Kyntronics
Innovation in Motion

TECHNICAL REPORT
TR-974

STEP 4, STANDARD HORNER HMI SCREENS

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REVISION HISTORY

Revision	Description of Change	Date (MM-DD-YYYY)	Revised by
A	Created	2/23/2023	SS
B	Add Stop button on Dwell screens.	5/31/2023	SS

TABLE OF CONTENTS

1   PURPOSE

To explain the use and screens for the Step 4 Standard Horner HMI touchscreen controller developed by Kyntronics for use with CT based SmartHydraulicActuators.

2   SYSTEM OVERVIEW

The system consists of one SHA (Smart Hydraulic Actuator) with a CT drive and controls, and a Horner touchscreen running the "Step 4" Human Machine Interface (HMI).

With the system in the proper condition, pressing START will cause the actuator to clamp at a predefined force, wait a preset time, and retract to a park position.

3   OPERATION

3.1   ESTOP circuitry

The drive presents a single STO (Safe Torque Off) input. This must be energized with 24VDC, otherwise the motor transistors are disabled. This is typically driven by the customer's Emergency stop circuit.

3.2   Start and Stop Buttons and Horner I/O

The START and STOP functions are available as icons on the HMI touchscreen.
Two of the HMI's discrete 24VDC inputs have been programmed to serve these functions as well.
This could save wear-and-tear on the touch screen and extend its life.
An external START/GO button should connect terminals I1 and C (=Common=0V) when pushed (normally open).
An external STOP button should connect terminals I2 and C, and is open when pushed (normally closed).
A jumper wire is provided here from the factory, to prevent spurious Stop signals when no physical Stop button is present. Replace the jumper wire with the normally closed switch wires, when a Stop switch is used.

3.3   Startup Screens

3.3.1   Estopped Page

This page should appear at powerup, barring a drive fault or other exception. (See Exceptions below.) It will also appear if STO is removed, as when an Emergency Stop is tripped during normal operation.
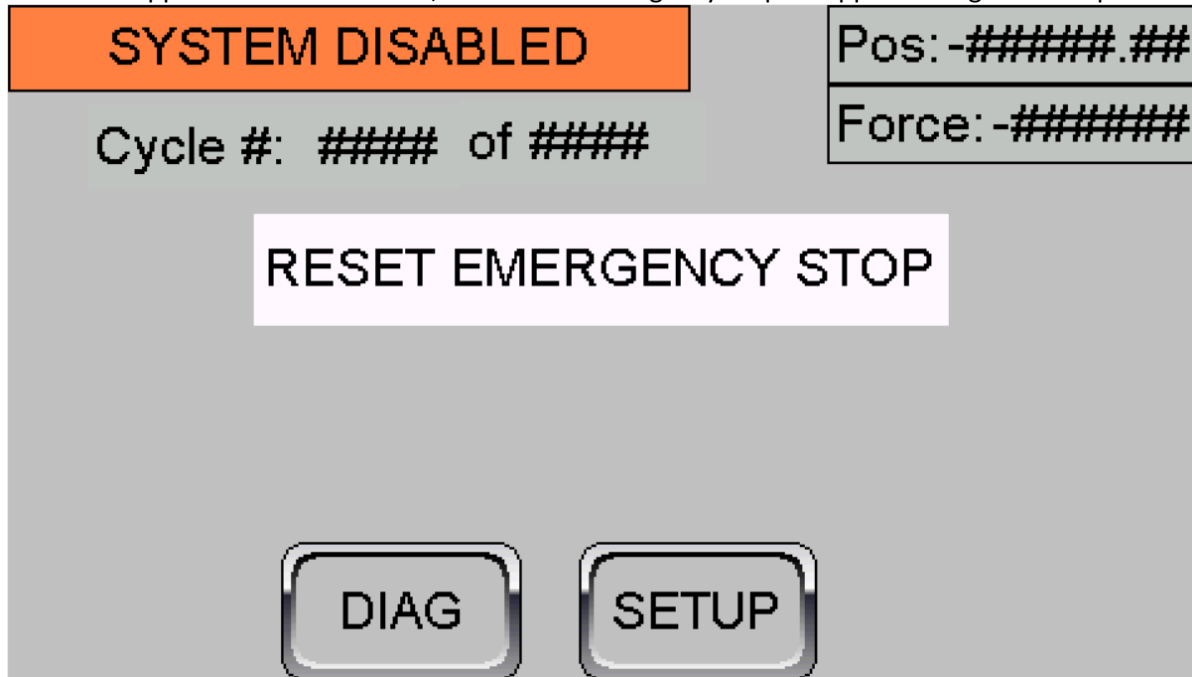
The live readouts in upper right read position in inches and pounds force.

Note the DIAGnostic and SETUP keys. Their rounded corners signify that they jump to another page. Each of the page jump keys is covered in its own section below.

Resetting the Emergency Stop circuit will jump to either NotParkedPage or ParkedPage, depending on the current position of the actuator.

3.3.2 NotParked Page

When recovering from an Estop or other exception, if the actuator is not at Park position, this appears:
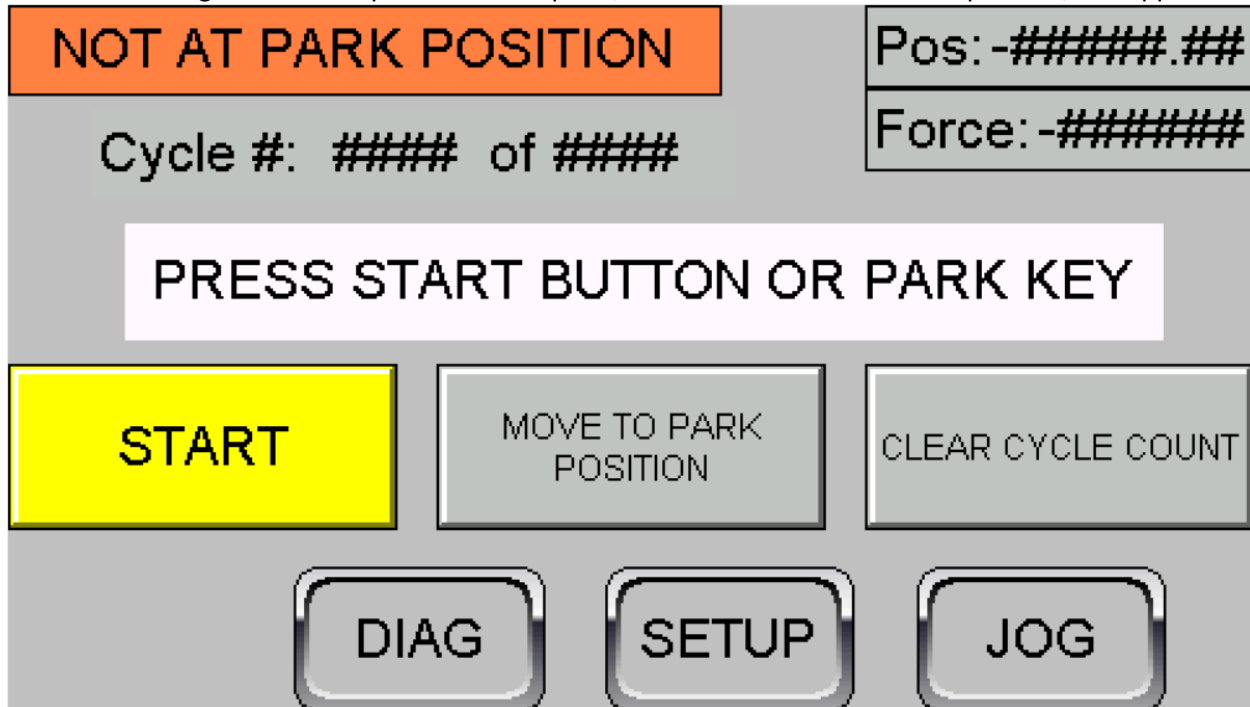
The readouts in upper right are live, as in almost every page.
You have the option of starting a cycle from here, or moving to the Park position.

3.3.3 Parking Page

As you might expect, pressing Move To Park Position displays this screen until the move is finished.

3.3.4 Parked Page

At this point, the actuator is in Park position, and everything is ready to cycle.

AT PARK POSITION	Pos:-#####.##
	Force:-######

Cycle #: #### of ####

PRESS START BUTTON

START   CLEAR CYCLE COUNT

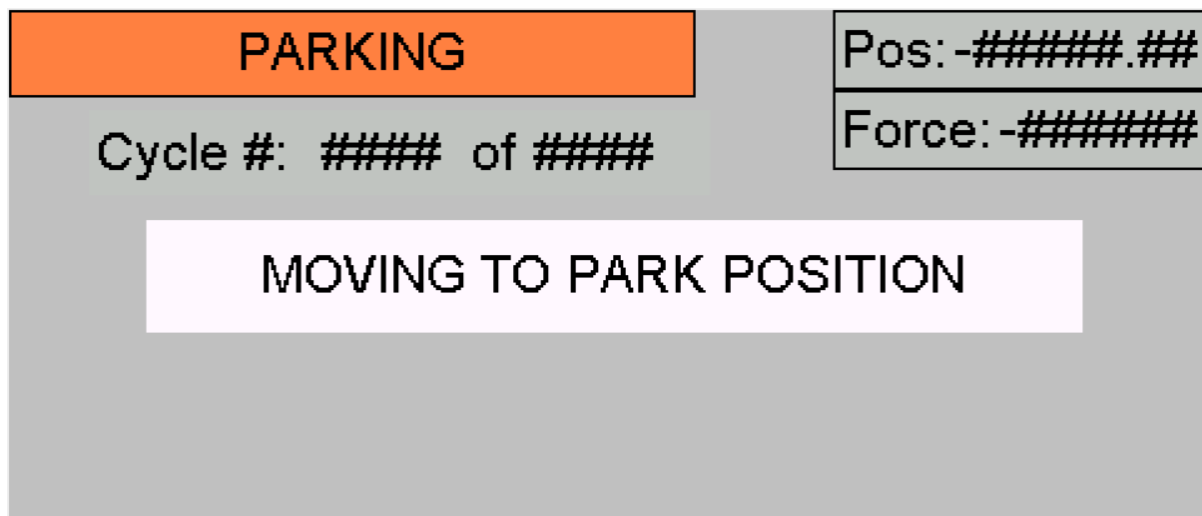DIAG   SETUP   JOG

Pressing one of the rounded keys will jump to a corresponding page detailed in sections below. Pressing START will begin moving at the accel, speed, and position and/or force of the first active Step from the setup page one.

PAUSED	Pos:-#####.##
	Force:-######

Cycle #: #### of ####

STOPPED WHILE MOVING TO POSITION A

RESUME THE SEQUENCE   MOVE TO PARK POSITION

DIAG   SETUP   JOG

IN CYCLE

Pos: -#####.##

Cycle #: #### of ####

Force: -######

DWELLING AT POSITION/FORCE A

STOP

REMAINING TIME

MM:SS.m

3.3.5 Reaching the End of a Cycle

When all of the active Steps have been run, this "moving to park" screen will appear.

PARKING

Pos: -#####.##

Cycle #: #### of ####

Force: -######

MOVING TO PARK POSITION

STOP

3.3.6 Cycle Complete Page

Once the actuator is back at Park position and all of the cycles have been run, this screen appears:
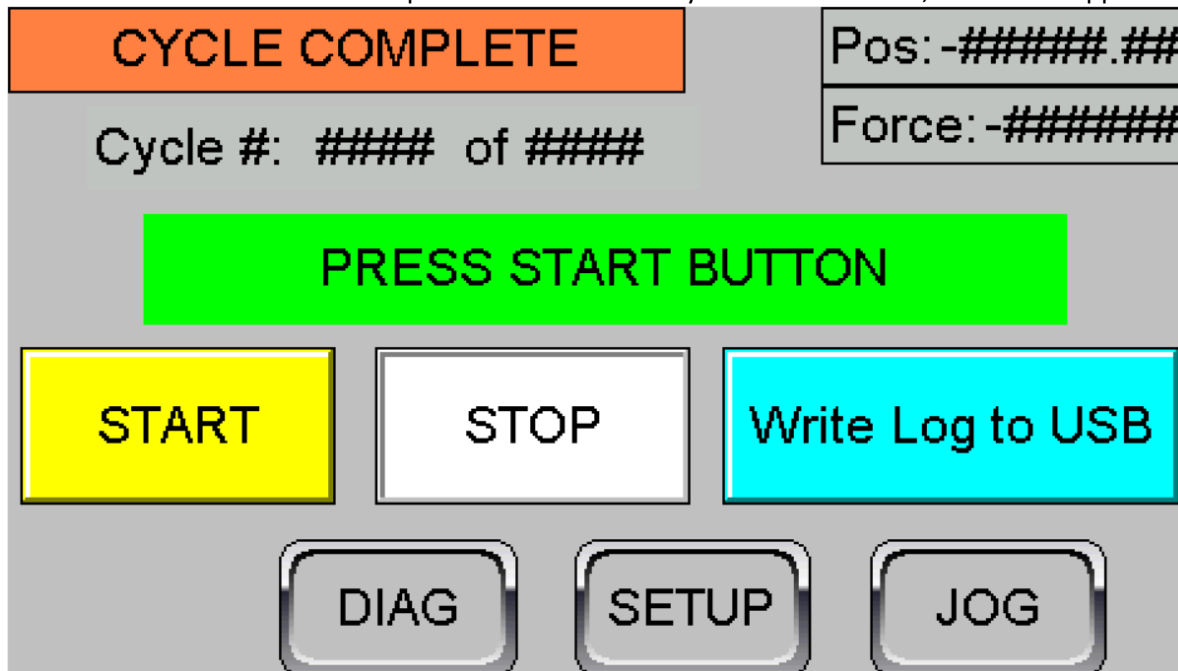
3.3.7 Drive Faulted Page

This will screen appear if there is a fault with the drive or its communications. The red TTT field will provide a terse description. The RESET DRIVE button performs the same function as the Reset button on the drive itself. If the fault is resettable, this will clear it, and the screen will jump to another page. Going to the DIAGnostics page may provide more info. Refer to that section below.
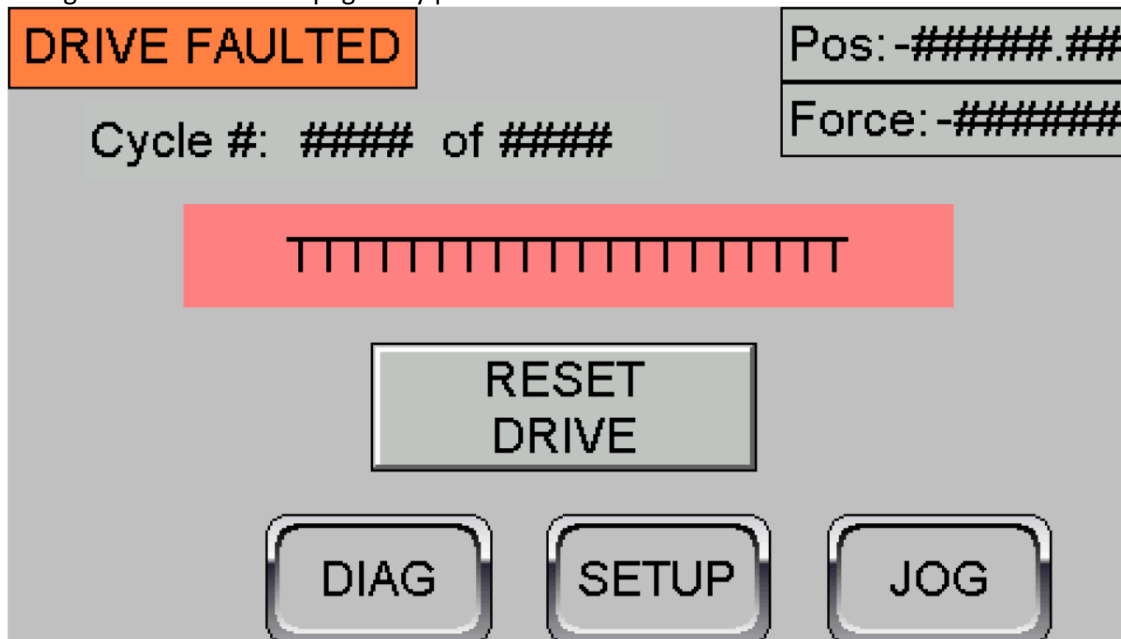
3.4   SETUP Pages

Pressing any SETUP key will jump to Setup Page 1.
All values on the setup pages are preserved when power is removed.

SETUP1	Step	Mode	Force	Posn	Speed	Dwell
# Cycles	A	P,L,F ✗	-##.##	###.##	###.##	#.#
####	B	P,L,F ✗	-##.##	###.##	###.##	#.#
(1 - 200)	C	P,L,F ✗	-##.##	###.##	###.##	#.#
MORE	D	P,L,F ✗	-##.##	###.##	###.##	#.#
RUN	Park			-#####.##	#####.##	####
	Skip		F-Unit	Pos-Unit	U/Sec	Secs

These parameters govern the move to the Park position, which is where the unit sits while not clamping.

Touching one of the parameter buttons pops up a keypad, allowing you to enter a new value.
The Step Letter buttons will toggle the Step active or inactive, so up to 4 steps can be used, plus an ending Park position.

Each Step has its own closed-loop Mode, which can be P=Position mode; or L=Position with force Limit; or F=Force mode. Consult the TR manual for your actuator: a pressure sensor or loadcell feedback is required in order to use the L and F modes).

The target force can be set for Force or Position with Force limit steps. The target Position can be set for position and position with force limit steps.

The Speed can be set for each Step. Again, consult the TR-xxxx user manual for your actuator to determine the maximum Extend and Retract speeds. It is your responsibility to limit the speeds to the range for your actuator.

The Step target Position and Park position need to be kept within the valid range for your actuator. It is recommended for the fully retracted position to be slightly negative; say -.1" to -.2" or -2mm to -5mm, so that a position of 0 does not hit the internal retract hard stop.

A dwell time can be setup for each Step.

A cycle count is available. The count is limited to 200 cycles, as there are options to log each Step or each Cycle, and then save this data to a USB stick at the end of the cycles.

The MORE button jumps to Setup Page 2.

In Setup Page 2, the position and force PI tuning values are exposed, to assist with tuning after any fixturing is in place. CT Scope software can also be used to capture and view the position and force data to help tune.

The system was tested and tuned before shipment, but without the customer's fixture attached. Therefore, better performance may be achieved by adjusting the loop gains.

      Kp = proportional gain
      Ki = integral gain

The Minimum Force can be specified, for Position with Force Limit applications. If only an extend pressure sensor or loadcell is present, the Minimum Force still needs to be set to a non-zero value, like -500 to -2000, based on the actuator.

Since Step 4 is a general/standard HMI, the Position Units Resolution button should be set for the position accuracy of your actuator, which will either be Hundredths of units (such as SSI metric position feedback), or Thousandths of units (for analog position in inches). Consult the TR-xxxx manual for your actuator and set this value to match. Note: The HMI will display positions to the hundredths, but will scale to thousandths as needed, for those units.

The MORE button jumps to Setup Page 3.

SETUP3	In 'Position' Tolerances:		In 'Position' Time Window:	
MORE	**Force Tol** ######		**Force Time** ##.##	
BACK	**Posn Tol** ###.##		**Posn Time** ##.##	
	Posn Units		Seconds	
RUN				

The system attempts to stabilize the applied force after the load has been encountered. Force is considered stabilized when it stays at Target Force +/- "In Position Tolerance", for the "In Position Time Window."

Likewise for Position steps, the target position is considered reached when the position stays within the +/- "In Position Tolerance" for the "In Position Time Window".

For Position with force limit Steps, the Step is considered complete once with the Force Window or the Position window is satisfied.

The MORE button jumps to Setup Page 4.

SETUP4

Screen IP Address: `###.###.###.###`

Drive IP Address: `###.###.###.###`

BACK

RUN

No Logging to USB

Log Cycle (Last Step Pos, Force)

Log each Step (Pos, Force)

This page allows you to specify the IP address for the HMI Screen (the Horner itself), and for the CT Drive.

Optional Logging allows the result of each Step, or of each Cycle (via the Last Step that is active) to be captured and stored. At the end of the cycle, the logged data can be saved to a CSV file on a USB Stick.

The BACK button loops back to Setup Page 3.

3.5   DIAGnostic Pages

Pressing any DIAG key will jump here:

In the upper right corner is the version of firmware which is running on the HMI.

20:35L Status is the status word of the drive itself. It is shown in hexadecimal.
   Bit 0 - Ready (No faults, and the STO is satisfied. Stays on while moving.)
   Bit 1 - In Position mode
   Bit 2 - In ForceLimited Position mode
   Bit 5 - Faulted
   Bit 11 - STO is satisfied
   Bit 12 - Jogging

20:37H Fault is the current or most recent drive fault, and 20:37L is the associated SubFault.
These also display in Hexadecimal. They do not clear to zero when fault is reset. But Status Bit 5 does.
Most can be decoded with the Control Techniques drive User Guide for the drive model being used, in the Diagnostic section.

However, there is one trip which is specific to this application:
The pump is supervised by a thermostat, which is closed when temperature is below the trip point.
The thermostat is monitored by drive input 6, readable at menu 08.006. It should be high (on) when OK.
If the thermostat trips, the keypad will announce this fault as "Reserved 001".
If you see this error right out of the box, verify the wiring of the PUMP THERMAL cable.

If the wiring is OK, and you still see the "Reserved 001" on every powerup, someone missed a step in the Make Changes Permanent procedure. Redo it.

The DRIVE COMM box concerns the ModbusTCP communication between the HMI and the drive.
Its icon should be green when communications is good.
Timeouts and BadPackets are counters, which should increment rarely if at all.
GoodScans is also a counter, which should increment dozens of times per second.
DriveNode is the ModbusTCP node state. Normally zero.

The READY button jumps back to the normal operation pages.

The MORE button jumps to DIAGnostic PAGE 2:
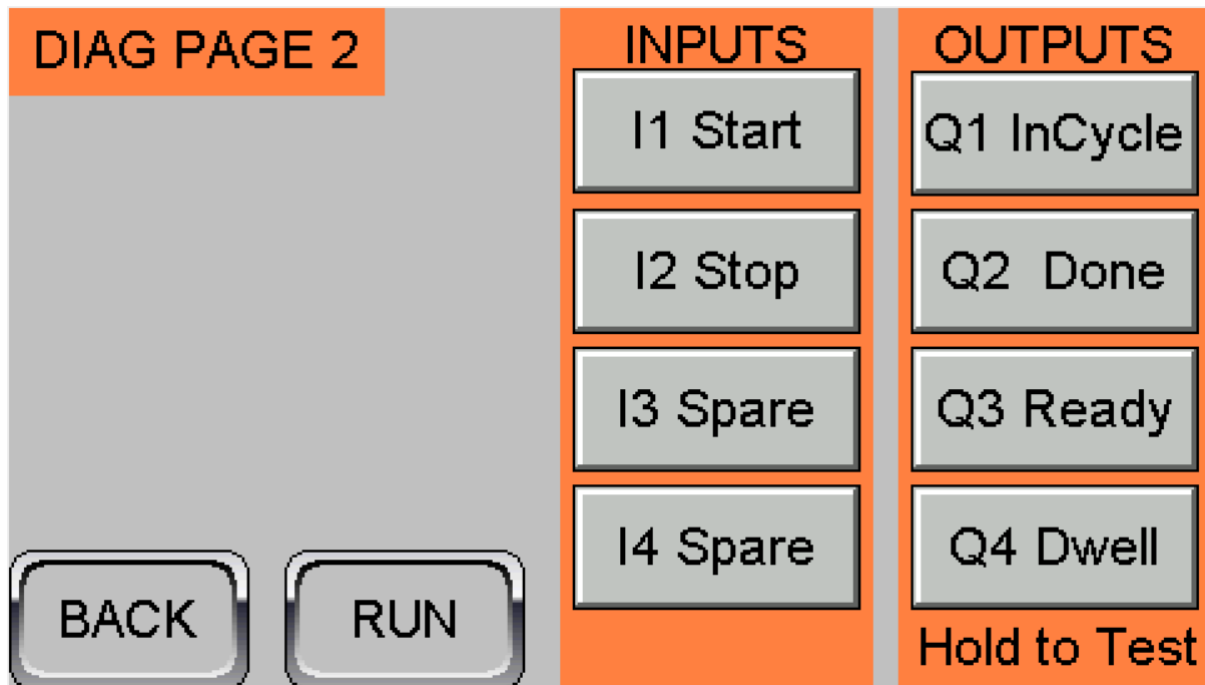
Diagnostic Page 2 shows the Horner Digital inputs and outputs, with labels for their mappings.

Input 1 is setup as the Start button, on the first digital input of the Horner. Use a normally open switch. Taking this input to 0 volts will operate as a Start/Go signal. Using the digital inputs rather than the screen buttons saves some wear and tear on the touchscreen; however, either method will work.

Input 2 is setup for a Stop button. This button expects a normally closed switch that is tied to 0 volts. Opening the switch will stop/pause the active Step. If no Stop button will be used, then jumper this input to 0 volts.

The four Horner digital outputs function as shown and can be wired and used as needed.

3.6   JOG Page

Pressing any JOG key jumps here:

JOG PAGE

Pos:-#####.##
Force:-######

Jog Speed
####.# RPM

JOG EXTEND

JOG RETRACT

RUN   DIAG   SETUP
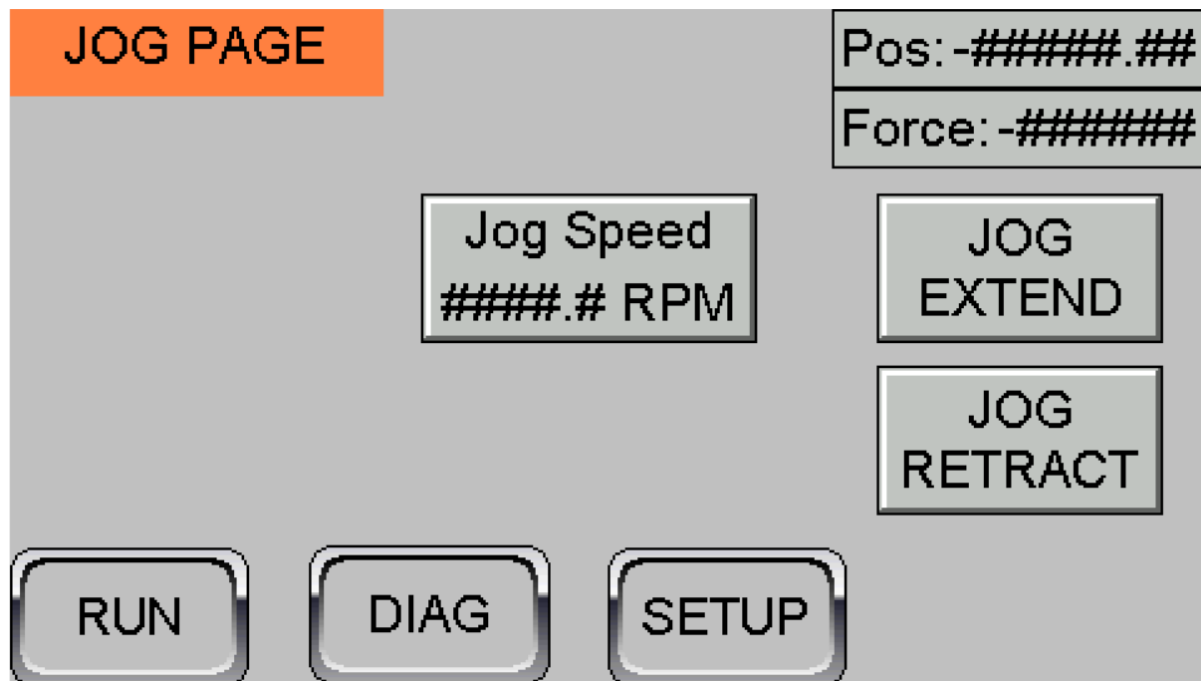
Jogging is a type of motion which occurs at constant speed for as long as a button is held.
The Extend and Retract icons on the right are the Jog buttons.

Touching the Jog Speed icon pops up a keypad, allowing you to adjust the jog speed. For most units, the jogs can be run at up to +-3000 rpm; however, values in the range of 250 to 500 are most typical. Consult the TR-xxxx manual for your actuator to confirm the rpm limits, as some large motors may have a lower rpm limit.

The READY button jumps back to the normal operation pages.

4   RUNNING A STEP, EXAMPLE

This section shows sample screens for a process of up to four positional moves, with optional dwells at each position, and a return to a Parked position.

4.1   Steps Setup Screen

Pressing the SETUP key will jump to Setup Page 1, which handles the cycle settings.

SETUP1	Step	Mode	Force	Posn	Speed	Dwell
# Cycles	A	P,L,F X	-##.###	###.##	###.##	#.##
####	B	P,L,F X	-##.###	###.##	###.##	#.##
(1 - 200)	C	P,L,F X	-##.###	###.##	###.##	#.##
MORE	D	P,L,F X	-##.###	###.##	###.##	#.##
RUN	Park			-#####.##	#####.##	####
	Skip		F-Unit	Pos-Unit	U/Sec	Secs

A cycle can consist of one, two, three, or four steps; plus a return to Park position.
Each step has a position and speed, plus a dwell once that position is reached.
There is no dwell at Park position.

The Skip buttons toggle when pressed. When a step is skipped, its other parameters disappear from the screen. But they are not forgotten. This can be handy if you are using less than four steps, as you can skip one step and unskip another rather than keying in new values.

Skipping all four steps will cause the Illegal Configuration page to appear when you leave this page.

The Park step may not be skipped. The PARK skip button is just a label.

Touching one of the parameter buttons pops up a keypad, allowing you to enter a new value.
Positions range from 0.0 to 5.500 inches, for example.
Speeds range from 0.0 to 8.60 inches per second, for example, although a zero speed will hang the system.
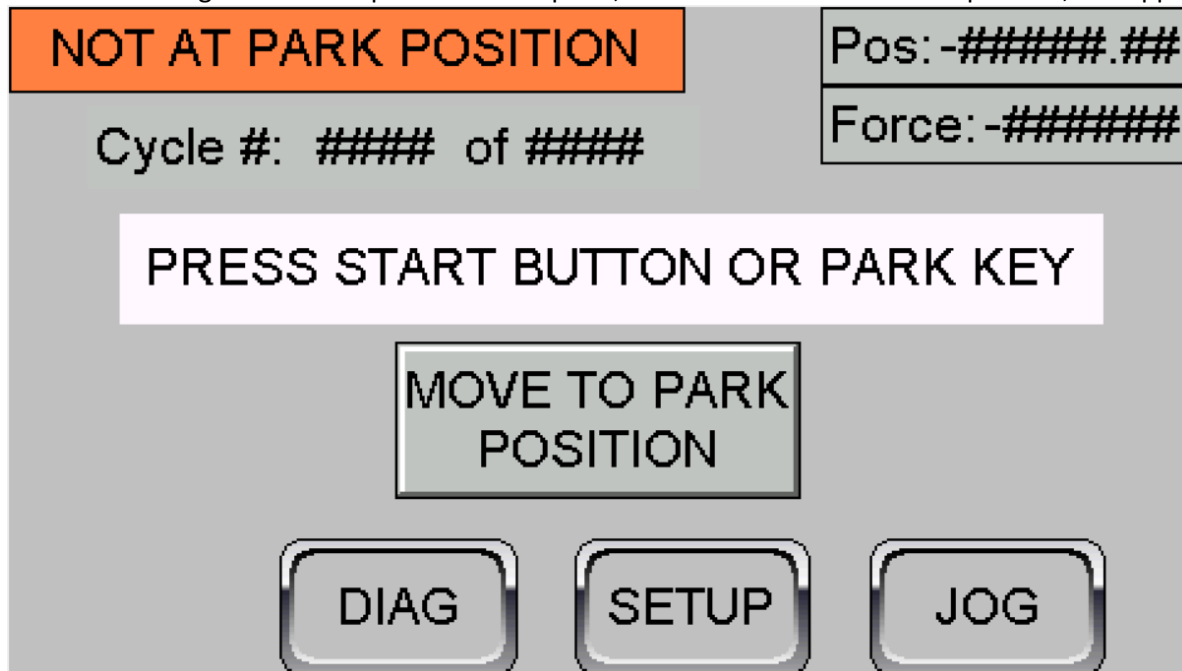Dwells range from 0 to 999 Minutes.

The MORE button jumps to Setup Page 2, which handles the drive position loop tuning.
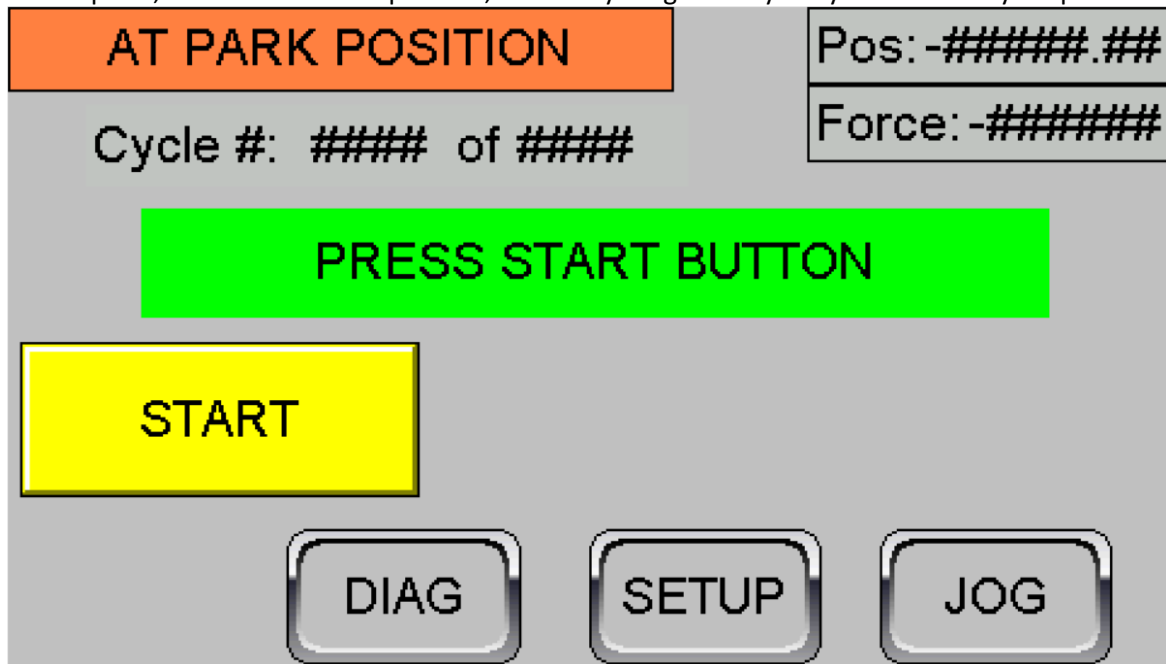
4.2   Not Parked Page

When recovering from an Estop or other exception, if the actuator is not at Park position, this appears:

NOT AT PARK POSITION	Pos: -#####.##
	Force: -######

Cycle #: #### of ####

PRESS START BUTTON OR PARK KEY

MOVE TO PARK POSITION

DIAG   SETUP   JOG

The POSition readout in upper right is live, as in almost every page.
You have the option of starting a cycle from here or moving to the Park position.

4.3   Parked Page
At this point, actuator is in Park position, and everything is ready to cycle. The Ready output is on.

AT PARK POSITION	Pos: -#####.##
	Force: -######

Cycle #: #### of ####

PRESS START BUTTON

START

DIAG   SETUP   JOG

Pressing one of the rounded keys will jump to a corresponding page detailed in sections below.

The SETUP page configures four Steps, called A, B, C, and D. Each has a position, speed, and dwell time. Steps can be skipped. But if you skip all four, an Illegal Config exception would be triggered.
Pressing START will begin moving to the position of the first non-skipped step, at its corresponding speed. At that point the Ready output would turn off and InCycle would turn on.

4.4 Moving In Cycle Page

The actuator is moving to one of the Step positions. The green background indicates InCycle.

4.5 Stop/Pause a Step

If a Stop is issued while a Step is active, the process stops, and the following screen is displayed (Step A is shown; however, each Step supports a similar screen). The operator has the options of continuing the Step or going to the Park position:

4.6   Dwelling Page

After the actuator reaches the step's position, this page persists during the dwell interval.

When the dwell is elapsed, the actuator will begin the next non-skipped move. If this was the last non-skipped move, it will head for the Park position. The parking move has its own Speed parameter.
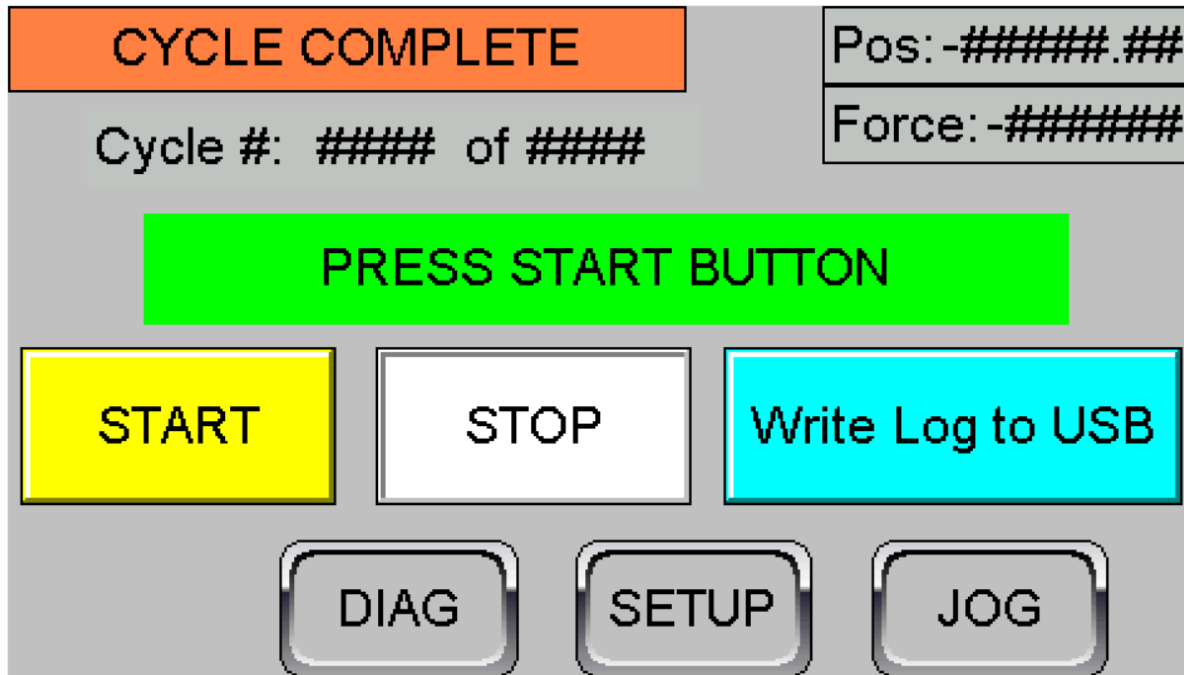
4.7   Parking After Cycle Page

The orange background in the upper left icon distinguishes this page as a manual park. The automatic park in a normal cycle will have a green background.

4.8   Cycle Done Page

Once all non-skipped steps have executed and actuator is back at Park position, this appears:

The InCycle output has turned off, and the Done output has turned on.
You can begin another Cycle from here with the START button.

Pressing the STOP button will jump back to the Ready page.
The Done output will turn off and Ready will turn on.
This was included as an acknowledge function; in case the Done output was driving a horn or strobe.