases complexity, creating more and more opportunities for Murphy to toot his whistle.

Knowing this, I have done everything but fire bullets and flame throwers at the CE-232. It works, and it goes right on working. If yours should fail to work, the first thing to do is RELAX – go have a cup of coffee or one cold beer. No doubt, that work took a lot out of you, so get away from it for a while.

When you come back, do so with the idea that the problem is going to be found on a few square inches of circuit board, either at the CE-232 or in the scanner.

No magic. No mystery. Just a little game of hide and seek awaits you. And you're gonna win!

CRYSTAL SPEEDUPS?

Several users had problems that frustrated me until I learned their scanners had been accelerated with a new crystal reference. Sorry, the CE-232 does not work with crystal-accelerated scanners. "Clip-or-add-a-diode" speedups are okay, but not crystal speedups.

Another scannist had me going for a couple of weeks until I learned he was trying to make his CE-232 work from an ancient Wang computer. Sorry, that old Wang and other historic computers may not be "PC/compatible." Another tried to get his to work with 256k RAM; nope, you need 512k minimum, with 640k better.

Another user went bananas for weeks, saying he'd checked everything dozens of times. Finally he sent me his CE-232 board. Wow, what a cobbled up mess! Repair of two defective solder joints and a general straightening up of things on the board resulted in perfect operation. *Yet, he swore upon all that was holy that there were no errors or bad solder joints on the board.*

A few hackers sent us the chips from their CE-232 Kits to test when nothing else at their end seemed to point to a solution. In most cases, the chips proved okay. Two users out of hundreds managed to zap their MPU chips (IC-3). Static discharge, mostly likely.

HELP ME HELP YOU!

If you run into trouble, can't find your way out, and gotta have Technical Support, help me by providing useful measurements, and a logical assessment from the procedures coming next.

Even if you have no trouble at the start (which is the case for the majority), you should make the measurements anyway so as to establish a base line for future troubleshooting, should it be required. Remember, even after you do everything in this book there's another dozen or two mods coming down the pike. So keep notes. You may never need them. But if you don't keep notes, it's certain that Murphy will step in.

SPECIFIC TESTS – RECORD THE RESULTS

For your records, and when invoking Tech Support (if needed):

1. Does the scanner receive signals normally?

If everything works just fine except that the scanner does not receive any signals, there will be a problem in Wires I, J, K, L, or M, or in the circuits at either end of these five wires.

If reception at the scanner is drastically affected and you find no errors in Wires I, J, K, L, or M, or in the respective circuits at either end, then you can suspect a blown MPU chip, IC-3, which we'll be happy to test for you.

You can do one additional test before suspecting this, however: remove the MPU from its socket and test the receiver again. If it works, the MPU could be blown. If the scanner still doesn't receive with the MPU pulled, then the problem is elsewhere and the MPU is likely okay.

2. Test the User Switches

Check by operating CTRL+F1, CTRL+F2, CTRL+F3, and CTRL+F4. Observe the

OUTPUT STATUS window in the upper-left of the computer's display to see that the zeroes change to 1's and back to 0's as the switches are operated. This test affirms the ability of the CE-232 and its MPU to respond to PC keyboard commands in general. It does not test the status of IC-7 itself, nor the status of your interconnecting wiring other than Wires A, B, and G

3. Test IC-7 and the User Switches

Connect the leads of an ohmmeter to Wires AA. High (almost infinite) resistance should be noted if User Switch #1 is OFF. Press Ctrl+F1 once, at which time the resistance should go low, down to 35-80 ohms or so. Press Ctrl+F1 again, and the resistance should go back high. This test can be repeated for Wires BB, CC, and DD (Ctrl+F2-F4) to test the integrity of IC-7. This test proves up the status of IC-7 and the ability of the CE-232 and its MPU to respond to PC keyboard commands in general.

User Switch errors are limited to Wires A, B, G, AA thru DD, and/or IC-7, only. Proper operation of the User Switches conclusively proves two-way communications between the computer and the CE-232. If other aspects of the CE-232 do not work, this is strongly suggestive of errors in your work.

NOTE: This test can be used to check the status of IC-4, 5, and 6, by plugging these chips into the socket for IC-7 and repeating the above tests.

4. Test the Data Acquisition side

Observe the display of the scanner's LCD functions on the Monitor. If the display on the Monitor is a faithful reproduction of the scanner's LCD, then Wires I, J, K, L, and M are proved good and the data acquisition mode is proved good.

You can go on to test the *AutoLogger, LookUp,* and *BirdieReject* functions if you like, but these tests are not necessary at this time.

Erratic or improper display in the Monitor is suggestive of errors associated with Wires I, J, K, L, and/or M, and/or the 74HC4050 buffer.

5. Test the CE-232 Scanner Control Circuit

Operate all the 29 normal scanner key functions from the keyboard of your PC. For instance, press MANUAL : SCAN : MANUAL. Does the scanner go into Manual mode, followed by Scan, and then Manual again?

Test all 29 scanner key functions in this manner. Make a table of those that work and those that do not. I like this sequence of keypresses: <M>anual : 1234 : <M>anual (*Error*) : <Backspace (Clear)> : <M>anual : 5678 : <M>anual (*Error*) <Backspace (Clear)> : <M>anual : 9000 : <M>anual (*Error*) <Backspace (Clear)> : <S>can followed by all other functions.

Problems with operation of the scanner from the computer keyboard when everything else is okay suggests faults or errors associated with Wires or Points O-Z, diodes D1-D8, resistors R4-R7, and/or IC-4, 5, and 6. You may as well verify proper voltage of +5V on pins 14 of each of IC-4, 5, 6, and 7, and IC-1, pin 16. An incorrect voltage at any of these supply pins may suggest a defective solder joint or PCB trace problem.

Since IC-4, 5, 6, and 7 are the same kind of chip, you can use the above test for IC-7 and the User Switches to check IC-4, 5, and 6 by swapping them around with IC-7, and repeating the AA-DD resistance checks.

6. Software installation and operation problems

This is a different animal altogether. The best checks and tests are to simply follow the directions for installation and operation of the CE-232 program and reinstall or continue working with it any number of times until you get it right.

We have observed that some Users are unfamiliar with the MS-DOS operating system, especially with hard and floppy disks and directory and subdirectory concepts.

Unfortunately, my job is not to teach you how to use your computer and I can't go to lengths over this kind of problem. Learning how to operate your computer and how to work under MS-DOS is your job and that's where it will stay. This is not to say that I won't help, because I will, but at my convenience and time. You can bet that I don't have the time to teach computing by mail.

But if you can work a BBS and send e-mail, then you know your way around the computer well enough to get help.

RESISTANCE AND CONTINUITY CHECKS

There isn't much else that can be dynamically tested. If all else fails at this point, the next logical step is to perform relevant point-to-point

continuity checks with an ohmmeter. This method can be used to detect faulty solder joints and wire/trace paths, if close visual inspection doesn't arouse your suspicions.

Here's an example: Note in *Figure 8-3* that there is a direct connection between and among IC-4, 5, and 6, pins 1, 3, 8, and 10. If you were to put one lead of a VOM on pin 1 of IC-4, on top at the chip, you should measure virtually zero resistance to: IC-4, pins 3, 8, and 10
IC 5, pins 1, 3, 8, and 10
IC-6, pins 1, 3, 8, and 10.

If a measurement of more than 1Ω is detected, that's a sign of trouble somewhere. You can perform a lot of continuity tests using *Figure 8-3* as a "roadmap." Just make sure all power to the CE-232 is off before doing resistance/continuity measurements.

TEST EQUIPMENT TIP

Here's a little tip for your VOM: use the kind of test leads that have *alligator clips* or *"mini hook clips"* on the business end. Get a large sewing needle, about 2-3" long, and wrap the eyelet end with tape to build up an insulated handle. Two pieces (with a gap for the alligator clip) of thin heat shrink tubing is even better, and let it extend to within a millimeter or so of the tip.

The idea is to make a very slender and very sharp test probe for the RED (+) lead of the meter. Grip the alligator or hook clip to the body of the needle when making a measurement. Benefits are hard to describe, but they'll be clear after you use "fat" test probes that come with most meters nowadays.

The sharp sewing needle allows entry into cramped areas to "dig" into solder spots and traces for quick tests. The thin insulated probe ensures that your test is "isolated," and touches exactly the right spot and nothing else.

Also, it's sharp and doesn't slide off the test points as easily as standard (blunt) test probes. Keep several of these "needle probes" handy.

RUMINATIONS

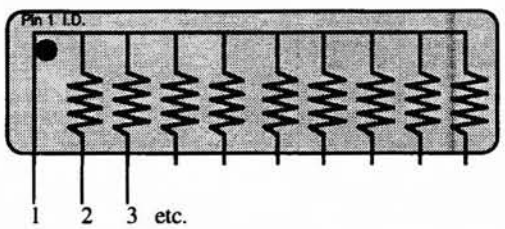
IC-3 cannot be tested and you really should not attempt to make any measurements at its pins. If all else fails and you think IC-3 has gone south, I can test it for you for a nominal shipping and handling charge.

Consider this a contingency to lean upon if you draw a blank on other options available to you. Statistically, one out of 500 Users may blow the MPU chip. Careful handling will reduce the risk.

If diodes D1-8 are connected backwards, the unit will have no keyboard control of the scanner, but no harm will be done; just reverse them. If the electrolytic capacitors are installed backwards, chances are that they will be damaged. Radio Shack carries them.

Unless you physically damage one, it is most unlikely that the monolithic capacitors will ever fail. R-2 is subject to failure by overheating if the CE-232 circuit ever draws too much current. In this context, R-2 serves as a protective fuse for IC-8 and the CE-232 in general, not to mention an easy way to calculate current drain.

R-2 will probably burn up (and turn black) with a current above about 50mA. If R-2 ever burns up, something else will have caused it. Like R-2, R-1 is unlikely to ever fail unless there's another problem somewhere else.



Resistor networks, RN-1, 2, 3, and 4, will never fail unless you do something that destroys them.

A resistor network is internally like the drawing above. The resistor networks can be tested with an ohmmeter by measuring the resistance between pin 1 and each of the remaining pins in the network. See the diagram here for how they're laid out.

Replacements can be done with conventional resistors installed into the holes for pins 2, 3, 4, etc., and the upper leads all soldered together and routed back to the hole for pin 1, as shown above.

IDIOSYNCRASIES

My 2006 won't AutoProgram...

A few PRO-2006's have surfaced in which everything except the AutoProgram function works perfectly. Slower settings of the time

constant won't stop the "error" messages in the scanner's display.

RELAX: There is an immediate and easy fix for this problem: use the 20045V13.PER file in the Basic Setup for the CE-232 Program. Just go back and redo your configurations, selecting the PRO-2004/5 setting instead of that for the PRO-2006.

This problem is rare and we've not seen it on the bench, but some PRO-2006's are afflicted with this oddity.

We suspect this phenomenon are caused by internal variances of devices within the scanner, which are not considered by the Program's 2006V13.PER file. So use the one for the PRO-2004/5 and you'll be all set with no handicap or limitations.

In fact, scanners with this odd problem will AutoProgram somewhat faster under the 2004/5V13.PER file than "normal" PRO-2006's with the standard setup. So except for the momentary adrenaline it's really an advantage.

What if it won't stop?

We've seen this problem in a few PRO-2004's, but it could appear in any, so I developed a sure-fire fix.

The problem shows up in CE-232s that work perfectly in all respects, but the scanner won't STOP even on strong signals when in the SCAN or SEARCH modes. Yet, if you MANUAL-step to a known signal, reception is just fine.

The cause of this problem is an oddity associated with the cable or wiring between the CE-232 and the scanner.

The culprit will be found to be in the area of Wires I, J, K, L, and/or M, and can sometimes be alleviated by shortening or rerouting the wires between the scanner and the CE-232. But in a few cases, nothing longer than 1 foot works.

We'd let it go at that, except that some people really need a longer cable than that.

For them, I designed a simple add-on circuit to permit any reasonable length and method of routing of the interconnect cable, to at least 6 feet or more.

So take your choice: shorten the cable until it works, or add a 74HC4050 buffer circuit for Wires I, J, K, L, and M as discussed earlier in this chapter. Install that buffer, anyway, if you know what's good for you and your scanner.

TECHNICAL SUPPORT

It's costly when hobbyists do their own work and then need Tech Support. To control that expense, there are restrictions that I must impose, and they are not flexible.

The most important is: *absolutely no voice tech support whatsoever.* The preferred method is to log on to my BBS (619) 578-9247 after 5:30pm and before 1:30pm, Pacific Time, where you will be guided to the forum for the CE-232.

This forum has a nice backlog of tech support messages and support files, and is electronically networked to other BBS's around the world.

IF you have read the backlog and did not find the information you need, ask for help!

The bottom line is that I provide accurate and to-the-point support for the CE-232, but to get it you must help me do it cost-effectively. If you do, you're assured of my assistance if you need it.

Now, *please* scan through Chapter 1 again.

SPECIALIZED HELP RESOURCES: BBSs

Regarding the HB-232, you can also reach me (and others who know a lot about the design and its operation) via the HB-232 message base on any of the following BBS's.

Incidentally, most of these BBS's have some dedication to radio, so you may find them interesting for other reasons than just CE-232 Tech Support.

For instance, all carry my generic radio engineering and hacking conference called RADIO-TEK.

That's where you can find answers to general technical questions about my books and their contents, and lively discussions of other things, too.

Table 8-5: BBS support for the CE-232

Telephone	ST	City	SySop	BBS Name
*619-578-9247	CA	San Diego	Bill Cheek	Hertzian Intercept
206-750-9703	WA	Vancouver	Leroy Pluard	Powers Of Two
315-425-5580	NY	Syracuse	Jim Bernier	SBE Syracuse
319-556-4536	IA	Dubuque	Pat Powers	Tri-State Data Exchg
319-583-6462	IA	Dubuque	Mike Donovan	Spec-Com
504-886-2157	LA	Sun	Nolan Lee	WSTPC
513-297-0250	OH	Dayton	Dan Hughes	Intercept Technology
619-278-7361	CA	San Diego	Brenda Donovan	PRI Wildcat. BBS
619-669-0385	CA	Indian Springs	Joe Nicholson	The General Alarm
810-478-4284	MI	Farmington Hills	Pat Richard	Enterprize
816-627-6366	MO	Kirksville	Forrest Joyner	NEMO Wildcat. BBS
908-245-6614	NJ	Roselle	Marv Shelton	The Micro Room
909-984-9580	CA	Ontario	Larry Files	Teleterm Amiga West
914-342-4585	NY	Wawayanda	Steve Fleckenstein	Red Onion Express
916-577-4438	CA	Lake Tahoe	Frank Gaude	HighSierra Online
297-8-56851	Aruba	Matividiri	Gerardo Oduber	Hack on The Beach

** Hours of operation: 5:30pm-1:30pm, Pacific Time, weekdays, 24-hrs/weekends/holidays*

OPERATING THE CE-232 INTERFACE

If you choose to write your own software then you'll have to write operating instructions that comply with that software. If you use a third-party control program or the program that I supply, the operating instructions will be on disk for you.

Therefore, not much space is required here for instructions on operating the system, but I will tell you about a few things to pique your interest and to keep the flame alive.

The AutoProgrammer is one of the strong suits of the CE-232 because it takes the drudgery and errors out of your channel programming.

Basically, you push a button, and the computer finds the file and loads it through the CE-232 into the scanner's memory.

The AutoProgrammer file is a plain ASCII, comma-delimited, text file with the extension of .APF.

My home is near Miramar Naval Air Station, here in San Diego. That's the (former) home of Top Gun training. Every year we have a truly major military air show, which invariably features many historic airplanes and exhibits.

It is also a showcase for our Navy's flight demo team; the Blue Angels. Their comm is a standard package, with specific frequencies allocated to the team, not to the location. It's fun listening to them as they rehearse and perform. With the CE-232 it's *more* fun.

Here is a ***portion*** of one of my *.APF files for the Blue Angels air team. The file is called BLUEANGL.APF

Table 8-6: BLUEANGL.APF

```
,161,121.900,   ,D,,Blue Angels - Ground Support
,162,123.400,   ,D,,Blue Angels - Common Airshow
,164,142.000,   ,D,,Blue Angels - Maintenance Alfa
,168,143.000,   ,D,,Blue Angels - Maintenance Bravo
,169,241.400,am,D,,Blue Angels - Air to Air Channel
,160,250.800,am,D,,Blue Angels - Air to Air Channel
,171,251.600,am,D,,Blue Angels - Demonstration
,172,263.350,am,D,,Blue Angels - Flight Line common
,174,275.350,am,D,,Blue Angels - Comm 1 Lead and Formation
,175,302.100,am,D,,Blue Angels - Comm 2 Talkback
,176,302.150,am,D,,Blue Angels - Comm 3 Solos
,177,307.700,am,D,,Blue Angels - Comm 2 Formation talkback
,179,360.400,am,D,,Blue Angels - Comm    Solos
```

(Yes, I know there are many more Blue Angel frequencies. This is a "portion.")

The AutoProgram function allows the user to program the scanner's channels from a plain text file that's been organized and structured to a specific format.

When selected, a Dialog Box pops up to allow selection of the file. Choose the desired file by highlighting it and press Enter. If you change your mind and don't want to load a file just press ESC. Additional data may be requested depending upon the option selected.

NOTE: The file must be a text file with data in the format shown below. The AutoProgrammer requires the delimiters (commas) to be present. The field sizes shown are maximum values.

The AutoLogger generates text files in exactly the same format as required by the AutoProgrammer, so the description will apply to both:

The first field is blank (not important here).

The next sets channel 160 to be programmed with 250.800MHz, AM mode, Delay set, no LockOut, and a brief description of the assignment.

The AutoProgrammer ignores the description. Easy as 1-2-3 when you examine it.

Table 8-7 shows the exact structure of an APF and LOG file, and descriptions of each element follow that.

Table 8-7: APF and LOG file structure

1 Filter	2 Chan	3 Freq	4 Mode	5 D	6 L	7 Ops	8 Step	9 Date	10 Time	11 Duration	12 Anything
aaaaaaaaaaa,	BBB,	CCCC.CCCC,	DDD,	E,	F,	GGG,	HHHH,	IIIIII,	JJJJJJ,	KKKKKK,	xxxxxxxxxxxxxxx
a	B	C	D	E	F	G	H	I	J	K	*your data*
12	3	9	3	1	1	3	4	6	6	6	255 chars/line
						<------ These fields, if sent to the ------- >					
Commas distinguish one						<------ CE-232, are *ignored* by the ------- >					
field from the next						<------ AutoProgrammer ------- >					

Now, here's what that all means...

A – Reserved field consisting of one character that is always logged blank by the AutoLogger, used by the AutoProgramming function only and can be up to 12 characters.

B– Up to three characters (0-400) represents the **channel #** or **search bank #**.

C – This field is the **frequency** and consists of nine characters (including the decimal point).

eg: 1234.6755 (MHz)

D – Receive Mode (WFM, NFM, AM) – three characters

E – Delay – (**blank** = delay off , "**D**" = delay on) – one character

F – Lock-out – (**blank** = lockout off , "**L**" = lockout on) – one character

The AutoProgrammer ignores everything after the 6th comma or Field "F".

The following fields are not used by the AutoProgrammer, but are generated by the AutoLogger.

G – Op Mode – Scanner Operating Mode: three or four characters as shown below:

SrUp – Search up

SrDn – Search down

Prgm – Program

Man – Manual

Scan – Scan

H – Step Size – one to four characters, including decimal: 12.5, 5, 50 or 30 *(kHz)*

I – Date – six characters: YYMMDD

J – Start Time of signal – six characters – 24 hour format: HHMMSS

K – Duration Time of signal – six characters – 24 hour format: HHMMSS

Table 8-8: Typical AutoLogger output

Filter	Chan	Frequency	Mode	Dly	L/O	OpMde	Step	Date	Time	Duration
,	283,	450.2875,	nfm,	,		,Scan,		,950303,	164538,	000007,
,	320,	173.3750,	nfm,	,		,Scan,		,950303,	164549,	000006,
,	310,	857.6750,	nfm,	,		,Scan,		,950303,	164605,	000014,
,	306,	455.7125,	nfm,	,		,Scan,		,950303,	164626,	000010,
,	310,	857.6750,	nfm,	,		,Scan,		,950303,	164641,	000009,
,	307,	455.5000,	nfm,	,		,Scan,		,950303,	164656,	000044,
,	320,	173.3750,	nfm,	,		,Scan,		,950303,	164750,	000005,
,	320,	173.3750,	nfm,	,		,Scan,		,950303,	164801,	000010,
,	288,	161.7600,	nfm,	,		,Scan,		,950303,	164822,	000002,

NOTE: **Maintain your frequency records in a database manager program. Most database programs can import and export comma-delimited ASCII text files in the formats above.**

MORE DOCUMENTATION – FREE!

Gosh, there are a hundred other things I could tell you about that are in the documentation. The CE-232 documentation package is available for free download from my BBS.

The downloadable doc file is CE232MAN.ZIP. For now, go back and review the features and functions of the CE-232 as described in the beginning of this section.

Detailed operating instructions are available on the disk that I provide, and in the downloadable CE-232 file, and in the hard copy Manual.

WHO ELSE SUPPORTS THE CE-232 INTERFACE?

PerCon Corporation supplies frequency data on CD-ROM and floppy disks straight from the FCC's records. Yeah, so do others (they say), but PerCon is unique. For one, their prices are low, and they are the prime contractor to the FCC to produce CD's, so you don't get any more direct than that.

But the slickest thing of all is that most PerCon CD databases come with a function that produces CE-232 Autoprogrammer (*.APF) files, all ready to feed into your scanner, hands off.

That's right! You need only query the master database for records of interest, and when the query is complete you press a button to have the records compiled into CE-232 Autoprogrammer format. Not only that, but these *.APF files are keyed to serve as the CE-232's LookUp files as well.

What a package!

PerCon offers a variety of products, one or more of which are probably tailored to meet your needs and the needs of your CE-232 Interface, including a full line of FCC frequency databases, ham and repeater, and FAA Frequency/Aircraft/Pilot and Airport Databases. Write or call:

PerCon Corporation
4906 Maple Springs/Ellery Rd
Bemus Point, NY 14712
Voice (716) 386-6015, fax 386-6013

Intercept Technology makes the mother of all enhancements for the CE-232, a solid-state **V**oice **A**ctivated **D**igital **E**lectronic **R**ecorder, called VADER. Imagine, if you will, a tape recorder with no moving parts that records signals from your scanner as controlled by the intelligent CE-232 Interface.

VADER works independently from the CE-232 otherwise, but records a special log file just like the AutoLogger does, and synchronizes all recorded sound to this log file. VADER is better called an intercept analyzer.

When your recording session is finished, you can play back the material as you would with a normal tape recorder, but there is much more.

For instance, you can selectively play back by channel or frequency, skipping everything else. After an all-night recording session, you can actually follow the events and conversations in sequential order. You can play back hand-selected intercepts or automatically by channel, frequency, groupings of identical frequencies, time of day, and duration.

VADER offers sound processing and convenient controls for instant lookup and playback, including repeats and partial repeats. There's a lot more, so you've got to get the data sheet and brochure for yourself.

VADER is basically "plug and play" and quite easy to install and set up. VADER is an AT-size plug-in board that works in most AT/compatible computers, 286 and up. Mine has worked well in a 386SX/16, 486DX/50, and in my Pentium. VADER's secret is the 16 MB of low-cost on-board audio RAM that stores up to an hour's worth of continuous audio.

This normally means several hours to several days of recording time, depending on the density of activity and the number of channels or bandwidth that you SCAN or SEARCH with VADER.

The audio stored in VADER's memory can be transferred to your hard disk at any time, and can even be converted to *.WAV files for playback and processing through other multimedia accessories. Perhaps for sound enhancement?

VADER will run from MS-DOS™, Windows™, or Windows 95™ and offers tremendous power to your monitoring capabilities. For more information, write to

Intercept Technology
74 Western Ave.
Enon, OH 45323

or log on to their BBS at (513) 297-0250. Detailed information is available in their BBS Conference Area #2 and you can download a demo VADER

file from File Area #1. Intercept Technology is a high tech company with a sideline in hobby radio.

They cannot deal with casual hobby inquiries by voice phone, but once you're a customer, they'll do everything but fly out to your location to make sure you get up and running. Good guys there!

If you use a Macintosh computer and are interested in the CE-232 Interface, there may be hope. While I don't know a Mac computer from a Mack truck, at least two Mac developers have produced software for the CE-232 and the Mac computer.

If you want more information, send me a business-sized SASE with the incoming envelope clearly marked, "CE-232/Mac Info" and I will be happy to put you in touch with Mac people.

You can also send me e-mail or log onto my BBS for the information.

THIRD-PARTY PC SOFTWARE

There are third party control IBM/PC programs for the CE-232, but either I have not been authorized to release their particulars, or their programs are still in the beta testing phases.

The control program that I provide for the CE-232 is very powerful and fully functional, but these other guys have worked to make theirs even better. You can log onto my BBS for the latest.

IF YOU DON'T WANT TO ROLL YOUR OWN.....

THIS SECTION WAS INTENDED AS A SERVICE, NOT AN ADVERTISEMENT, BUT YOU ARE AUTHORIZED TO BECOME INDIGNANT IF YOU MUST.

The CE-232 is available as a Kit of Parts, Program Disk, and detailed Instruction Manual for the PRO-2004/5/6. Selected other scanners are also supported at extra cost.

The Basic Kit includes a printed circuit board, microprocessor with socket, 9 IC's, 4 resistor networks, 1 crystal, 7 resistors, 8 diodes, 15 capacitors, and a partridge in a pear tree.

NOT supplied are: computer, scanner, serial cable, common IC sockets, wiring, lugs, connectors, pin-line sockets, tools, solder, project box, and optional items.

The kit is functionally complete. Whether you use it or gather the parts yourself, the disciplines are the same. Assembly and installation require basic soldering skills, patience, and the ability to read and follow directions.

Installation, whether in a project box or inside the scanner, is a mechanical task. The CE-232 has been beta-, gamma-, and market-tested by hundreds of hobbyists, from entry level to expert.

Construction and installation typically requires 6-12 hours. For a hobbyist, the best results are obtained if the work is broken into segments of 2-3 hours each.

IF YOU CAN'T FIND ALL THE PARTS...

But you still want to roll your own CE-232 Interface, then you can get the most critical ones from me, independent from the kit offered above. There are only two parts that have been an occasional problem: IC-2 and IC-3.

IC-2 is called an "Undervoltage Sensing Circuit," the purpose of which is to prevent the MPU (IC-3) from operating when the supply voltage is too low. This is a critical part and cannot be substituted or eliminated.

Part numbers known to be viable are the Motorola MC34064 and the Texas Instruments TL7757C. I don't know of others. The MPU is a Motorola 68HC11F1FN and there are no substitutes. A good independent source of either IC-2 or IC-3 is Future-Active Electronics, (800) 757-9438.

If they are out of stock, and you can't find an alternative retailer, write, or call my BBS for a price. DigiKey Corporation is a reliable supplier of all the rest of the parts required for the CE-232.

For that matter, you can get most of the resistors, capacitors, and connectors from Radio Shack. You can even special order most of the chips and the crystal from Radio Shack.

If you prefer, I can usually provide one-stop shopping for almost anything you'll need, but please understand that I am not a parts-house and cannot price-compete with the big guys. Please don't expect me to sell a chip for the same price as the company that sells a few thousand a month.

Therefore, I do not provide common components on a piecemeal basis. *Table 8-9* is a list of what I *can* supply, should you have supplier problems.

Table 8-9: What I can provide...

Item	Description
CE-232K1	CE-232 Kit of Essential Parts, Program Disk, detailed Manual
CE-232K2	CE-232 Assembled/Tested Board, Program Disk, detailed Manual
Program1	Current CE-232 program, and supporting files/docs: 3.5" disk
Program2	Current CE-232 program, and supporting files/docs: 5.25" disk
PCB	Etched/Printed Circuit Board, ready to assemble
IC-3	MC68HC11F1FN Microprocessor Unit
XU-3	PLCC 68-pin Leadless Chip Carrier (LCC) Socket for IC-3
IC-1	MAX232CPE or AD-232 RS-232 Receiver/Transmitter (I/O)
IC-2	TL7757C or MC34064P-5 Undervoltage Sensing IC
IC-4,5,6,7	74HC4066 Quad Bilateral Switch, 4 each
IC-8	78L05 Voltage Regulator, +5V @ 100mA, TO-92
IC-9	74HC4050 Hex Non-inverting Buffer
RN-1-4	Resistor Networks, 4 each
X-1	Microprocessor Crystal, quartz, HC-18, 8MHz
R1-7	Resistors, all required, 7 each
C1-15	Capacitors, all required, 15 each
D1-8	Silicon switching diodes, 8 each
CE-DOC	The complete Assembly, Installation, and Operation Manual for the CE-232
XU-1,4-7	IC Socket Kit, 1 each, 16 pin DIP, and 4 each, 14 pin DIP, machine pin
J-1	DB-9 jack, male
J-2	DB-25 jack, female
W-1	Serial cable, 9-cond, straight-thru, w/female DB-9 and your choice of other end
W-2	Parallel cable, 25-cond, shielded, (DB-25 male)-to-(dB-25 male)
Misc	Pin-line sockets, strip of 16 (4-8 strips required)

Contact me by BBS, FAX, e-mail, or U.S. Mail for a current price list. You can also call my business office for matters of this nature, with the understanding that I'm not available by phone and that the receptionist does not offer tech support of any kind. Here are the "contact" details once again:

COMMtronics Engineering
World Scanner Report
PO Box 262478
San Diego, CA 92196-2478

BBS/FAX (619) 578-9247, 5:30pm-1:30pm, Pacific
Voice admin: (619) 578-9247, 1:30pm-5:30pm, Pacific
Internet: bcheek@cts.com
Compuserve: 74107,1176
FidoNet: 1:202/731

Table 8-10: Resource List

In no particular order of preference, the following companies are known to provide parts, materials, and other resources essential, useful, or supplementary to the CE-232 Interface:

All Electronics Corp.	PO BOX 567	Van Nuys	CA	91408 . (800) 826-5432	Parts/Materials
COMMtronics	PO Box 262478	San Diego	CA	92196 . *(619) 578-9247	CE-232 Source
Derf Electronics	37 Plain Ave	New Rochelle	NY	10801 . (800) 645-5030	Parts/Materials
Digi-Key Corporation	701 Brooks Ave So	Thief River Falls	MN	56701 . (800) 344-4539	Parts/Materials
Electronic Salvage Parts	706 Middle Country Rd	Centereach	NY	11720 . (800) 645-5030	Parts/Materials
Fordham Radio	260 Motor Parkway	Hauppauge	NY	11788 . (800) 645-9518	Test Equip/Tools
Future-Active Electr	41 Main Street	Bolton	MA	01740 . (800) 757-9438	Parts/Materials
Hosfelt Electronics, Inc	2700 Sunset Blvd	Steubenville	OH	43952 . (800) 524-6464	Parts/Materials
Intercept Technology	74 Western Ave	Enon	OH	45323 . #(513) 297-0250	Vader
JameCo Electronics	1355 Shoreway Rd	Belmont	CA	94002 . (415) 592-8097	Parts/Materials
Jensen Electronic Tools	7815 S. 46th Street	Phoenix	AZ	85040 . (602) 968-6231	Tools/Supplies
MCM Electronics	858 E. Congress Park Dr	Centerville	OH	45459 . (800) 543-4330	Parts/Materials
Mouser Electronics	2401 Hwy 287 No	Mansfield	TX	76063 . (800) 346-6873	Parts/Materials
Newark Electronics	5308 W. 124th ST	Alsip	IL	60658 . (312) 371-9000	Parts/Materials
Parts Express Intnti	40 E. First Street	Dayton	OH	45402 . (800) 338-0531	Parts/Materials
PerCon Corp	4906 Maple Springs	Bemus Pt	NY	14712 . (716) 386-6015	FCC DB
Tandy National Parts	900 E. Northside Dr	Ft. Worth	TX	76106 . (800) 442-2425	Parts/Svc Manuals

** On my BBS – Voice 1:30-5:30pm, Pacific Time. BBS/FAX all other times*

 # BBS number only – no voice

IF YOU WANT TO WRITE YOUR OWN SOFTWARE...

I'll help as much as possible.

I can provide a "developer's toolkit," with the understanding that the original developer is no longer available for support. In a word, you're on your own if you write your own software for the CE-232 Interface. On the other hand, the price for the toolkit is "right" *(free)*.

But it's not that big a challenge... A number of third-party developers have successfully used the toolkit without complaint.

To get this toolkit ***at no charge***, contact me on the BBS and I'll direct you to the file.

Good luck to you... and remember to share your insights with the other hobbyists who can benefit from your experience. Also, you may do a whizbang software package that really deserves to be shared with others... use my BBS for that.

SO YOU'RE COMPUTERIZED NOW...

Yes, now the nastiest part of our hobby is being done by a machine that doesn't know the meaning of the word "boring."

Your scanner will be programmed, and your files will be maintained, automatically, by that ultimate ingredient of the Ultimate Scanner – the computer!

CONGRATULATIONS!