Voltages?
What are False Positives?
What about Ripple?

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Electrical Safety always comes first. The chances of you getting hurt or killed might be one in ten million but remember; that one could kill you. Pull the plug!

When trouble shooting equipment you rely on fundamentals and then fill in the gaps with bits and pieces. I will present some specific data about a given item or problem and I hope this information may be used by you to build your service database. The real advantage in reading this material is when you get a sense of the information and then intermingle what you have read into your order of things. I do not imply my way is the best or only way to do something.

When troubleshooting a problem it may often be tracked down by measuring voltages. Let's start at the beginning with AC power line voltages. Often a problem may be the AC line voltage but since it can vary you have to measure the voltage <u>when the problem exists</u>. One case history that comes to mind is a location with 6 pool tables with a bill acceptor in each table. The vendor spent several months trying to find and fix bill acceptance problems on just one of the six pool tables. He replaced the acceptor many times, installing new power supplies, installed heavier gauge wiring, ete cetera. He finally gave up! He was told to buy a meter that has a Max-Min hold feature so he could track the AC line voltage. He purchased the meter and installed the meter on the problem pool table's AC outlet. After a week, he went back and he asked about the bill acceptance. He was told it did not accept bills on Saturday night. He checked his Fluke meter Max-Min voltages and he found the high was 120 VAC but when he switched the meter to Min he found it at 93 VAC. He switched the meter to read the line voltage and it was OK at 117 VAC. Until now he only worked on the problem during Monday through Friday day time so he went back on a Saturday night and he setup the meter were he could watch it. Everything was normal for a while but then the voltage suddenly dropped down to 94 VAC. At the same time, he noted the sound of the smoke the smoke eater coming on. He put a bill into the acceptor and it did not accept the bill. His fix was to get the AC from another plug until the owner got the AC problem resolved.

Take note that voltage measurements must be made while the problem exists and meters with Min-Max Hold features maybe required to help locate a problem. How are you going to find high or low voltage problems when you are not there? I did say "high" I remember one location where the voltage jumped up to 134 vac when a few industrial sites on the street shut down at 3:30 PM. Will you be able to establish the AC line problem does exist when something like a compressor in a food or beverage machine, air conditioner, air compressor in a game, photo copier, water cooler, coffee machine, microwave, smoke eater, et cetera comes on and/or just when it starts? Maybe there is a loose screw connection in the electric power panel? You have to ask yourself if the problem you are trying to find might be something external to the unit you are trouble shooting.

I once asked a game service manager what was the main problem he faced in the field. He stated many of the field problems were related to the AC line voltage. These problems were too many games and other devices on a single circuit, line voltage swings, miss-wired AC plugs and missing AC line grounds, et cetera. He also installs one of those AC line protectors on every game because of noise and spike problems.

Are line protectors worth using? I would say yes based on the damage I see on power supplies and computer control boards after we have lighting storms go through our service area. Many of these AC line protection devices also knock down a lot of the noise and spikes which come down the AC line.

In some cases, operators and manufactures have installed devices like uninterruptible power supplies or AC line voltage regulating devices to resolve problems caused by worst-case AC line ups and downs plus those dangerous noise and spikes.

What about ripple ? In trouble shooting a problem you might measure the AC line voltage, DC voltages and document the measured values. How about going to a deeper level of troubleshooting? To measure the noise and/or ripple on a DC voltage many people would normally use an oscilloscope but who carries a scope around with them? If you did have a scope would you know how to use it? No! Well here is a very important Bear service trick for you. Measure the DC voltage with your meter as you normally do. Leave the leads connected and then switch the meter to the AC scale. The majority of meters will now be reading the AC ripple and noise voltage riding on the DC voltage. This ripple and noise measurement information may not mean much to you now but over a period time you can record the voltages of good and bad units and build yourself a reference library which can turn out to be very important to you.

Be careful when using auto-scaling meters. Let' s say you read 435 volts but you may fail to notice the MV on the meter has come on. This would make the value 435 MVAC or .435 VAC

In order to give you an idea of how to build a history of voltage and ripple data I have recorded measurements taken from many working power supplies used in the Rowe BC-11, 115, 12, 12R, 20, 25, 25MC, and 35 bill changers. I then looked at the max and min measurements from each voltage 5, 14, 30 and 40 volt sections along with the VAC ripple/noise readings from each section and placed them into the table presented below.. The line voltage is a factor so always record the line voltage too.

Voltage	5	5	14	14
Type	VDC	.Ripple	VDC	Ripple
MAX	5.10 .	040	14.28	.600 .
MIN	4.91 .	035	13.90	.430

Voltage	30	30	40	40
Type	VDC	.Ripple	VDC	Ripple
MAX	30.84	040	43.20.	036
MIN	27.59	.006	42.10	.030

Before going any further let me say LED indicators really do not mean much in terms of the amount of voltage or the amount of the ripple. That said, lets look at one example in the table, (with an average line voltage of 122 VAC), the 14 v section had a range of to 13.90 to 14.28 VDC. The ripple range is .420 VAC [420 MVAC] to .600 VAC [600 MVAC]. I do not show bad ripple readings greater than .600 VAC which were caused by things like a bad filter capacitor, et cetera. There are times when you needlessly replace the computer center or other parts to resolve a problem but the real problem could be bad voltages and/or too much ripple. There are many problems that are related to the ripple/noise voltage. When the voltages are outside the parameters shown in the chart a repair is normally required. These repairs include replacing diodes, filter caps, and other parts or perhaps re-soldering bad connections, et cetera. Sometimes the contacts or the connectors for the power supply card have to be repaired. In the Rowe BC-11, 115, 12, 12R, 20, 25, 25MC, and 35 the 30 VDC pass transistor or the 5 VDC regulator mounted on the main housing of the power supply may have to be replaced.

Measurements should be taken before you turn the power supply off. If you turn off the power supply even for a second you may never see or locate the problem. One example of a 5 VDC problem occurs in early Rowe BC12 and BC12Rs. You may have a condition where the P1 and P4 settings keep changing but you do not know why. If you measure the 5 VDC you may find it is low or changing. If you turn off the supply even for a second the low voltage may restore itself to 5 volts for a period of time and you set P1 and P4 and walk away confiden the 5 volts is OK. If you did not measure the 5 VDC first you really don' t know if you fixed it or not and you may be back repeatedly for the same problem. One fix for this 5 VDC problem is to replace the small ceramic disc cap .1 MFD on the socket of the 5 VDC regulator with a 2.2 MFD tantalum capacitor [Rowe part # 700251-07].

When you are trouble shooting a problem before you do anything first stop, look, analyze the problem, record error messages and then measure voltages. There are many other problems akin to a bad solder connection/s on a board or a problem with a component which goes away temporarily when you turn the power off for a while or in some cases, even for a second. After turning the power off and then back on again you may be able to check out the equipment and sign it off as working but this may be a false positive. Turning off the power in most cases does not provide a long term fix and you may have to return to the site to fix the same problem in a few hours, days, or weeks. You may be back repeatedly for the same problem until you realize your order of things has an analytical fault and an alternate approach is required.

Generally 5 VDC regulators such as 309 or 7805 need an input of at least 8.5 VDC [varies because of the ripple factor] and anything below this value may effect the system's operation. Low voltage or a high ripple factor can cause various system problems. An example of low 8.5 VDC is often found in many Rowe jukebox power supplies. This can occur in both very old or some later Jukeboxes. Some service people never measure the 8.5 VDC and fewer service techs make the AC ripple/noise voltage measurement. Some of the new Juke power supplies go for + 9.2 VDC. Note: Over the years Rowe as updated the older power supply boards and now use new switching type power supplies in many of their units. If nothing else start measuring and recording the AC line voltage, DC voltages plus the noise and ripple voltages. The one exception the 8.5v rule is when the newer switching power supplies whuch can have a rock solid voltage level and they have almost 0 volt ripple/noise level.

In other systems like the DC voltage for a Rowe CBA-2/4, UCBA-2/4 or RBA-7 [under load - motor running] at least 12 VDC is required. Where the voltage is taken from an external supply and not from a good Rowe transformer power supply the voltage may be just too low for good operation. Even if it works for while, as the acceptor ages its acceptance range may fall off to poor or no acceptance. Any supply could fail so when was the last time you measured the AC, DC and ripple voltages feeding an acceptor? In some pool tables and games the voltage maybe just to low so you can replace the original power supply with the Rowe transformer power supply or one of those small 5/12 VDC power supply cranked up to 13 VDC. In other cases resistor/s in a power supply maybe tweaked to raise the 12 VDC slightly so you end up with > 12 VDC at the acceptor.

Just measuring a voltage at the source does not mean the voltage reaches the load. Bad connectors, bad solder connection on the connector strip, wire size and its IR voltage drop, bad crimps, loose terminal screws, and so forth, are just a few of the factors to consider. Remember to measure voltages at the connected load and it should be drawing the normal current the load requires.

Circuit breakers are a device which can cause problems but they are often overlooked. Once a breaker trips it may appear to reset normally but it could be defective. The breaker looks like it reset correctly but it maybe intermittent and/or cause a voltage drop. Measure the voltage on both sizes of the breaker and or across the breaker in which case you should read basically 0 volts. Frequently an ohmmeter test on a component may not indicate there is a problem so a full load voltage measurement test is the only valid test.

A Bear Note: An ohmmeter test may show a component is bad but an ohmmeter test which indicates it is good does not always mean the component being tested is good because the test is made at a very low voltage level. At the full applied voltage and the normal current being drawn the component may fail. This brings us to false positives.

False Positives: When taking voltage meter readings you cannot always accept what you see on the meter or scope as a valid voltage reading which is capable of delivering the current you need. Without getting into ohms law when you are using a high impedance meter, or measuring voltages with a scope, you may have voltage burned carbon paths, back feed paths, leakage, bad connections, et cetera and you read a voltage value which you assume valid. In reality it may not a legitimate voltage and there can be called False Positives.

Here is a false positive for you to think about. You could assume when you turn off the AC power switch on a piece of equipment the AC voltage stops at the switch. In fact you are sure it is off because the equipment did stop operating. I have found several pieces of commercial equipment where the hot leg of the AC line and neutral where wired in reverse so while the equipment did shut down the return was opened and not the hot side of the AC line. In this case, the UL label means nothing. Any miss-wiring of the AC line could cause the same type of problem. Depending on the wiring configuration, you may find the hot 117 VAC were you do not expect to have it. By not pulling the AC plug you and the equipment are at risk! The reverse could take place at the outlet, old non-polarized outlet or plug, miss- wired outlets or plugs, extension cord, line cord, or even miss-wired within the equipment. I have seen a lot of people turn off the AC switch and start plugging and un-plugging connectors that have hot AC line voltage present on the connectors.

As you get into deeper levels of trouble shooting you will find many cases of false readings. I have already written in another article [Basic 101} stating why I prefer to use a light bulb [not neon] and I wrote about measuring voltages at the connected load. You may find false positives caused by bad electronic components including breakers, relays, switches, et cetera or maybe a poor or no connection. You may have some copper on a board has blown away but there is a burnt carbon path and you may read a false positive voltage. If you get a chance watch accomplished board techs work and note when they put down the scope probe or volt meter and they pick up the Ohm meter to make a zero (0) ohm connection test or maybe pick up a clip lead or a piece wire and starts shorting this point to that point. If you know what you are doing and depending on your own order of doing things you too can do an ohm meter test or use a clip lead, or a piece of wire to short one point to another point. Do not be misled by false positive measurements and be prepared to find alternate ways to locate and fix a given problem.

One of the most common false positives is to believe an ohm meter test on a component is the final word that the component is good. When troubleshooting remember your assumptions or conclusions may be based on false positives so at some point in time it maybe a good idea to ask yourself if you could be dealing with data based on false positives. Remember my pool table story? In order to get the problem fixed he had to change his order of doing things. He had to get new test equipment, be there when the problem occurred, and get new information in order to get this problem resolved in a few hours. If he did not take an alternate path the problem may have never been resolved.

Where you connect the meter leads could give you a false positive reading. You may have the – meter lead on a common and/or ground and your voltage measurements tell you the voltage is OK but perhaps the load' s return is open at [A open B] and the return wire never gets back to the return [neutral] or ground. While I show 117 VAC here it could be any voltage and any electronic component. Let assume this load is a motor.

```
117 VAC hot -----o------------------------o
                 |                        |
               Meter          [Load= motor]
                 |                        |
117VAC return –o--------A open B-----o
```

You read the 117 VAC at the motor with the + lead and the – lead not on the motor but back on a common or ground. You found the 117 VAC [so you think] at the motor so you replace the motor but new does not work and you do not know why. The problem is a false positive because you assumed the voltage was at the load. If the new motor does not work and you do not get stressed out you can start looking for the open wire, a bad connector pin, a section of burnt copper, or a bad solder connection, and so on. Often the open occurs because a motor shorted and the short takes out a connector pin, hunk of copper, piece of wire, etc. You could home in on the open circuit problem [point A open B] by leaving the – lead on the return and use the + lead to find where you no longer read 117 VDC and where you start reading the 117VAC. Maybe your order of things is to pull the AC plug and use the ohm meter to find the open. Always start by measuring the voltage at the load.

This is another nasty false positive.

```
117 VAC hot------o----[Resistance]----o
                  |                    |
Source         Meter                [LOAD]
117VAC return__|_-o/o___________o
                    Switch
```

Load may be a motor relay, triac whatever

The resistance could be a cold solder joint, bad connector pin, or one of those circuit breakers you just read about, switch, bad fuse holder, loose connection or whatever but if the switch o/o for triac, SCR, transistor, whatever] is OFF you measure the full voltage and you say OK! Wrong! You got a false positive. When the switch device is turned ON the voltage could drop anywhere from almost normal down to zero (0) volts at the load and you do not know why. The false positive led you to believe the voltage as OK when in fact the IR voltage drop of the resistance will reduce or kill the voltage when the switch is turned on. With the switch in the off position there is no current (0 amps) being drawn so zero (0) times R [any resistance] = a zero (0) voltage drop across the resistance because no current is being drawn through the resistance so you measure the full source voltage.

```
Eload = Esource - EResistance :
    117 VAC Esource
 -    0  VACEResistance   I*R drop
   ---------
 =  117 VAC
```

at the load which is a false positive. The load could be electronic devices, bulb, common 24 V [AC or DC] relay circuit, solenoid, et cetera. Sometimes a short occurs and the short creates a resistance in a connector pin, a hunk of copper is wiped out and ends up with only a carbon path, and so on. While I have shown the resistance on the hot side the resistance could be anywhere along the path. No matter what the voltage or the load is, it is all the same: A BIG FALSE POSITIVE!

That Mr Ohm guy must have been a good tech to come up with his Magic triangle:
Just cover the one you want and do the math. Keep track of those decimal points.
Calculators can be an important tool.

```
   E
----------
 I  *  R          E=I*R   I=E/R   R=E/I
```

A unit's markings may not be correct so do not go crazy or waste your time if you do not come up with the voltage listed unless you really know what it should be. A marked + 24 VDC might normally be 32 VDC all the time. Sometimes many of the voltages listed in manuals or marked on a unit may be wrong. You may see + 8 VDC which might really be 7.5 VDC 8.5 VDC, 10 VDC, 12 VDC, or 14 VDC, et cetera. Which one is right? You may also find a given type of unit has one, two, or more versions and they all have slightly different voltages. On a given unit, schematic, or manual you may find the markings/labels are wrong. Correctly made your documentation maybe more accurate.

I am not old enough to have known Mr. Ohm but in 1948 as an eight grader with a little elementary algebra my mentor, Mr. Keeler [a radio station engineer] after school taught me Ohm' s Law and other material which I did not really completely understand at that time. He was a good teacher and he gave me many problems to solve. I got good at getting the right answers but it took years before I began to comprehend what he had taught me. Jack also set a great background for voltage point of reference, you know + and – stuff and control ladders, etc. Jack had his own law:
Keeler's Law: Do The Math!

With my background and point of reference the only thing I can suggest to you is pull out the calculator occasionally.

Measuring a DC motor' s brush electrical noise like those used in bill acceptors says a lot about the condition of the motor brushes. I will write more about this in FEK and A MOTOR TEST UNIT!" but here it is in a nut shell. Assuming a 12 VDC motor you put the meter leads on the 12 VDC feeding the motor and put your meter on the AC scale. You are now reading the AC motor ripple plus the brush noise. Granted there will be a little data keeping because motors may, or may not, have noise filters in the motor or the filters may be on an interface board. The noise will vary with the amount of drag on the motor. You will have to measure a lot of good and bad motors to build your data base to get the values of what is acceptable or what is substandard.

What we are dealing with here is your order of doing things and voltage measurements, ripple and noise measurements, Ohm' s Law and false positives which are all fundamentals which all lead to a little deeper level of service procedures. For those who did not know about ripple/noise measurements perhaps this article will help you get started. Whatever type of equipment you work on the key is to take AC line, DC, ripple/noise voltage and motor electrical bush noise measurements on both working systems and non-working systems and to keep the data in a notebook or a place were you can get to it. I hope you have picked up a few bits and pieces that will increase your level of trouble shooting proficiency.

False positives can have very serious side effects that can bring on a serious a mental sick day, week, month, or life.

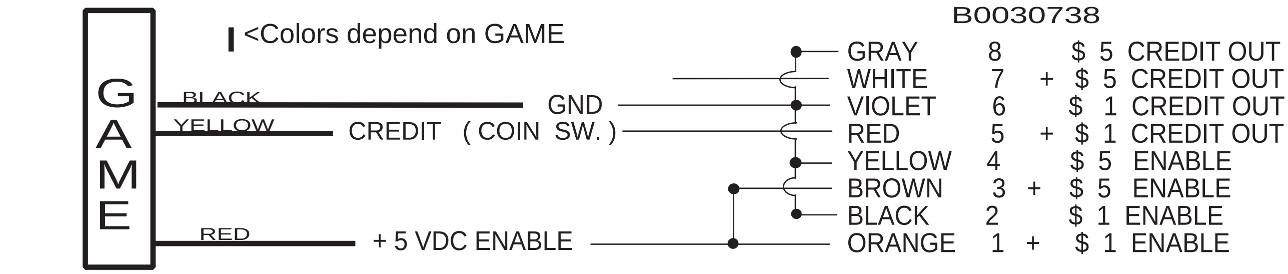
"May the meter be with you!"
"May the false positive not be with you!"

CBA-2 / UCBA-2 TYPICAL GAME OR POOL TABLE ($1 and $5 ACCEPT) AND USING B00307-38 INTERFACE CABLE plus other data

Switches 6 and 7 set output pulse, each add 100 msec. With 6 and 7 off output pulse = 30 msec.

Typical switch settings 2 3 4 7 ON

NOTE: Corrected drawing Jan 25,1996
Previous were incorrect !!!!



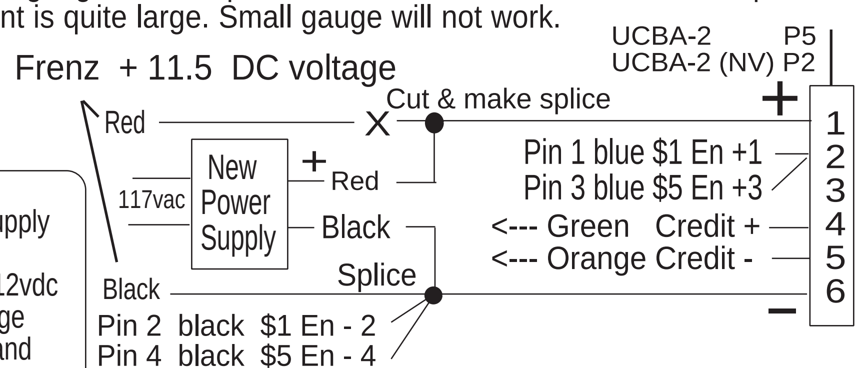
For any given interface for a CBA-2/UCBA-2 it is best to look at the manual. Interface. Switch settings vary a great deal. This interface is just one of many interfaces. This interface uses ROWE's 8 wire cable plugged into P3.

Some systems take the DC votlage for the CBA-2/UBA-2 from the existing system rather than a ROWE transformer power supply. The DC voltage must be at least 12 vdc (under load - motor running) at the acceptor for a proper acceptance range. Some power supplies are not regulated, wires are too small, poor connections exist, or the line voltage drops from things like brown outs or when a smoke eater comes on than the acceptance drops off or has no accept. The voltage must be measured when the acceptance problem exists and/or use a meter with a MAX-MIN HOLD feature.

Full Court Frenz II with UCBA-2: Switch settings = 2 6 7 on.

The voltage of 11.5 vdc is too low. Use the Rowe power supply transformer (Part number 4-08231-01) or [other > 12 vdc supply] and put into the system. Pick up the AC after the fuse and switch. At the UCBA-2 DC power plug, cut the Red +11.5 volt wire and tie the new power supply (+) red wire into the UCBA-2. Splice in the (-) side by pealing back some insulation on the black wire near the UCBA-2 and slice the black (-) of the Rowe tranformer or power supply to the existing black (-) side of the Frenz II system. Use large gauge wire for power connections to reduce the IR drop in the wire. With motors running the current is quite large. Small gauge will not work.

New power supply:
Rowe CBA power supply or a small switching supplywith only the 12vdc is used turn up voltage adjust to get 13vdc and use large gauge wires.



Alternate cable for $1, $5 Enables Part # B00307-38

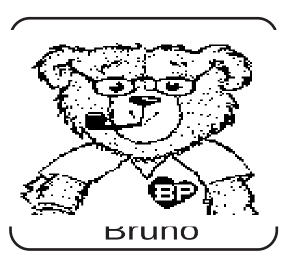
Pin 1 Orange
Pin 2 Black
Pin 3 Brown
Pin 4 Yellow
Pins 5-8 not used

Typical Crane interface

GRAY	8		
WHITE	7		
VIOLET	6	-	CREDIT OUT
RED	5	+	CREDIT OUT
YELLOW	4	-	$ 5 ENABLE
BROWN	3	+	$ 5 ENABLE
BLACK	2	-	$ 1 ENABLE
ORANGE	1	+	$ 1 ENABLE

P3 CABLE PART #
B0030738

Typical switch settings = 1 2 3 4 ON



CBA_GAM1N.ps
Jan 6, 2002 1 N

At some point in time you may want to check out my other Bear notebook articles because they contain a great deal of related material. You will find them on Bruno's Page in http://www.eastcoastamusements.com/ then: left click on: **Visit his page for service notes and tips.** **OR:** http://www.eastcoastamusements.com/services.htm and then click on the BEAR with the flower!!

Note: These files were checked with Acrobat Reader 7.0. Earlier versions **may not** view/print correctly. I know version 5.0 will not work correctly.

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You will want to check the East Coast Amusements site for revised or new articles. I do have more titles in the works. Here are some the posted articles.

ROWE 4900 ACCEPTOR ISSUES
ROWE BC-1 BILL CHANGER
THE MAGIC WAND (Dick's - my favorite)!
CONNECTORS - FIXING AND TESTING (another good one)
ROWE BILL CHANGER HOPPER REPAIR
MEASURING VOLTAGES
BUCKET POWER ON ERRORS
ROWE STACKERS
MAG HEAD LOOP SECRETS
DREMEL & ROWE STUFF
FEK MOTOR TEST UNIT
OBA ACCEPTORS
JACKPOTTING, FS, BUCKET POWER ON & CRASHES
BC-8 to BC-35 Bill Changers
CBA_UCBA
Basics_101
BCxx00_bill_changers

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Please take note that East Coast Amusements is supplying the Bear Note pages on their web site for you and for me at their expense. I just write and East Coast Amusements does all the rest.

To East Coast Amusements
> THANKS ! Bruno 1F