

## Understanding the Rod Force, Multi-Point and Seal Drag

### Part 3 – Seal Drag

CTW Probe has various ways of measuring the resultant force generated by the damper shaft displacing fluid as it moves in and out of the damper body.

The Seal Drag command is a method to generate a number that is an estimate of the drag force inside the damper. The idea is to move slowly through a window centered around mid-stroke, slow enough as to not involve dampening, only the effects of the seals and drag of moving the shaft. Recall, the Rod Force was a static test, stopping at mid-stroke. The Multi-point was to generate a curve, but still the data coming from static measurements. The Seal Drag was designed to generate a number based on motion, slow speed. This command is not widely used in racing but manufactures worldwide often use a version of this to check every damper.

\*\* This feature was likely added to Kurt Roehrig's Shock program in the late 90's after a request from KONI and Bilstein.

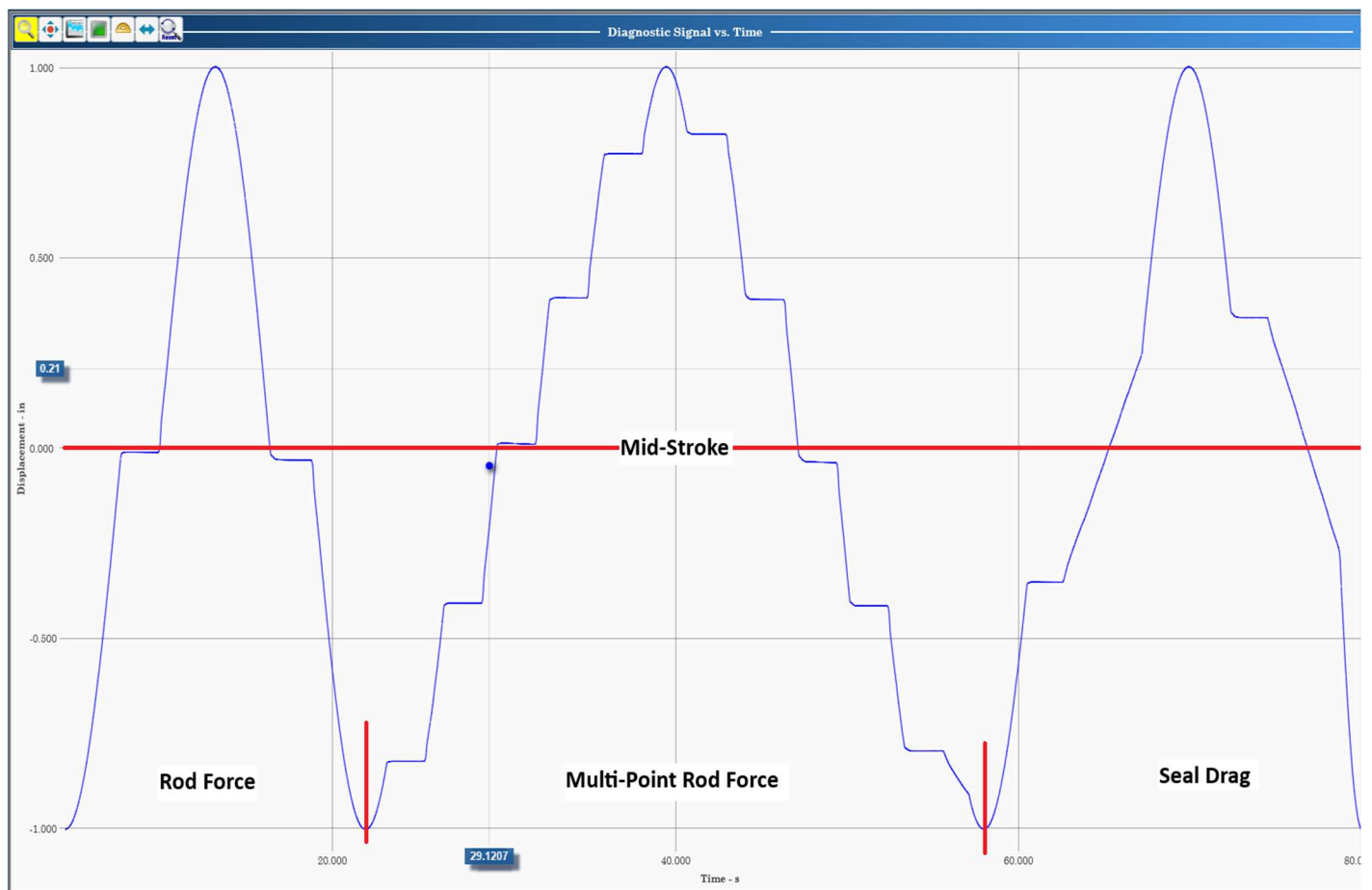


Figure 1: All 3 methods to gather information on the damper

The “seal drag” moves slowly through a User defined window centered around mid-stroke. The motion is close to a constant velocity, driving the shaft into and out of the damper to isolate the drag caused by seals, gas pressure and the mechanical fit of the piston to the body. And it most definitely will be affected by temperature. Yet another reason to warm the damper before testing.

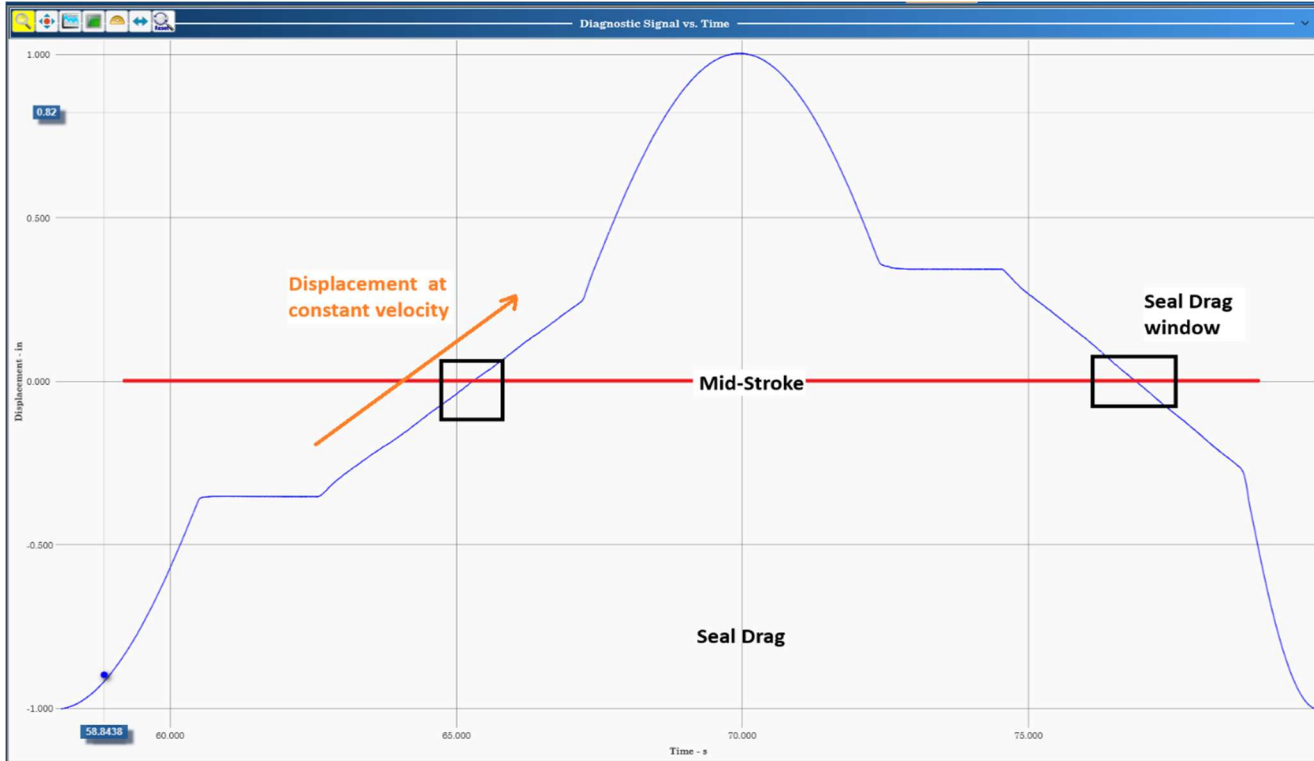


Figure 2: The Seal Drag command using Displacement vs. Time

The Seal Drag Command allows the User to define how fast to move through the window, Test Speed, and to define the Window as a percentage of the stroke.

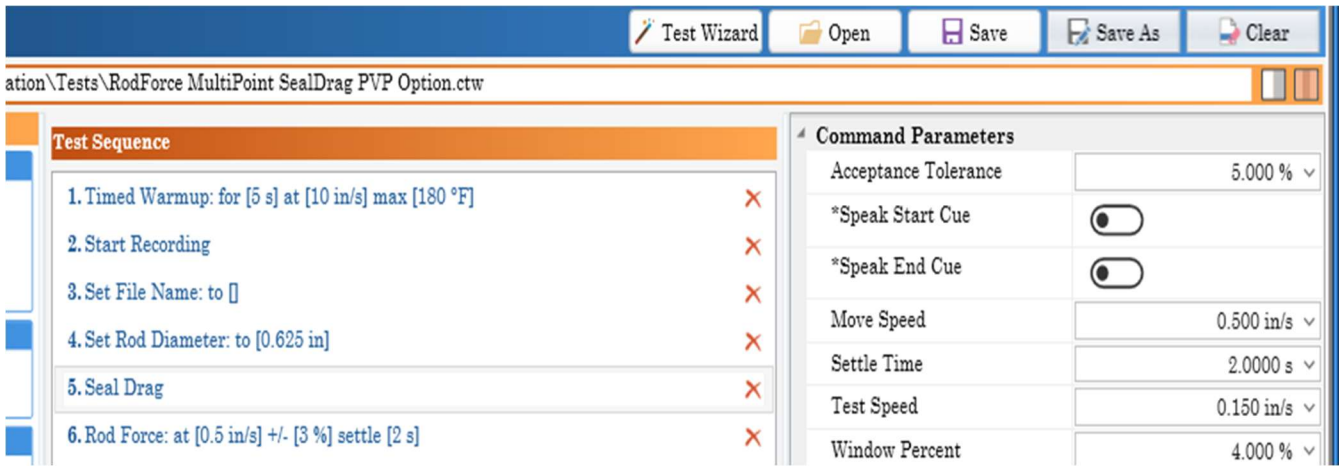


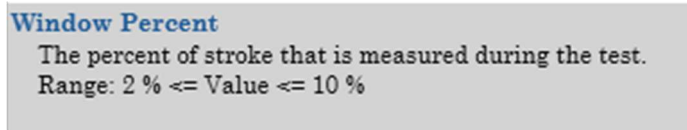
Figure 3: The Seal Drag command

**Move Speed:** how fast the dyno moves from one side to the other side, before the Seal Drag measurements.

**Settle Time:** how long to stop and wait before starting the Seal Drag phase.

**Test Speed:** you want to go slow to attempt to avoid the piston and valve stack. Noting, bleed can have an effect as bleed paths are operating at low velocities. The User could use the CTW Probe “prompt” command to allow for the bleed to be opened during this command. This will be shown later in this document.

**Window Percent:** the User defines how large a window that is used to gather the data. All of this data is summed up and reported as an average.



**Window Percent**  
The percent of stroke that is measured during the test.  
Range: 2 % <= Value <= 10 %

Figure 4: Window Percent defined by Probe

## The Math

The Seal Drag reported number must take into account the Rod Force as it is part of the Seal Drag force. You are pushing and pulling on the shaft which includes the seals and friction but also the Rod Force.

The Seal Drag adds all the data in the window in the compression direction and generates an average force. It then does the same thing in the Extension direction. These two numbers are subtracted from each other and then divided by two to generate an average seal drag in each direction. The numbers are subtracted so that the Rod Force component is removed.

Example: Seal Drag Comp = 30 lbs. and Seal Drag Extension = 10 lbs.

The Rod Force is contained in those results as a function of the damper (in each direction).

$(30 - 10) / 2 = \text{Seal Drag}$  which would be 10 lbs. in each direction. Rod Force would be assumed to be 20 lbs.

\*\* The Seal Drag result is not removed from the data, it is only reported.

### The Good Stuff – Advanced view

Probe unlocks a very powerful part of your dyno by allowing the User to view the force data during this command. This gives the User a way to see how the Force signal reacts to the slow velocity input. This directly relates to the track, the driver’s feeling during slow velocity events.

Note: The “Window Percent” has been expanded to the maximum value allowed to gain more data.

Figure 5 shows the Diagnostic view of the same damper run at two different bleed settings. You can now see a damper at constant velocity on a crank dyno, or a close approximation. Notice the large difference in the Force signal as the less bleed data shows extreme motion and erratic force values compared to the open bleed.

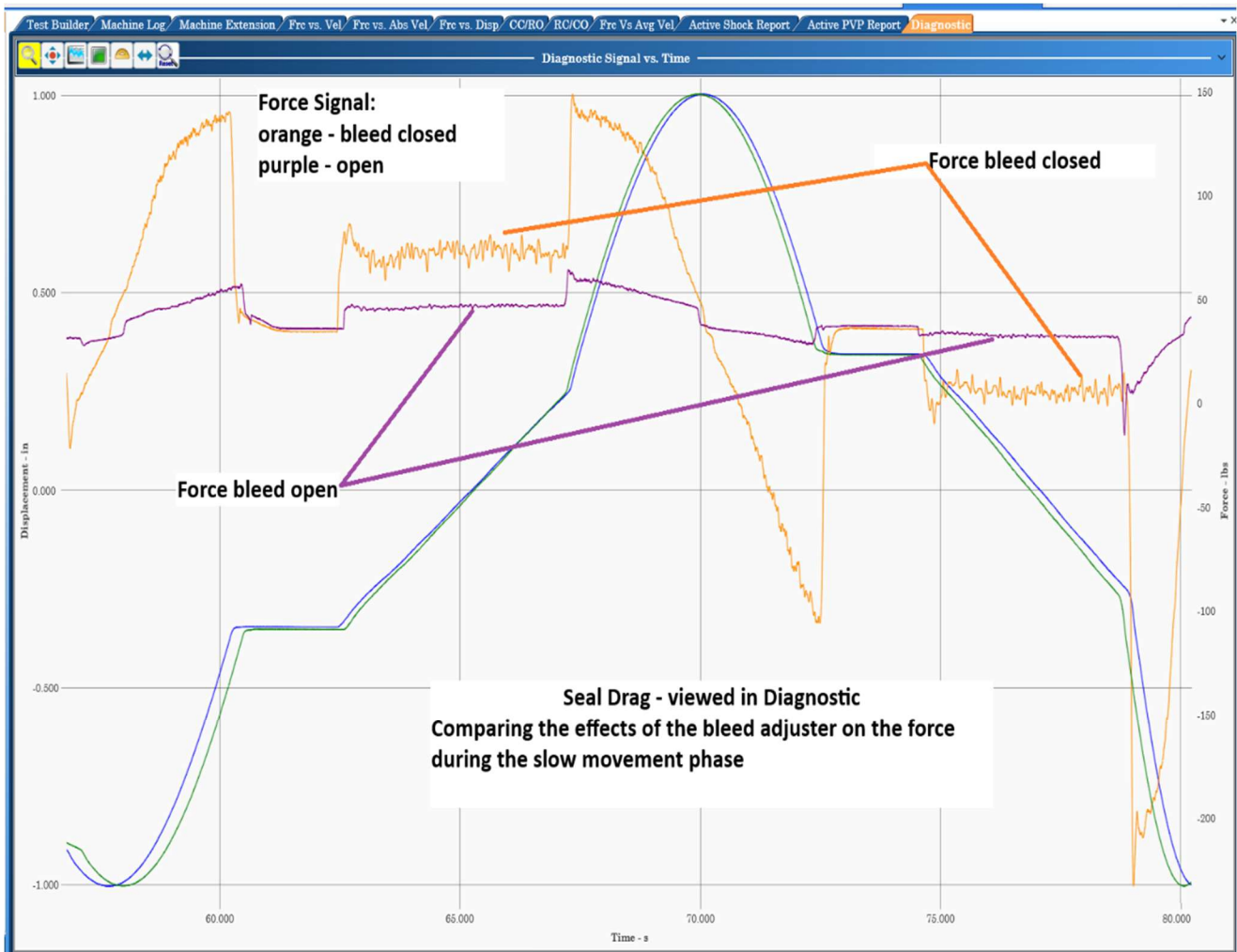


Figure 5: Viewing the Seal Drag in the Diagnostic area

In figure 6 we zoom in to the Compression side, and we show the effects of bleed on the force signal. When your damper moves slow, bleed has many effects but, in this way, you can measure how the force reacts to moving slowly. You can see when the bleed is closed, the force is rough, erratic and spiking. When the bleed is open, it is smooth and consistent.

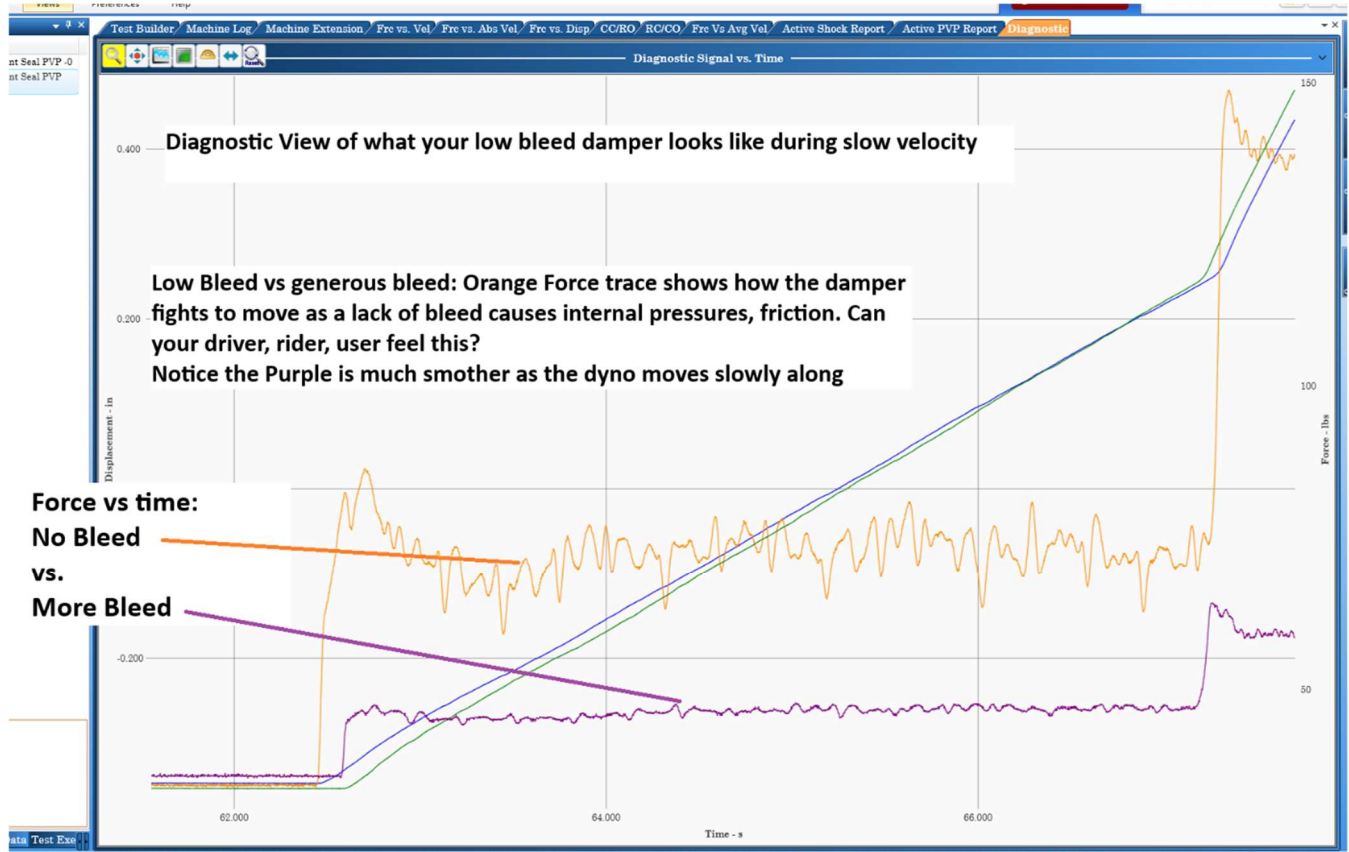


Figure 6: View of the Seal Drag in Time

At any point if you do not want the bleed of the damper to be part of the data, and this goes for the Rod Force, you can add the "Prompt" command to Probe to allow you to make an adjustment before the command is run. For example, you could run the Seal Drag and the Rod Force with the adjuster open, then add a Prompt command that allows you to set the damper before running your Speeds.

In figure 7, below, you can see we have added a Prompt User command to line 8. In this case, you do not want the effects of the no bleed damper to enter the data, you start with the adjuster open. After the Test runs the Seal Drag and Rod Force, the software will stop and ask you to make a change. Then you set the adjuster to the desired setting and click "ok" to start the next step.

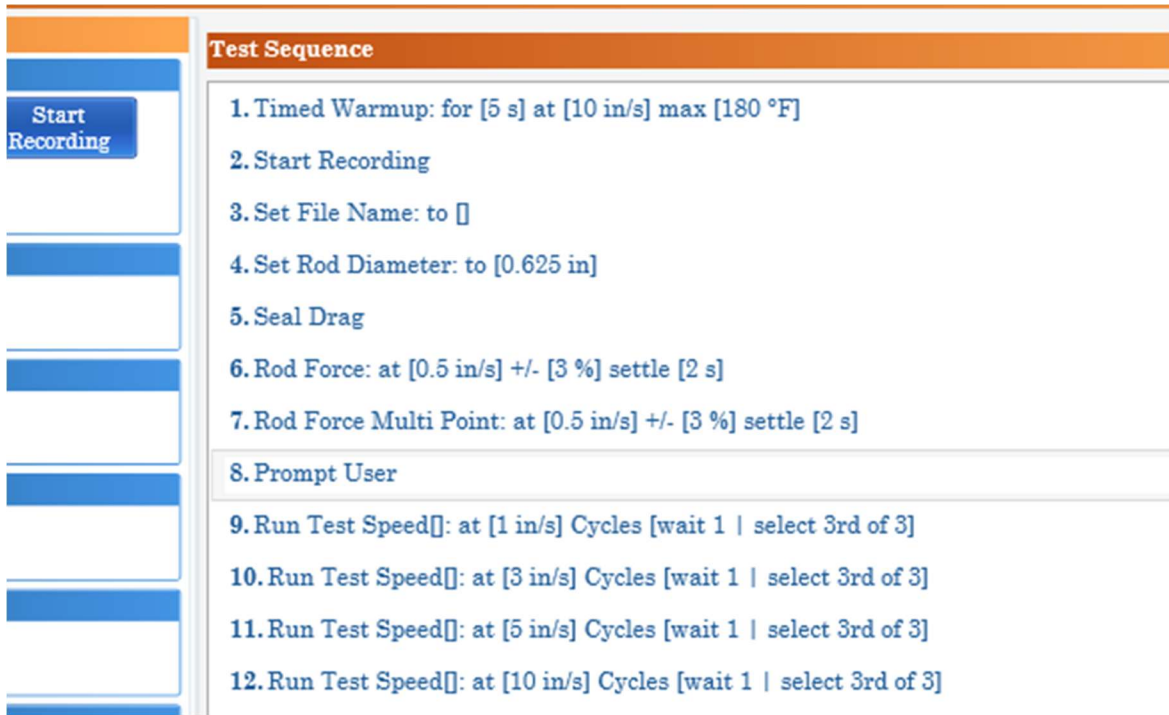


Figure 7: Using the Prompt command

The Seal Drag command is a powerful way to view how your damper operates at low speed. You can even run the Seal Drag faster to gain more insight.

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CTW Automation Inc.

100 Lexington Parkway

Lexington, NC 27295

“Don’t Panic”