P.A.C.T. PC^2

For Rev. Bx Software

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Introduction

We've been building chronographs since 1983. Our design philosophy is to build for the customer, not the engineering department. Whenever a PACT customer calls with a suggestion for improvement (or a complaint) we write it down and act on it. We incorporate most of these changes into our product line on a continuous bases. However, some of them would require a complete overhaul of the chronograph to implement and that's exactly what we've done. Your PC^2 (pronounced PC squared) incorporates every practicable (and affordable) neat idea that's been suggested to us over the last ten years. We've kept things like the printer and serial port optional on this machine in order to let you buy only the features you want.

The design of your PC^2 is left wide open for future software up-grades. So you can count on a long and interesting string of refinements and additions. These will always be made available to you at a minimum cost. What form will these changes take? You tell us!

We encourage you to spend an hour or so at the range with your new PC^2 and this manual working down the learning curve. On one hand a 12 page manual for a chronograph may seem a little excessive, on the other hand the software in your chronograph contains over 8000 lines of code. Were we to actually walk you through every possible permutation of key strokes this manual would get a lot thicker. You wont get your moneys worth out of this chronograph if you don't get past the basic chronograph functions.

System Overview

The PC^2 has a completely redesigned "Hot Key" user interface which allows the shooter to examine any aspect of his velocity data on a "real time" basis without having to end the particular firing session.

> *Whenever you turn the PC^2* on it will come up in chronograph Mode, waiting for you to fire, with all the defaults reset. If you get "lost" in the software just turn it off and back on again.

In normal operation the PC^2 will display the current average velocity of your string as you fire. This updates automatically each time with each shot. Because the PC^2 is primarily intended for use as a chronograph, the majority of the keys are dedicated to easy access of the advanced features of the PC^2. By pressing the appropriate Hot Key you can make the PC^2 display the Extreme Spread **EXTM SPRD**, Standard Deviation **STD DEV,** Mean Absolute Deviation **MAD** and Highest and Lowest Velocities **HIGH LOW**.

Chronograph Operation

The on/off switch is located on the back of the chronograph. Switch it to **ON**. The chronograph will display the model of your machine, the version number of the software installed, such as "**Chronograph Revision B1**" Our copyright notice is then displayed followed by **FIRE WHEN READY**. At this point you are ready to roll. Note that the chronograph always wakes up in chronograph mode.

If you are already familiar with chronographs, you could probably use your PC^2 without reading this section but take a few minutes to look it over, you'll be glad you did.

A Few Points to Remember

ALWAYS WEAR EYE PROTECTION WHEN SHOOTING!
DO NOT PLACE ARMOR PLATE IN FRONT OF YOUR SKY SCREENS!

IF YOU SHOOT A PLATE OF STEEL A FEW FEET IN FRONT OF YOUR FACE
BITS OF METAL WILL FLY BACK AT YOU AND *RIP YOUR EYES OUT!*

* When you set your skyscreens up, put them two feet apart, center to center. (The PACT bracket is already set to an exact 24" separation). When you switch to chronograph Mode, it assumes this separation. If you are using a different screen separation, just push the "SET" key and enter your separation in inches, i.e; 48 inches would be 48, then push "SET" again.

* chronographs don't like sunlight reflecting off of shiny bullets. If you are chronographing on a sunny day and start getting odd velocities, this is probably the cause. Rigging up some sort of sun screen so that the bullet is in the shade while it passes over the skyscreen will eliminate this problem. Also note that snow on the ground will bounce a lot of light off the underside of the bullet.

*chronographs also don't like florescent lights. If you are going to use your chronograph indoors, you will have to rig an incandescent light over each screen.

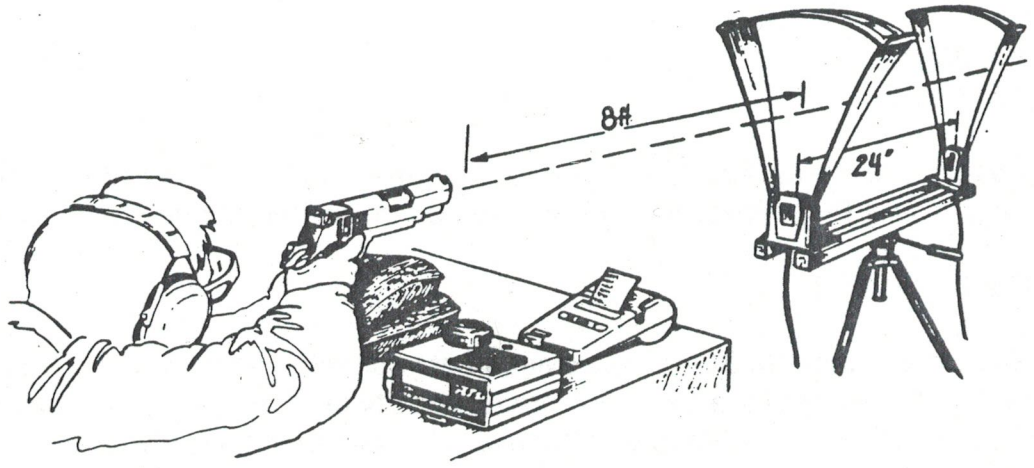
Skyscreens

Your chronograph comes equipped with the finest Skyscreens on the market. The new PACT MK5 Professional Skyscreen contains two lenses that serve to magnify the bullet and bring it into sharp focus. This provides more accurate triggering at a given range than un-lensed skyscreens. The diffuser screens provide serve as both an aiming guide and light diffuser. (On blue sky sunny days they make it easier for the chronograph to see the bullet by providing a portable cloud for the sun to illuminate.)

If you have our optional skyscreen mounting bracket just screw the skyscreens to it as shown in the illustration. The skyscreens should fit snugly against the cross pieces to insure proper screen separation. The center of the bracket is threaded for a standard camera tripod (1/4-20). If you have one this is a pretty good way to go although you can set the bracket on any flat surface.

If you are fabricating your own mounting bracket take care to insure that the screens are precisely 24 inches apart, center to center. Whatever % error you make in screen separation will result in the same % error in velocity readings.

Fit the side pieces into the cross piece and slip the unit into the skyscreen. When you have done this to each skyscreen the completed package should look like this:



Plug the first screen into the **START** plug located on the back of your chronograph, and the second screen into the **STOP** plug. With the screen displaying **FIRE WHEN READY** fire a round, aiming in such a way that the bullet passes over the center of each screen at an altitude of between 4 and 6 inches above the screens. If you get lazy and fail to set up an aiming point, you will probably shoot your second screen. (Welcome to the club!) The display should say something like this:

#001 2506.2 FPS
AV 2506.2 FPS

Each time you fire, the shot number and velocity of your last shot will appear on the top line of the display and your current average velocity will appear on the bottom.

Now let's say that an odd-ball velocity appears, like "6952.3 FPS". This is an obvious error. You can remove it from memory by pushing the "NO" key. The chronograph will "back up" to the previous shot.

Note: *The PC² needs about 1.5 seconds between shots. This is to allow the smoke to clear. If you fire too soon, the PC² will not record the shot or*

get a very odd reading and another 1.5 seconds will be required before it is again ready.

As indicated above your PC² actually calculates and updates all of you statistical data each time you fire. Most folks want the Average Velocity displayed so that is what we default to. However you can tell the PC² to display any of the statistics on the current string by pressing the appropriate key. This feature is unique to PACT chronographs. Lets fire a few more shots then work through the Hot Keys.

#005 2508.6
AVRG 2507.9

Press the **EXTM SPRD** button and the PC² will display:

#005 2508.6
ES: 14.1

This tells you the difference between the highest and lowest recorded velocities on this string is 14.1 FPS. Press **STD DEV**. The bottom line will change to:

SD 5.3, CV .21%

This tells you that the Standard Deviation of your string so far is 5.3. This is .21% (**Coefficient** if **V**ariation) of the current average velocity of 2507.8 FPS. By always showing you the SD as a percentage of the average velocity we allow you to be sure that you are comparing apples to apples when you compare the SD of one string to that of another. Press **MAD**.

MAD 3.9, CV .15%

The PC² now gives you the actual average variation of your shots (Mean Absolute Variation). Once again we express it as a percentage of the average velocity. This number is **the key** to measuring the velocity variations in your loads. The load illustrated *varies an average of .15%.* This is the number that should be used to compare one load to another. The smaller the better. Press **HIGH LOW**.

HI 2514.1/LO 2500.0

This indicates the range of velocity that the current string covers.

When you are done with your string, the PC² will provide you with a statistical summary of your string in **REVIEW** mode as well as allowing you to take a look at the individual shots again. If you have a printer just push the PRT key and you will receive a hard copy of you string number, statistical summary and each shot fired.

Push **REVIEW** the PC^2 will default to the current string number. If you want to look at a previously fired string press the appropriate number and **REVIEW** again.

HI #003 2514.1
LO #004 2500.0

The highest and lowest shot velocities and their corresponding shot numbers are displayed.

Push **REVIEW** again:

SD: 5.3
CV: .21%

The Standard Deviation of your string is displayed in addition the SD is displayed as a percent of your average velocity (coefficient of variation).

Push **REVIEW** again:

MAD: 3.9
CV: .15%

Your chronograph calculates the Mean Absolute Deviation (average variation) of your string and once again displays it as a percent of your average velocity.
One more time:

ES: 14.1 FPS
AVRG: 2507.9 FPS

"ES" stands for Extreme Spread which is the difference between the high and low shot velocities. "AVRG" is obviously the average velocity of you string. At this point you can continue to press the review key and review each shot. You can also jump to a specific shot by using the Find Shot feature. Simply enter the number of the shot you want and press **REVIEW**. The PC^2 will jump to that shot.

You can EDIT out individual bad shots with the NO button during review. The chronograph will recalculate your statistical summary less the edited shots.

When you are done reviewing your data, you can push "GO" and the PC^2 will file this string away in memory and display **FIRE WHEN READY** again.

Note: *If you don't want to mess around with all the review functions, you can start a fresh string by pushing "GO" at any time.*

Options

The REV B software has two features tied to the option button: Lead Calculation for moving targets and the calculation of Kinetic Energy (KE). Press the **OPTN** button, the display reads: **CALCULATE LEAD? (N).** This tells you that current option is lead calculation and it is set to "no." If you press **NO** or **SET** here the PC^2 will move to the next option. Let's try a lead calculation so go ahead and press **YES**.

The first thing the machine will ask you is for is the velocity of the round. Type in **2500** and press **SET**. The PC^2 will then need to know the distance to the target press **50, SET**. Now enter a target speed of **25** fps and press **SET**. The PC^2 calculates the lead at 18 inches.

NOTE: *This is the lead in a vacuum. No allowance has been made for the deceleration of the bullet. The PC^2 will slightly over estimate the actual lead required. At close range this error is negligible. With long range and/or slow bullet combinations this error becomes significant.*

The second option is the KE Calculator. The PC^2 will ask you to give it the bullet weight you're using. When you fire, the PC^2 will display the KE on the bottom line of the display.

Notes On Screen Separation

The screen separation of your chronograph can be set to the 10th on an inch. The default is 24 inches. So what's the "best" screen separation for you?

First of all understand that, unlike some other chronographs on the market which use very dated designs, there is no electronic limit on how close you place your screens. In other words you can set your screens at 6" and blaze away with your 4000+fps .17 wizbang and, while the quality of your readings will be poor, the chronograph will read. Secondly, because the bullet starts decelerating as soon as you drop it into our nice thick atmosphere, the farther apart your screens are the **greater** the instrumental error. To illustrate this principal with another extreme example, imagine the sort of readings you would get with you screens set at 100 **yards**. To be sure, you would have a wonderfully "accurate" reading which would shed little light on the question of your actual muzzle velocity.

The effect of mechanical errors in set up, such as improperly spaced skyscreens and manufacturing variances in the photo transistors and skyscreens, is aggravated by close screen separation. On the other side of the coin, lugging a six foot long mounting bracket around in your Porsche 959 is a drag.

We recommend a screen separation of 24" for most applications. This is a pretty good compromise between accuracy and ease of transport and set up. If most of your shooting is done in the 3000+ fps range you might consider stretching your screen separation out to 36 or 48 inches. However we have had some very knowledgeable people opt for the closer screen separation right through the 4000 fps mark. They have felt that the slight loss of accuracy was a small price to pay for the convenience of the closer screen separation.

How It Works

Each skyscreen contains a photo-transistor which is constantly measuring the current light level. Because the bullet is darker than the sky, when a bullet goes over the skyscreen the light level drops a little bit. The amplifier inside your chronograph takes note of this drop in light level and amplifies it to the point that the drop is big enough for the computer to notice. The computer then times how long it took for the bullet to travel from the first screen to the second screen where the light level again drops. Accurately converting this time into a velocity is easy; provided the computer knows how far apart the screens are.

Many light sensitive chronographs have a reputation for being flaky under certain light conditions. We have gone to great lengths to minimize this problem, but you **will** still occasionally run into a combination of conditions that may make it hard for your chrono to read correctly (or at all). It will help if you develop an understanding of how your chronograph works.

Your PACT chronograph is looking for a decrease in light level when the bullet passes over the screen. Assuming that enough light was entering the screen to begin with, your chronograph will always get an accurate reading. If, on the other hand, the light level increases as the bullet crosses the skyscreen, you will probably get no reading at all.

How could the light level increase? Let's say that you are chronographing under a dark blue sky and that the sun is reflecting brightly off of the bullet. Now the bullet is actually brighter then the sky above it. When it crosses over the skyscreen the light level goes up instead of down, thus we get no reading. Note that with a slow bullet like a 45 ACP fired under these conditions you may still get a reading. This is because the bullet may be over the screen long enough for the bullet to be considered the "normal" light condition. When the bullet leaves the light level drops and triggers the computer. This will still give you an accurate reading, but it is not "ideal".

If you find that your chronograph is having trouble getting readings on a sunny day with a dark blue sky you should try shooting lower over the skyscreens. You may also eliminate the problem by changing the light conditions. Put a shade to the **side** of your screens so that the bullet is in the shade when it crosses over the skyscreens, thus increasing the **contrast** in light level between the bullet and the sky. You might

also try changing the direction of fire and/or tilting your skyscreens. Remember we are trying to get as big a contrast between the bullet and the sky as possible.

If the light level increases to the point that the photo-cells in the skyscreens "saturate" the unit **will not** read. This condition is usually only encountered in the middle of the day in the summer in the southern states. When the skyscreen is saturated with light the PC^2 will simply stop reading bullets, shooting lower will probably not help. You may be able to get it running again by changing the direction of fire. Otherwise you'll need to wait a few minutes for the sun to move off a little.

Muzzle Blast

Most of our original customers were pistol shooters and we designed into our chronograph some special "anti blast" circuitry which really minimizes muzzle blast problems without sacrificing sensitivity. When you fire a subsonic (below around 1200 FPS) round, the sound of the gun reaches the skyscreens before the bullet does. If it shakes the screens hard enough they will trigger and give you an incorrect reading. For example, let's say that you are firing a .45 ACP at 850 FPS and find that your chronograph is telling you that your round is going 680 FPS. What's happening is that the muzzle blast is triggering the start screen before the bullet gets there, but it lacks sufficient power to trigger the stop screen by the time its traveled that far. So we have a situation where the blast started the computer and bullet stopped it, hence the low reading. If the blast is severe enough to trigger both screens, you will be measuring the speed of sound instead of your bullet velocity. In either case the solution is simple: BACK UP!

When you fire a supersonic round the bullet gets to the skyscreen before the blast does. Keep the muzzle a four to eight feet back from the first skyscreen to keep from beating it up. Remember that the farther your screens are from the muzzle the lower the velocity your chronograph will read (the bullet starts slowing down as soon as it leaves the barrel). If the blast shakes the screens hard enough they may trigger together causing an erroneous reading.

Another muzzle blast problem occurs when the skyscreens trigger on the **shadow of the muzzle blast.** This can happen when the sun is quartering to directly behind you and fairly low on the horizon (otherwise known as shooting north in the winter months). What happens is that you have a fairly dark blue sky, so the Glint Guard turns up its sensitivity. The sun is reflecting off the edge of the slit in your skyscreen. When you fire, your muzzle blast expands rapidly outward and as it crosses the line between the sun and your skyscreen the amount of light impacting the edge of the skyscreen slit drops producing an absurdly high reading (like 2700 FPS for your rim fire 22 pistol). Changing the direction of fire **will** solve the problem. Another solution is to attach a small piece of cardboard to the front of each skyscreen so that the slit is in the shade.

One other odd effect of muzzle blast occasionally crops up when the blast so severe that it will cause the skyscreen jacks to vibrate in the chronograph causing both the start and stop screens to trigger together. Because this occurs before the bullet to gets to the start screen no velocity will be recorded and the unit will appear to be dead. This problem seems to crop up most often with heavy revolvers, pistols chambered for center fire rifle cartridges and rifles with **muzzle brakes**. If your chronograph seems to have mysteriously capped out the moment you pulled out your .500 Linbough try firing a few rounds with a .22 rim fire or other low blast gun. If the chronograph goes back to working you'll know that shock wave was causing the trouble.

To correct the problem make sure that the cables are not stretched out (they should be touching the ground between the chronograph and the skyscreens. Secondly don't run the cables directly under the muzzle, place them to the side. The last thing to try would be to place the PC^2 behind something (shooting box, jacket, bench) so that the chronograph is not **line of sight** to the muzzle. The problem seems to only crop up with high blast guns and is worse when the sky is dark because the Glint Guard circuit will turn its sensitivity up under these conditions which of course also increases the units sensitivity to blast.

Odds And Ends

How do you know if your chronograph is telling you the truth? If the reading you get is close to what it should be you can count on it being within .5%. That's point five per cent **not** five percent. Normally you will find that the reading are actually better than that. If the unit prints a bad velocity it should be off by enough to be obviously wrong. If you get a bad reading just hit the "NO" button.

Ballistic Calculator

When we introduced our revolutionary Professional chronograph with Ballistic Computer last year we immediately began getting requests for this software in the Precision chronograph. Unfortunately the PC simply did not have the room in memory to do it as well as we'd like. This has been corrected on the PC^2 and an abbreviated version of the Ballistic Computer has been installed in your PC2 at no extra charge.

The benefits of having easy access to trajectory information are twofold. First of all you can find an ``optimized'' zero for your specific gun/load combination, zero your weapon accordingly and take to the field with a new confidence about the required hold over (or lack of it) for a given shot. The second benefit you'll enjoy (and the one you'll probably get the most use out of) is using the Ballistic Computer as a ballistics teacher. An hour or two of ``what if'' will destroy a lot of ballistic myths that most of us hold dear and make you a real bore at your next cocktail party.

The Ballistic Calculator is so easy to use that you really don't need much explanation. But it does have some trick features that may not be apparent on the first pass. Turn your PC2 on and press **TRAJ**. The first thing the Ballistic Computer needs to know is the velocity to base the calculation on. If you're shooting at the range it will pick up the current average velocity (which you can over ride) from the chronograph. If none is present in memory it will default to 2500.0 FPS. The format for entering information into the Ballistic Calculator is always the same:

1. Pushing **SET** means that you want the machine to use the data on the screen. For example when you first enter the Ballistic Calculator it will display a default velocity. If you push **SET** it will accept this and move on to the next question or calculation.

2. If you want to change the default stay away from the **SET** key and first tell the machine what it needs to know. For example if you want the machine to use 2650 FPS for its calculation just type **2650**. If you make a mistake entering a number just use the back arrow key GO to erase it. When the number entered is OK with you hit **SET** and the Ballistic Calculator will accept it and move to the next screen.

3. Yes/No questions are answered with the **YES** and **NO** keys. No **SET** is required.

4. Any time you are messing around with the Ballistic Calculator and you realize you've painted your self into a corner hit (gently now) the **REVIEW** button. This will take you out of the Ballistic Calculator. Then hit **TRAJ** again and it will let you start from the beginning with the last things you entered as the defaults.

Let's make a sample trajectory printout. If you haven't already pressed the **TRAJ** do so now so that the screen shows:

ENTER VELOCITY:
2500.0

Let's change the velocity to **2650** and press **SET**. The Ballistic Calculator will now ask you for the Ballistic Coefficient (BC). This is always a decimal number (a . in front of the number) but the Ballistic Calculator is smart enough to add the decimal if you forget it. Enter a BC of .475 and press **SET**.

Note: The Ballistic Calculator will only produce correct results with ``C1" ballistic coefficients. This is the industry standard and is what you will find in every bullet manufactures **current** specifications even if they don't label it as ``C1."

Next the Ballistic Calculator asks you if you want it to use Standard (sea level, 59 degrees) or nonstandard conditions. Tell it **YES** to accept the standard conditions. If

you answer **NO** it will ask you for altitude and temperature information. Based on the this data the Ballistic Calculator will correct the BC to your nonstandard conditions.

The next question the Ballistic Calculator asks you is the sight height of your gun. Sight height if the distance from the center of the bore to the center of you sight. If you're just playing around, use the default of 1.5". However if your making a ``for real" field drop card do it right and measure the thing (a pain in the back side). If you're using an iron sight gun (particularly handguns) don't use the 1.5" number at all. It's so far from your gun that the resultant trajectory data will be pretty bad.

The Ballistic Calculator now has all the data it needs for the trajectory calculation. You'll now need to tell the Ballistic Calculator what sort of zero you want. If you select the **MAX PB RANGE** the Ballistic Calculator will find the maximum range at which you can fire the gun with out the bullet traveling more than so many inches above or below the line if sight. This option is strongly recommended for field marksman (hunters and warriors). The default value is a six inch ``vital zone." This means that you'll end up with a zero that keeps the bullet within an imaginary six inch tube (three inches above to three inches below the line if sight) from the muzzle to the maximum ``point blank" range. The Ballistic Calculator will tell you where to zero at 100 yards for this and print a drop table according to that zero.

The second option of **SPECIFIC RANGE** is of use to target shooters. If your local range only goes to 100 yards but your competition is at 500 yards you can have the Ballistic Calculator figure out ware to set your gun at 100 to be dead on at 500. Again it will print you a drop table based on that zero. One neat trick we added to this zero option is the ability to off set the zero. Normally when the Ballistic Calculator asks you if you want an off set you'd just hit **SET** to accept the zero default. However, if you've got a gun in the safe that you have already zeroed two inches high at 100 you can use this feature to back into a drop table that puts the bullet two inches high at 100. The off set option will add about 20 seconds to the drop calculation. It is, however, quite a bit faster than rezeroing your gun.

> *At the moment the math in the Ballistic Computer will "blow up" as Dr. Haddick says, if you try to use the zero off set at pistol ranges. We are working on a way to use this feature on the up-hill side of the trajectory and will get it to you on a future up grade.*

The next three questions (starting range ending range and increment) are self explanatory. You'll probably find your self hitting the **SET** key three times to accept each default.

The final question is whether or not you want the Ballistic Calculator to print to the screen or paper. If you opt for a paper print out the PC2 will go on automatic from here giving you a print out based on your parameters. If you find your self using the Ballistic Computer a lot you really ought to look into getting a printer. It really enhances

the operation of this feature. If you want to print to the screen you'll use the **SET** button to advance from screen to screen. To make another print out just push **TRAJ** again. All of the parameters you used on the last print out will appear as defaults (assuming you did not turn the machine off) speeding data entry.

If you ever have a problem with your PC2 that you can't resolve **don't suffer in silence!** Call us at 1-800 PACT INC. We'll get you squared away.

Good Luck and Good Shooting!

DON'T BE A DUMB ASS!
ALWAYS WEAR EYE PROTECTION!