



# Smart-Arm

## Operations Manual – Rev 1.5

---



**The information contained within this document is confidential. Any unauthorized reproduction or dissemination of its contents, in whole or in part, is strictly prohibited without the expressed written consent of Kolver USA Limited.**

Kolver USA  
One Park Drive, Unit 9  
Westford, MA 01886

# Table of Contents

<b>1</b>	<b>Introduction .....</b>	<b>1-1</b>
1.1	Contact Information .....	1-1
1.2	Smart-Arm Overview .....	1-2
1.3	Safety .....	1-3
<b>2</b>	<b>Power On/Off .....</b>	<b>2-4</b>
<b>3</b>	<b>Operating Modes .....</b>	<b>3-5</b>
3.1	Torque Control Mode - Overview .....	3-5
3.2	Sequence Control Mode – Overview .....	3-6
<b>4</b>	<b>Smart-Arm Basic Functions .....</b>	<b>4-8</b>
4.1	Parent Menu Overview .....	4-8
4.2	FIND - Find Function .....	4-8
4.3	SELREC - Select Recipe Function .....	4-9
4.4	DELREC - Delete Recipe Function .....	4-9
4.5	MAINT - Maintenance Menu Overview .....	4-9
4.6	LOGIN - Login Function .....	4-11
4.7	CHMOD – Change Mode Function .....	4-11
4.8	bINCNT / bITCNT – Set Number of Bins and Bits .....	4-11
4.9	TEACH - Teach Function .....	4-12
4.9.1	Torque Control Mode .....	4-12
4.9.2	Sequence Control Mode .....	4-12
4.10	TOL - Set Tolerance Function .....	4-13
4.11	CHPSW - Change Password Function .....	4-13
4.12	OUTTYP – Select the torque controller the Smart-Arm .....	4-13
4.13	FRCOUT - Force Output Type Function .....	4-14
<b>5</b>	<b>Set-up Procedure – Quick Reference .....</b>	<b>5-15</b>
<b>6</b>	<b>Quick Connect Guide .....</b>	<b>6-16</b>
	Smart-Arm Connections .....	6-16
<b>7</b>	<b>Appendix A – Torque Controller Configurations .....</b>	<b>7-18</b>
	Kolver Configuration .....	7-18
	Microtec Configuration .....	7-18
	Atlas Copco Configuration .....	7-18
<b>8</b>	<b>Appendix B – Troubleshooting Guide .....</b>	<b>8-19</b>
	Troubleshooting Guide .....	8-19
	Frequently Asked Questions .....	8-21

---

9	Appendix C – PM Schedule .....	9-22
10	Appendix C – Smart Arm Assembly Drawing .....	10-1

---

## 1 Introduction

### 1.1 Contact Information

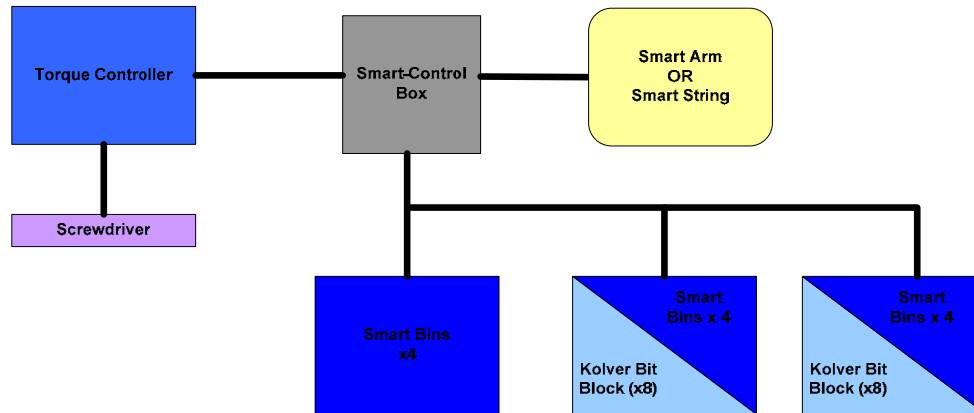
If any service is required on the equipment, contact Kolver USA's Service Department during normal business hours (9am-5pm, Monday-Friday):

**Kolver USA Service Department - (978) 692-3042**

If you are calling after-hours, leave a detailed message and our service department will contact you on the following business day.

## 1.2 Smart-Arm Overview

The Smart-Arm is a tool locating device that integrates with the Smart-Control Box to create a manual assembly error proofing system. The Smart-Control Box is the common interface that controls all of the Multi-Torq error proofing accessories. The system configuration of the Smart-Control Box is shown below. For the purposes of this manual, the Smart-Control Box when configured with the Smart-Arm tool locating device will simply be called Smart-Arm.



Smart-Arm controls the manual assembly process by setting the program of a torque controller. The program can be selected by the position of the tool or by the step of a programmed assembly sequence. The selection of the torque program is determined by the operating mode of the Smart-Arm.

The Smart-Arm may function in two different operating modes. The modes are called Torque Control mode and Sequence Control mode. Torque Control Mode is the standard operating mode of the Smart-Arm and it sets the torque program by tool position. Tool positions are taught with the controller and have a torque program associated with the taught position. Bin-picks and tool bits (if configured with Smart-Bins and Kolver Bit Block) may also be set for the location. The program is set and the tool is enabled when the taught position is reached. The tool is disabled if the location, bin-pick or tool bit is incorrect.

Sequence Control is a more advanced control mode for the Smart-Arm and is an optional add-on. With Sequence Control, programmed steps must be performed in order. A step may contain a torquing operation or a bin-pick (if Smart-Bins are configured). The steps must be verified before the next sequential step is performed. The tool will not be enabled if the position, bin-pick or tool bit is incorrect for that step. Once all of the parameters are correct, the tool will be enabled.

Smart-Arm supports Kolver, Microtec and Atlas Copco digital controllers. Custom boxes may be available for alternate screwdriver controllers.

---

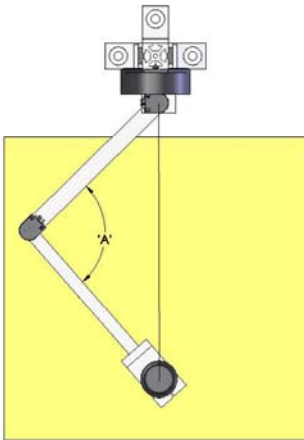
### 1.3 Safety

Many safety features have been designed into the Smart-Arm assuring reliable and safe operation. These features should not be removed under any circumstances.

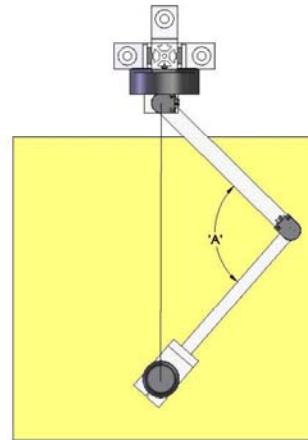
Observe all warning labels and signs. Do not attempt to service the Smart-Arm box.

## 2 Power On/Off

1. To power up the system, turn on the power switch on the screwdriver controller. The control unit will turn on automatically.
2. The control unit LED display will flash "HOMING". The Smart-Arm needs to pass zero-orientation. To do this, move the Smart-Arm into both a left-hand orientation and a right-hand orientation. Refer to the diagrams below that illustrate the left and right-hand arm orientation. When this has been completed, the control unit will be in run mode. The control unit will default to the last recipe that was used before the Smart-Arm was last turned off.
3. To power off the system, turn the power switch on the screwdriver controller to off. The control unit will also turn off.



Left-hand arm orientation (Top view)



Right-hand arm orientation (Top view)

### 3 Operating Modes

Smart-Arm may operate in 2 different operating modes, Torque Control Mode and Sequence Control Mode. Torque Control Mode comes standard with Smart-Arm; Sequence Control Mode is an optional add-on to the device.

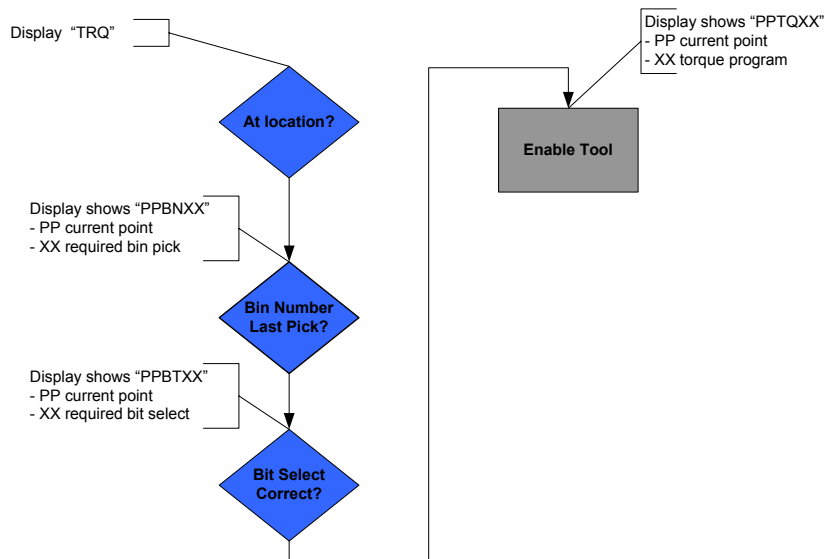
#### 3.1 Torque Control Mode - Overview

Torque Control mode is the standard mode of operation and is used to set the torque during assembly based on peripheral inputs. In this mode, up to 40 points and up to 5 recipes can be taught on the controller. Each point will set a torque based on tool position. Bit selection at each point may be verified if a bit block is present. Each recipe is a set of 40 points.

Tool location is the default parameter for setting the torque program on the controller. If Smart-Arm is configured with Smart-Bins or a bit block then bins picks and tool selection may be verified. Bin picks and bit selection do not set the torque value. The controller will not be enabled if the XY position, bin pick or bit selection is incorrect.

Smart-Arm will enable the tool only when the XY location, bin-pick and bit selection match. As the tool location device is moved throughout XY, the display will show "TRQ" (torque mode), displaying to the operator that a matching point has not been found and that torque mode is enabled. Once a taught XY position has been reached, the display will change to show the settings for that point. If the incorrect bit is selected or bin-pick is not correct for that point, the display will flash indicating the appropriate value. If the bin is incorrect, the display will flash 'bNXX' where bN stands for bin and XX are the correct bin to pick from. If the bit is incorrect, the display will flash 'bTXX' where bT stands for bit and XX is the correct bit for the position.

This flow chart displays the control logic when in Torque Control mode. If the device is not present, the step is omitted. The displayed values on the Smart-Control box are also shown.



The table below summarises the display values when in torque mode.

Step	Display	Description
Bin Check	PPBNXX	PP - Point Number, BN - Bin, XX - Bin Number
Bit Select	PPBTXX	PP - Point Number, BT - Bit, XX - Bit Number
Torque Enabled	PPTQXX	PP - Point Number, TQ - torque, XX - torque program

In each case, if the display parameter is flashing, the parameter is incorrect and must be corrected before moving forward. For example, if the bin-pick was incorrect the XX value would flash the correct bin-pick value. The screwdriver is disabled until the torque enabled step, at which point the torque program is displayed.

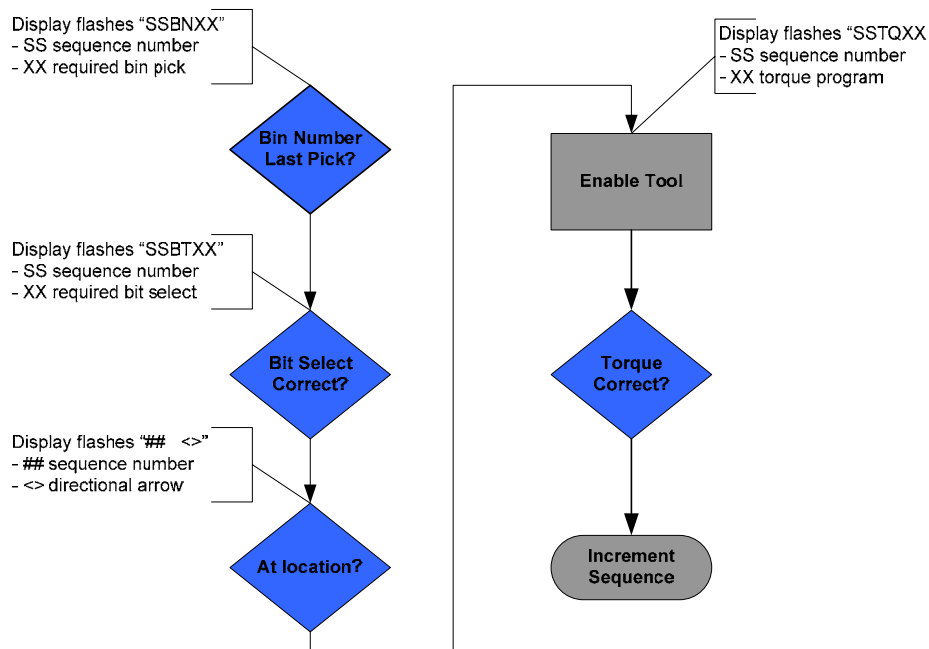
### 3.2 Sequence Control Mode – Overview

Sequence Control mode is an advanced control mode and is used to verify and control assembly steps. In this mode, up to 40 points and 5 recipes can be taught on the controller. Each point is a unique operation that may or may not include a torque, bin-pick, bit select and unique XY location.

The Smart-Arm must be configured before teaching points, see 4.5 MAINT - Maintenance Menu Overview. Once this is complete, sequence points may be taught. For each point, the XY location, bin-pick, torque program and bit select must be taught using the controller Teach Function, see 4.9 TEACH - Teach Function.

During operation, the location of the Smart-Arm is verified with the encoders. The decision tree for Smart-Arm is shown below. In the case of the bin-pick decision, the programmed bin must be the **last** bin-picked, and not necessarily picked during that sequence point. This will allow operators to pick multiple screws from the same bin for multiple torquing operations. As shown below, once the bin, position, bit select are correct, the tool will be enabled. At that point, a correct torquing confirmation signal from the torque controller will increment the sequence.

The decisions shown below will be omitted if the Smart-Arm configuration does not include that device. For example, if Smart-Bins were not configured, the decision would check only the bit selection and tool position before enabling.



---

During Sequence Control operation, the Smart-Arm box will display the current step in the sequence along with the needed input to increment the sequence. The display messages for each of the decisions are shown in the table below.

<b>Step</b>	<b>Display</b>	<b>Description</b>
Bin Check	SSBNXX	SS - Sequence Number, BN - Bin, XX - Bin Number
Position Check	SS <>	SS - Sequence Number, <> - Arrow for direction of torque
Bit Select	SSBTXX	SS - Sequence Number, BT - Bit, XX - Bit Number
Torque Enabled	SSTQXX	SS - Sequence Number, TQ - torque, XX - torque program

In each case, if the display parameter is flashing, the parameter is incorrect and must be corrected before moving forward. For example, if the bin-pick was incorrect the XX value would flash the correct bin-pick value. The screwdriver is disabled until the torque enabled step, at which point the torque program is displayed.

## 4 Smart-Arm Basic Functions

### 4.1 Parent Menu Overview

The following chart shows the main menu functions along with a general description. **Functions shown in bold are restricted** and may not be accessed until the LOGIN function has been activated.

Main-Menu #	Main Menu Display Item	Function Description
1	RUN	Sets the Smart-Arm to run mode. Run mode may be either Torque Mode or Sequence Mode.
2	RESTRT	Restart will reset the sequence when in sequence mode. Function not available in torque mode.
3	MAINT	Maintenance menu. See 4.5 MAINT - Maintenance Menu Overview
4	<b>TEACH</b>	Teach function is used to teach torque points.
5	FIND	Find function used to find points previously taught.
6	SELREC	Select recipe. Smart-Arm stores up to 5 recipes of 40 points each.
7	<b>DELREC</b>	Delete recipe. Used to clear previously taught points.

### 4.2 FIND - Find Function

Find function can be used to preview all taught points for the current recipe and to guide the user to taught location for any taught point

1. Turn the knob on the encoder board box until "FIND" flashes on the display
2. Press and release the knob to select Find Location function
3. The display will flash "##" for the point number
4. Turn the knob to select the desired point number
5. The display will show: "F d pp", where the "d" character is an arrow (←↑→↓) that indicates which way the tool needs to be moved to find the selected point. When the tool is at the taught point the arrow will change to show the "★" character, "pp" is the point number. If the selected point was not taught or was previously deleted the display will show "F pp"
6. To exit the find function, turn the knob until it displays "F EXIT", and then press the knob

**4.3 SELREC - Select Recipe Function**

Five recipes can be stored in the control unit. Use this function to select the current running recipe. This function is enabled only after a maintenance person has logged in.

1. To select the desired recipe, turn the knob on the control unit until “SELREC” flashes on the display
2. Press and release the knob to select recipe function
3. The display will flash “REC#” where # is the number of the current recipe
4. Turn the knob to select the recipe (1 to 5)
5. Press and release the knob to save the selection
6. Any consequent operation will be performed with the selected recipe

**4.4 DELREC - Delete Recipe Function**

This function is enabled only after a maintenance person has logged in.

1. To delete all points within the current recipe, turn the knob on the control unit until “DELREC” flashes on the display
2. Press and release the knob to select delete all function
3. The display will flash “DEL# N?” where # is the number of current recipe
4. Turn the knob to select “Y” (Yes) as the last character on the display
5. Press and release the knob to confirm to delete all points in the current recipe
6. To cancel the operation without deleting points, turn the knob until the last character displays “n” and press the knob

**4.5 MAINT - Maintenance Menu Overview**

Some menu items are available only after logging in. The Maintenance menu is used to access options used to troubleshoot problems and to access setup functions. Functions shown in bold are restricted and may not be accessed until the LOGIN function has been activated. Some of the functions shown below are explained in greater detail later in the document.

Sub-Menu #	Maintenance Menu Display Item	Function Description
1	LOGIN / LOGOUT	Used to gain access to maintenance functions.
1	S#####	Smart Arm Serial Number
2	L#####	Internal Use Only
3	VER###	Smart Box Version Number
4	A ###	'A' Axis Encoder Count
5	B ###	'B' Axis Encoder Count
6	H1 ###	Home count for joint 1. Factory maintenance function.

7	H2 ###	Home count for joint 2. Factory maintenance function.
8	X ###	Current calculated X position (mm)
9	Y ###	Current calculated Y position (mm)
10	IN####	Display of bit inputs.
11	OUT###	Displays current output. Used to check forced outputs.
12	<b>SETORG</b>	Used to set the Smart-Arm origin. Origin is set during manufacturing. Do not adjust origin unless trained to do so.
13	<b>FRCOUT</b>	Used to test connection to torque controller. Use this function to force output signals to torque controller.
14	<b>FRCHOM</b>	For testing purposes only. Used to force a home command.
15	<b>OUTTYP</b>	Used to configure the torque controller.
16	<b>CH PSW</b>	Used to change the Smart-Arm password. Do not change the password unless authorised.
17	<b>CH MOD</b>	Configures the mode of the Smart-Arm. Use to change from Torque Mode to Sequence Mode.
18	<b>bINCNT</b>	Bin count function is used to set the number of bins.
19	<b>bITCNT</b>	Bit count function is used to set the number of bits.
20	<b>TOL</b>	Sets the tolerance of the Smart-Arm in mms.
21	<b>bITTYP</b>	Configures the bit tray type. Options are 8 bit tray or 4+LEDS.
22	<b>RSTINP</b>	Configures the remote reset input. Remote reset input is enabled (H9 connector) or disabled (knob input).
23	<b>LNKTYP</b>	Used for linking two Smart-Control boxes together. Function is not available unless setup at factory.
24	<b>PNTCNT</b>	Point Count – Memory Upgrade Only – The number of points per recipe.
25	<b>RECCNT</b>	Recipe Count – Memory Upgrade Only – Number of recipes available.
26	<b>TCH BC</b>	Teach Barcode – Memory Upgrade Only – Used to teach a barcode and

		associate it with a recipe.
27	<b>DEL BC</b>	Delete Barcode – Memory Upgrade Only – Used to delete a barcode association with a recipe.
28	<b>OUTFLT</b>	Output Filter – Advanced Feature – Used to hold the enable signal ‘On’ for a set time before a disable state change
	<b>EXIT</b>	Exit to parent menu.

**4.6 LOGIN - Login Function**

Login allows access maintenance and recipe teaching options.

1. Turn the knob on the encoder board box until “LOGIN” flashes on the display, press button
2. Display will show “P 0###”, turn the knob to select the first digit of the login password, then press button
3. Continue to enter all digits
4. If the login was successful the encoder will display “OK”; if login was not successful the display will show “ERR”.
5. **Default password** pre-programmed at factory is “7439”.
6. After successful login, the password can be changed by using change password option in maintenance function
7. Contact Kolver USA service team if login information is unknown
8. To Log-out select “LOGOUT” option from maintenance menu

**4.7 CHMOD – Change Mode Function**

This function enables either Torque Control mode or Sequence Control mode. This mode must be set correctly before points are taught.

1. Enter the maintenance menu by selecting “MAINT” and depressing the knob.
2. Select “CHMOD” from the maintenance menu and depress the knob.
3. The display will flash “SEQOFF”, choose this selection for Torque Control mode or rotate the knob to “SEQ ON” for Sequence Control Mode
4. Depress the knob to select the correct mode. Sequence Control mode is only available if the Smart-Arm unit has this add-on option

**4.8 bINCNT / bITCNT – Set Number of Bins and Bits**

This function is enabled only after a maintenance person has logged in. The bins and bits that are present on the Smart-Arm box must be configured before teaching points.

1. Enter the maintenance menu (you must be logged in) under “MAINT”.

2. Press and release the knob to enter the maintenance menu.
3. Select “bIN CNT” from the menu to enter the number of bins.
4. Rotate the knob to the correct number and depress to select
5. Select “bIT CNT” from the menu to enter the number of bits being used. Please note that this is not the number of Bit Blocks but the number of bits. This feature allows a tray to be used without filling up all of the bit locations.
6. Rotate the knob to the correct number and depress to select

## 4.9 TEACH - Teach Function

Teach function is used to teach, edit or delete recipe points. Follow the steps below to teach a new point or to edit a previously taught point. This function is enabled only after a maintenance person has logged in. Steps may be omitted if the configuration of the device does not include the appropriate devices. If the sequence below does not match expected, check configuration settings.

### 4.9.1 Torque Control Mode

1. From the main menu, turn the knob on the control unit until “TEACH” flashes on the display.
2. Press and release the knob to select the teach function.
3. Set the Smart-Arm to the desired position.
4. The display will display “PNT ##”, where “##” is the point number.
5. Turn the knob to select the point number (0 - 39).
6. Press and release the knob to save the point number.
7. The display will show “bIN XX”, where “XX” is the bin-pick required for this operation.
8. Turn the knob to select the desired bin number. If you select “ANY”, the bin-pick is not verified at this point.
9. The display will show “bIT XX”, where “XX” is the bit block selection for this point. If you select “ANY”, the bit selection is not verified.
10. Press and release the knob to save the bit selection.
11. The display will show “TRQ XX”, where “XX” is the torque program selected for this operation.
12. Turn the knob to select the torque setting program.
13. Press and release the knob to save the torque program selection.
14. The control unit will now save the Smart-Arm position for that point.
15. To add the next point in the recipe follow steps 2 –13. Continue this process until all the points in the recipe have been taught.

To delete any previously taught point follow the teaching procedures above but select “DELETE” for the bit block selection number. This will delete all of the details of the selected point.

### 4.9.2 Sequence Control Mode

Teaching in Sequence Control Mode is similar to Torque Control mode. Sequence points are displayed as “SEQ ##” when teaching.

Please note the following attributes of Sequence Control mode:

1. Untaught points will be skipped.
2. The sequence can be reset by selecting “RESTRT” from the main menu.
3. To delete any previously taught sequence number follow the teaching procedures above but select “DELETE” for the bit block selection number. This will delete all of the details of the selected sequence.

#### **4.10 TOL - Set Tolerance Function**

Set tolerance function allows the user to specify the maximum distance between the current tool position and the taught position. The default value is 15.0 mm.

1. Enter the maintenance menu by selecting “MAINT”.
2. To enter the set tolerance function, turn the knob on the control unit until “TOL” flashes on the display
3. Press and release the knob to select the find location function
4. Turn the knob to select the desired tolerance in millimetres
5. Press and release the knob to enter and store the selection

#### **4.11 CHPSW - Change Password Function**

Change password function is used to change the maintenance login password on the control unit.

1. Turn the knob on the control unit until “MAINT” flashes on the display
2. Press and release the knob to select Maintenance function
3. Turn the knob on the control unit until “CH PSW” flashes on the display, press button
4. Display will show “P 0###”, turn the knob to select the first digit of the new login password, the press button
5. Continue to enter all digits
6. Enter the new password second time for verification
7. If the new password process was successful the encoder will display “OK”; if changing the password was not successful the display will show “ERR”

#### **4.12 OUTTYP – Select the torque controller the Smart-Arm**

This function is used to match output type to the used screwdriver controller.

**Important Notice: All recipes will be deleted when the output function is changed.**

1. Turn the knob on the control unit until “MAINT” flashes on the display
2. Press and release the knob to select Maintenance function
3. Turn the knob on the encoder board box until “OUTTYPE” flashes on the display, press button
4. Turn knob to select one of following options:
  - “MICRTC” – to be used with Microtec controller
  - “KLV dO” – to be used with Kolver controller with digital inputs
  - “ATL SL” – to be used with Atlas Copco SL Tool

- 
5. Press and release button to store selected option Outputs Function

### **4.13 FRCOUT - Force Output Type Function**

Force Outputs function is used to set the torque to a specified value. This can be useful during the setting of torque values in the screwdriver controller.

1. Turn the knob on the control unit until "MAINT" flashes on the display
2. Press and release the knob to select Maintenance function
3. Turn the knob on the encoder board box until "FRCOUT" flashes on the display
4. Press and release the knob to select force outputs function
5. The display will flash "FRC ##", where "##" is program number to force
6. Turn the dial to select the desired program number then press the knob

To disable the forcing of outputs, repeat the process but select "FRC CA" instead of program number and press the knob.

## 5 Set-up Procedure – Quick Reference

Proceed with the following steps for quick start-up.

1. Turn on the screwdriver controller. The Smart-Arm unit display will display “HOMING”
2. Home the Arm
  - a. Rotate the Arm about its two joints. The unit will display exit homing mode and enter TRQ (Torque Mode) or Sequence Mode (shows first sequence number ##) when complete.
3. Enter the Login information
  - a. Rotate the knob until “LOGIN” is displayed and depress the knob
  - b. Enter 7439.
4. Select recipe on the control unit
  - a. Turn the knob until the “SELREC” message appears, then press the knob
  - b. Turn the knob until the desired recipe number appears (1 to 5), then press the knob
5. Delete any previously taught recipe points
  - a. Turn the knob until the “DELREC” message appears, then press the knob.
  - b. Turn the knob until the last character shows “Y”, and then press the knob.
6. Select the operating mode
  - a. Enter the maintenance menu.
  - b. Select “CHMOD” and select “SEQOFF” or “SEQ ON”
7. Teach a new point.
  - a. Position the Arm to the desired position
  - b. Turn the knob until the “TEACH” appears, then press the knob
  - c. Turn the knob the select the desired point to be taught (0 to 39) and press the knob
  - d. Turn the knob to select the tool bit number (0 TO 15) and then press the button. Select ANY to disable tool bit check. Skip this step if there is no bit tray.
  - e. Turn the knob to select the bin number (0 TO 11) and then press the button. Select ANY to disable bin pick check. Skip this step if there are no bins.
  - f. Turn the knob to select the torque program number (0 TO 15 for Microtec, 0 to 7 for Kolver, 0 to 15 for Atlas Copco) and then press the button.
  - g. Repeat the teaching point process for any additional points.
8. The Smart-Arm is now ready for the assembly operation
9. Install the tool required for the operation
10. Position the Smart-Arm to a taught position

## 6 Quick Connect Guide

### Smart-Arm Connections

Smart-Arm cables and connections are labelled and should be installed so that the cables match the Smart-Arm box labels. The following images may be used as reference:



Front View – Smart-Arm Control Box



Torque Controller Cable



Encoder Cables

The following table shows the Smart-Arm connector definitions:

H1	Encoder 1 – encoder between arm links
H2	Encoder 2 – encoder mounted on arm post
H3	Not used on Smart Arm
H4	Not used on Smart Arm
H5	Extended connector – for connection between master and slave box
H6	Service connector
H7	Bit holder/Bins– see below
H8	Bit holder/Bins– see below
H9	Bit holder/Bins/Reset Input – see below
H10	Torque Controller

There are 3 available I/O connectors on the Smart Box v3. Shown below is a list of supported combinations of bit holders, bin sets and external reset. Each bin set consists of 4 bins. Each bit holder contains 8 bins (no guiding lights) or 4 bits with guiding lights.

Configuration	Bit Holders	Bin Sets	External Reset
1	2	0	1
2	2	1	0
3	1	1	1
4	1	2	0
5	0	2	1
6	0	3	0

External reset input is set by closing the contact between pins 10 and 9 on connector H9. To use external reset, first enable the function using the maintenance menu.

Smart Arm v3 supports up to two bit holders. There are two types of bit holders – holder for 8 bits (no guiding lights) and holder with 4 bits with guiding lights. If two bit holders are connected they must be of the same type. The first bit holder must be connected to connector H7. Bits in this holder will be associated with bit numbers 0 to 7 (0-3 for 4 bit holder). If second bit holder is used it must be connected to connector H8. Bits in this holder will be associated with bit numbers 8-15 (4-7 for 4 bit holders).

Smart Arm v3 supports up to three sets of bins. The first bin set must be connected to the first available connector H7, H8 or H9; bins in this set will be associated with bin numbers 0 to 3. The second bin set must be connected to the first available connector H8 or H9; bins in this set will be associated with bin numbers 4-7. The last set of bins will be connected to the connector H9; bins in this set will be associated with bin numbers 8-11.

---

## 7 Appendix A – Torque Controller Configurations

### Kolver Configuration

1. No change to the Kolver Torque Controller is necessary.

### Microtec Configuration

To configure the Microtec tool to operate with the Smart-Arm, please see Microtec tool instruction manual. The following changes to the Microtec tool configuration must be made:

1. Access controller configuration tab by entering extended mode (PIN 3800).
2. Configure program select to digital I/O.
3. Configure reverse output signal OK to trigger at infinity

### Atlas Copco Configuration

To configure the Atlas Copco tool to operate with the Smart-Arm, please see Atlas tool instruction manual. The following changes to the Atlas tool configuration must be made:

1. Configure digital inputs for Pset select. Configure digital inputs 1-4 for Pset Select 0 through 3.
2. Configure digital output 1 for OK bit.
3. Configure Pset select for digin.

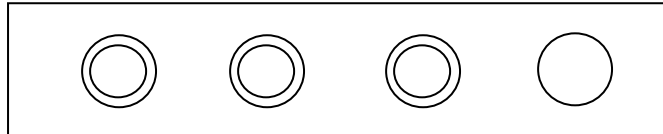
## 8 Appendix B – Troubleshooting Guide

### Troubleshooting Guide

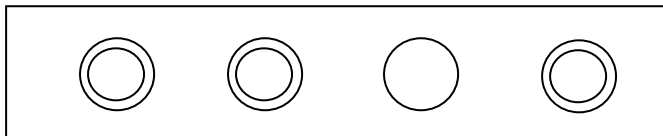
This section will address the most common faults and how to address them:

1. **Moving Points** – the taught points have all moved
  - a. This is most likely due to the encoder wheel slipping inside the encoder reader. This can be caused by a few different things. Perform the following procedure:
    - i. Check that the cable is plugged in properly. Black wire to the left for encoder connector orientation.
    - ii. Check the end of stroke number of counts on the A and B encoders. Enter MAINT menu and select 'A #####'. Move the 'A' joint from home to the full clockwise stroke, note the encoder pulses. Repeat. Repeat for counter-clockwise. Are the values stable? Repeat for B encoder. Unstable end of stroke count values indicates encoder problems.
    - iii. Can the A or B encoder housing be moved when pushed by hand? If yes, tighten the screws and ensure that the housing does not move. Points will have to be re-taught. If the problem persists, the encoder housing will have to be disassembled, return the Smart-Arm for servicing.
    - iv. Check that the shaft set screws are fully seated and tightened. At the A and B joints, there are 2 shaft set screws that keep the shaft from spinning. Ensure these screws are tightened.
    - v. Has the Smart-Arm been taken apart? The Smart-Arm should not be disassembled by untrained persons. This will void the warrantee. Return arm for service in this case.
    - vi. Is there vertical play in the joints? This is most likely caused by the Smart-Arm being assembled incorrectly by an untrained person. Return arm for service in this case.
2. **Moving Points** – some taught points have moved
  - a. This is most likely due to intermittent encoder wheel slipping while teaching. This can be caused by a few different things. Repeat procedure as above.
3. **Bit Holders** – the tool won't enable and displays that the incorrect bit is being used, even though the correct bit is out of the bit block.
  - a. The Smart-Arm needs to be configured for the correct number of bits being used and the bits need to be placed in the bit holder in the correct order.
    - i. Check that the number of bits being used is correct. Enter MAINT menu and check BITCNT. This should equal the number of bits you are using.
    - ii. The bit block must be filled from the least significant bit holder in a continuous fashion. This means that if you have 2 bits, you must fill the 1 position and the 2 position.
    - iii. Check that the bit holder is plugged into the right connector. The Smart-Arm can be configured with more than one bit block. Make sure that if you are using only one bit block, that it is plugged into H7 (the lowest bit block location).

- iv. Make sure that there are no open spaces, unless they are after the number of bits configured. If you have 4 bits configured, there can be no open spaces until after the 4<sup>th</sup> bit holder hole.



3 Bits Configured - Correct Bit Tray Arrangement



3 Bits Configured - Incorrect Bit Tray Arrangement

4. **Sequencing Not Working** – the sequence will not increment after a correct torque
  - a. This can be caused by several reasons. Use the following procedure to check the problem.
    - i. Is the cable correct? As of Rev 3 of the Smart-Arm, all cables provided will be fully populated for sequencing. Check that the cable part number is for sequencing.
    - ii. Has the controller been configured properly? Both the Microtec torque controllers and the Atlas Copco controllers have to be configured to work with sequencing. Consult Appendix 7 for a general explanation on configuring the device. Consult the device manual for specific details.
    - iii. Check that the OUTTYP (Output Type) matches the controller. Enter maintenance menu (MAINT) and verify settings.
5. **RH to LH is not the same XY point** – the XY point of the tool can be verified in the maintenance menu. When switching from RH to LH, the XY values should remain constant (some error 1-2 mm) may occur.
  - a. Follow the procedure below:
    - i. Set the origin. Enter MAINT menu and enter SETORG. Pick a point along the centreline of the Smart-Arm. The arm should be bent at the point, do not choose a point near the end of the working space where the arm would be straight.
    - ii. Follow the instructions, moving to the same point in LH and RH.
    - iii. Check again that the XY coordinate is the same in RH and LH.
    - iv. Has the tool adapter been changed? If the tool adapter has been changed, the Smart-Arm may think that the tool end is in a different location than it actually is. In this case, place the factory installed adapter back on the Smart-Arm.

- 
6. **Tool is Not Enabling** – the tool is not enabled, even though the a correct point has been reached by the Smart-Arm
    - a. The Smart-Arm may not be configured properly for the tool being used.
      - i. Enter the MAINT menu and select OUTTYP. Ensure the tool selection is correct.
      - ii. Check the cable and make sure the correct cable type is being used. Inspect the cable and connectors for damage.

### Frequently Asked Questions

1. Is a point taught in the right-hand orientation the same as the left-hand?
  - o Yes. The Smart-Arm calculates its position by counting the encoder pulses from home position. It uses these pulses to calculate the tool end in X, Y coordinates. It is the X,Y coordinate of the tool end that is saved when a point is taught, therefore the RH or LH orientation of the arm will result in the same X,Y point.
2. Will the system count bin picks?
  - o No. Assemblers typically grab the total number of screws needed from the bin and not one at a time. Part pick counting has not been implemented because it slows the assembly process down.
3. Does the Smart-Arm count screws?
  - o No. The Smart-Arm enables the torque controller when it is in the correct location with the correct bit and bin pick. When sequencing is enabled, the taught points must be followed in order and the sequence will not increment unless a 'torque OK' signal from the controller has been received.
4. What is the torque capacity of the arm?
  - o The current rated torque limit of the arm is 40 ft lbs.
5. What is the accuracy of the arm?
  - o The arm's rated accuracy is < 2mm.
6. Does the bit selection set the torque?
  - o No. The location of the arm sets the torque.
7. What is the maximum tool weight the arm can support?
  - o The tool weight is limited by the tool balancer. Currently the Smart-Arm has a 5lb tool balancer.

---

## **9 Appendix C – PM Schedule**

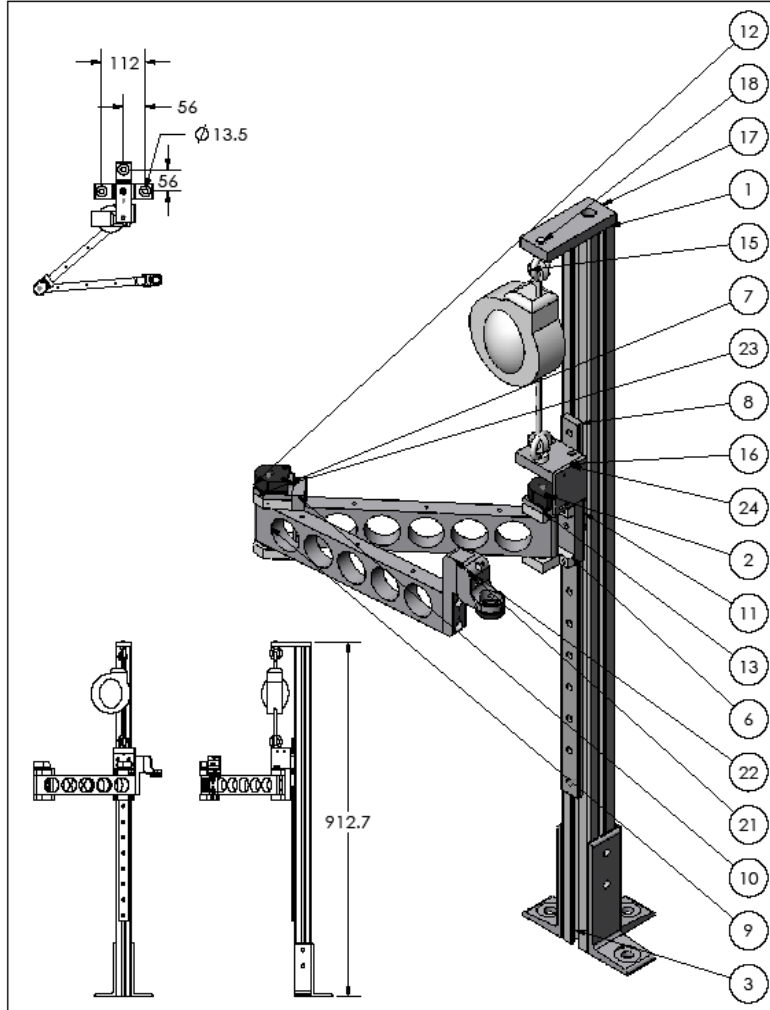
The Smart-Arm is a relatively maintenance free device. Follow the procedure below for preventative maintenance.

Monthly:

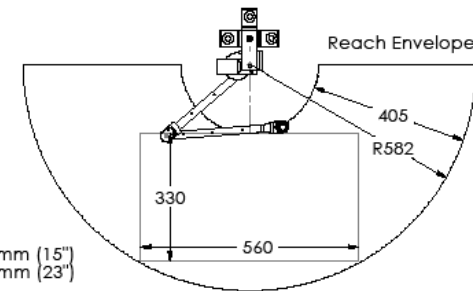
1. Apply lightweight spindle oil to linear bearing rail and radial bearings.
2. Inspect fasteners to ensure tightness.

# 10 Appendix C – Smart Arm Assembly Drawing

The information provided in this drawing is the sole property of Sterner Automation Limited. Any reproduction in part or whole without the written permission of Sterner Automation Limited is prohibited.



#	Item Number	Description	Qty.
1	1330202	80/20 40mm x 40mm extrusion	1
2	2700050	E2 Optical Kit Encoder	2
3	1330201	Floor Mounting Bracket	3
5	1111134	#0-80 X 1/4 machine screw	6
6	1220107		2
7	1220108		2
8	1220109		1
9	1321824	Arm Segment	2
10	1321825	Pivot Mount	1
11	1321826	Slide Mount	1
12	1321827	Encoder Mount 1	1
13	1321828	Encoder Mount 2	1
14	1321829	Stepped Shaft	2
15	1160072	Tool Balancer ReelCraft TB-05	1
16	1321830	Eyebolt Mount 1	1
17	1321831	Eyebolt Mount 2	1
18	1111195	Misumi-CHIC8	2
20	1120170	Economy T-Nut M4	20
21	1321841	Microtec Screwdriver Adapter	1
22	1321842	Microtec Arm-Tool Adapter	1
23	6230387	Encoder Cable Assembly	2
24	1321881	encoder connector protector	1



Total Vertical Travel: 380mm (15")  
 Total Horizontal Reach: 582mm (23")

<b>Metric (mm)</b> X ± 1.00 .X ± 0.25 .XX ± 0.10 X* ± 1* Tolerances unless otherwise specified	<b>STERNER automation</b> 55 Fieldway Road Toronto, ON Tel: (416) 536-1826 www.sternerautomation.com		Description <b>Smart Arm</b> Parent Assembly			
	Designed: T.F. Checked: P.P. Approved: P.P.	Date: Jun 22, 2007 Date: Jun 22, 2007 Date: Jun 22, 2007	Part Number <b>6210927</b>	Sheet(s) <b>1 of 1</b>	Scale: NTS	Rev.