Ogden Kodiak 6ft. 6in. Saw Operation Manual - BPS Eq. 332

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Introduction

0.1 Manual Overview

This is an Operation Manual for the Ogden Kodiak 6'6" Saw (Bruce Peninsula Stone equipment number *332*) with revised control system. Each chapter topic covers one operator screen, along with related controls and indicators. The following format is used for indicating tips and information **i** and cautionary notes **!** where necessary. As an example, figure 1 below shows the Main Operator Screen. Details that would follow the image of the screen shall include items of interest, such as control items and information areas, as well as status indicators. The descriptions and explanations are given from the perspective of proper equipment operation by the reader. A basic understanding of machine operation and safety procedures specific to the facility housing the equipment, should be considered a pre-requisite.

i The Main Screen shown in Figure 1, and all of the Operator Screens, use the same layout style. Navigation between screens is done using the physical buttons on the left side of the terminal, with the labels referencing what screen to goto. The operator can always return to the Main Screen from any other screen by pressing the Menu button located at the bottom left of the terminal.

! A fault will be triggered by the program logic if the Operator tries to begin an Automatic Cycle without first entering a valid cut program.

Above notes are examples of Information and Cautionary notes related to the display screen being discussed.

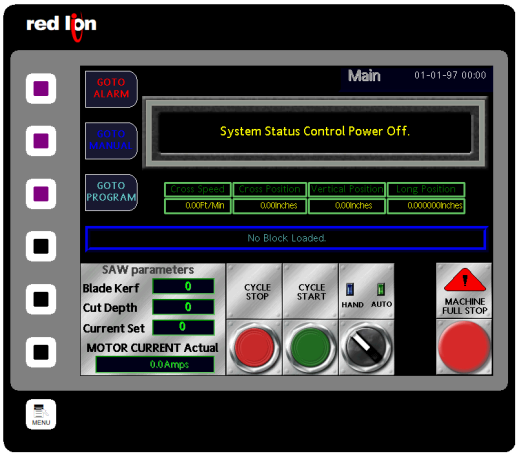

Figure 1: Example Screen

0.1.1 Screen Layout Style

Screen navigation is done through the use of the left hand Terminal Programmable keys and the Terminal Menu key. If a Programmable Key can be used to navigate to another screen, it will be noted by a label next to that key. In the above figure of the Example Screen, there are labels next to the top three Programmable Keys. This would indicate that the Operator can navigate to the labelled Screens by pressing the adjacent key. In this example, the Operator is able to navigate to either the Alarms Screen, the Manual Screen, or the Cut Program Screen. The Menu key will always return the Operator to the Main Screen from any other screen. As a note, there are times when an FKey is programmed to do an action as a Push Button. These are always indicated by a different coloured label beside them, than the blue used for navigation to other screens. Alarm messages and Information messages scroll through all active messages continuously until they are no longer active. Alarms are active until the Operator acknowledges them by resetting them using the Alarm Reset button on the Alarm Screen. On the Main Screen above, the Message Display Area is at the top of the Screen below the Title. The Message Area will display messages for the Operator's information, which will change according to the state of the machine. No interaction is required by the Operator since it is information only. All Alarms are displayed in the Alarm Screen Alarm Message Display Area, but indication an alarm condition exists will be displayed in the Information Display Area. Looking at the Main Screen figure above, there are control buttons located at the bottom of the screen. These are an example of how Operator Control devices and Indicator devices will be displayed and interacted with.

All of the Buttons and Pilot Lights have been chosen to resemble physical Industrial Operator and Indicator devices that would normally be found on a control panel for a machine.

Chapter 1

The Main Screen

1.1 Overview

The Main Screen is the primary display screen. It is shown at power up, and is where Operation Mode (Hand or Automatic) is selected. It displays the Operator Message Centre which provides the Operator with current and relevant machine state information. There are also controls for *Mode* ***Hand/Auto***, *Automatic* ***Cycle Start*** and *Automatic* ***Cycle Stop***, plus ***Machine Full Stop***. There is an information area for Saw details, and one for the current running cut program. Finally, there are screen navigation keys provided for Operator access to other machine functions.

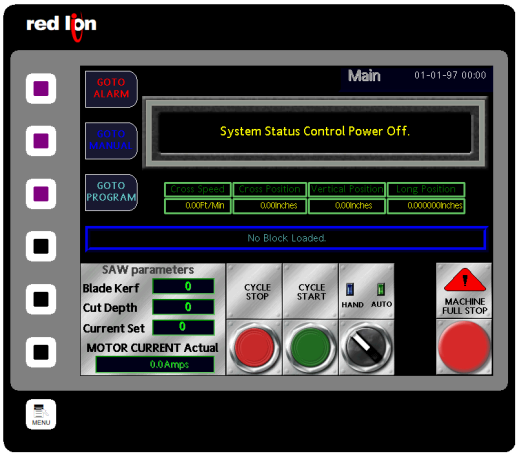

Figure 1.1: Main Screen

1.2 Main Screen Details

Main Screen Details are divided into the general categories.

- ◇ **Screen Navigation**
- ◇ **Operator Message Centre**
- ◇ **Saw Information**
- ◇ **Program Details**
- ◇ **Operation Control**

1.2.1 Screen Navigation

Navigation is performed by using the programmable Function Keys (FKeys) located down the left hand side of the OI Terminal (refer to Figure 1.2). For the Main Screen there are three screens accessible using the labeled FKey's, **Alarms**, **Manual**, and **Program**.

- ◇ **GOTO ALARM** Navigate to Alarms Screen.
- ◇ **GOTO MANUAL** Navigate to Manual Screen.
- ◇ **GOTO PROGRAM** Navigate to Cut Program Screen.

Figure 1.2: Main Screen Navigation

i The Menu Key located on the terminal at the lower left below the FKey's, will return the Operator to the Main Screen, from all other screens.

i The Menu Key is pictured as it looks on the Terminal.

Figure 1.3: Main Screen Message Centre

Figure 1.4: Main Screen Axii Position

1.2.2 Operator Message Centre and Axis Position

The message display area located on the Main Screen below the Screen Title, is the Operator Message Centre. It is used to display information for the Operator during machine use. It doesn't display Alarm details, those are found on the Alarms Screen, though it will indicate if an Alarm condition exists. The *Operator Message Centre* is shown in Figure 1.3. The display will scroll through messages continuously based on conditions and state change. The Operator isn't required to initiate any message change, or acknowledge a message, this display is merely for their information.

Axis Position (Figure 1.4) is displayed below the *Operator Message Centre* and shows positional data from the feedback for each of the saw's axii, as well as the current velocity of the cross travel axis.

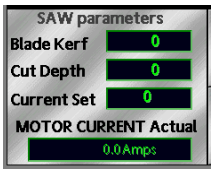

Figure 1.5: Main Screen Saw Information

1.2.3 Saw Information

Is an area where the Operator can see information about the Saw at a glance. **Saw Kerf**, **Cut Depth**, and **Current Set** are displayed along with the **Motor Current Actual**. (i) This information is display only, in order to make changes to the saw parameters *Blade Kerf, Cut Depth, and Current Set* the operator must navigate to the Program Screen. Where they may be changed at any time and in any mode, even while running in automatic/manual or faulted. More details on those settings can be found in the chapter dealing with the Cut Program Screen.

Figure 1.6: Main Screen Program Details

1.2.4 Program Details

The display area will show the Operator details about the current step of the saw program. This will include such details as the current block being cut, or position moving to, while the Mode is automatic and the program is being executed. If the mode is automatic and the program execution is interrupted, or has completed, the display will show the last step being executed. If the Mode is Manual (Hand), and automatic operation has not been started/completed/interrupted, then it will display no block. Otherwise, the display will be the last step details from program execution, the same as if in Automatic mode. (i) The saw will keep track of where it is in the Cut Program execution cycle, even if cycle stop is pressed. Further details about how the Cut Program is executed, and what behaviour to expect from cycle interruption due to completion, alarms or Operator action can be found in the section(s) following. The Program details (figure 1.5) will display information about the current Block being worked on, if running in Auto Cycle. If the cycle has been stopped, the details displayed will be about the current block being worked on, this is the same in both Hand and Auto Modes, as well as in the case of a faulted condition. This means that if the saw has finished cuts for a block entirely, the display will actually show details about the next block to work on since it is now the current block. If the cycle has completed without error, then the details of the last block programmed will be displayed, in either Hand or Auto Modes. If the program has not been run, and the Mode is either Hand or Auto (not in cycle) then the first block in the program will have it's details displayed.

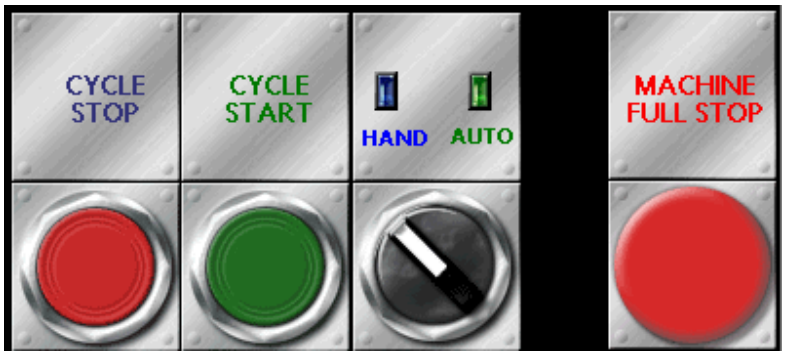

Figure 1.7: Main Screen Operation Control and Machine Stop

1.2.5 Operation Control

Is provided by a group of Push Buttons and Selector Switches that allow the Operator to Select Modes (*Hand/Auto)*), Start and Stop the Auto cycle (*Cycle Start, Cycle Stop*) or execute a *Machine Full Stop* command.

(i) The cut program may be restarted from any position, providing it was *Cycle Stopped*. If the machine was stopped by pressing the *Machine Cycle Stop* Button, the program will need to be re-entered as this is considered a faulted condition initiated by the Operator when machine safety is a concern. The same applies to any Fault generated by other emergent conditions that require the saw to be stopped mid-cycle. If the saw is stopped by pressing the *Cycle Stop* Button, it may be placed into *Hand* by the Operator if manual control is required. From a cycle stopped state, selecting *Auto* and pressing *Cycle Start* will restart the *Cut Program* at the last known cut location and depth.

(!) Extreme Caution must be exercised when restarting the *Cut Program* after a *Cycle Stop*. If motion in the Long Travel Axis has been made after cycle stopping, there is a high probability that the saw will not return to the exact cut location due to mechanical tolerances in the axis. The saw will move the *Vertical Axis* to the last programmed height when *Cycle Stop* was pressed. Both of these conditions when combined, can lead to re-engaging a cut pass in a Block which is not perfectly in line with the original path the saw blade had established prior to stoppage. An example would be if the Long Axis was moved in the positive direction prior to a restart being issued, it would attempt to return to the last cut location from the home end of the machine. It accomplishes this type of move by traveling past

Figure 1.8: Main Screen Operation Control

the cut location back in the direction of home, then moving to the desired cut location. The repeatability of the saw position is not small enough to guarantee near perfect allignment of the blade with an existing cut. The vertical axis would then lower to the last cut height. If the saw blade is now near perfect in allignment with the existing cut location, the saw will finish the cut without incident due to misallignment. However, if the allignment is a blade width out in either direction, the potential for damage to product and possibly the equipment is greater.

Mode Set

Refer to Figure 1.7 shown above. The *Hand/Auto* selector switch is provided for the Operator to be able to select *Hand* or *Auto* modes. Above both mode positions is an indicator light. As well as the switch position, the corresponding light will be on indicating which of the modes is selected. The blue light on will indicate that *Hand* mode is selected. While the green light indicates *Auto* mode is selected. When the selector is set to ***Hand***, the *Blue Hand Indicator* will be on solid if no faults exist and flash if there is a fault, or if the machine needs homing of any axis. Selecting *Hand* while in *Auto* will change the mode to *Hand*, even if a programmed cycle is running. When the *Hand/Auto* selector switch is set to ***Auto***, the *Green Auto Indicator* will flash if the saw is ready to run a cut program. In order to be ready to run a cut program in *Auto* all of the saw axii must have been homed, no faults of any kind may exist, and a valid cut program must have been entered. When in *Auto* mode, and once the **Cycle Start** pushbutton is pressed, the saw will begin *Automatic* execution of the **Cut Program** the Operator entered and

Figure 1.9: Main Screen Machine Full Stop

the **Auto** indicator will be on solid.

Cycle Stop

When pressed while an *Auto* cycle is executing a *Cut Program*, will cycle stop the saw at completion of the currently executing step of the cycle. In practical terms what this means is that if the saw was moving to a new cut location, it would stop motion, and pause *Auto* cycle, once that particular move was completed. This includes *Cross Travel* motion, *Vertical* motion, and *Long Travel* motion. The saw will remain in *Auto* mode after a ***Cycle Stop*** has occurred.

Machine Full Stop

Refer to Figure 1.8 above. ***Machine Full Stop*** pushbutton is intended to be used in the event the Operator feels an immediate stop of automatic or manual motion is necessary. Unlike the ***Cycle Stop*** pushbutton, pressing ***Machine Full Stop*** will immediately stop all motion of the saw and exit *Auto* mode.

! Unlike an Emergency Stop pushbutton, this is a programmed response to an Operator perceived hazard potential and **must not** be relied upon as a safety measure in any respect.

i A program that has been ***Cycle Stop***'d can be restarted from the stop location, even if the program has been changed within the limits of the program as it was running until then. What this means in practice is that if

the Operator determined they need to correct an error in the cut program, in a part that hasn't been cut yet, they would be able to cycle stop the saw, correct the error, then ***Cycle Start*** the program to continue.

! If a program has been modified after a ***Cycle Stop*** occurred, the restart of the cut program could generate and error if the data change exceeds the known saw limits. Refer to the chapter on **Cut Program** entry and details for further explanation.

Chapter 2

The Alarm Screen

2.1 Overview

The Alarm Screen is the screen the Operator uses to diagnose the Saw when it is in a Faulted State. It will provide information to the Operator about the nature of the Fault, and allow for acknowledgement of the faulted state by the Operator.

Figure 2.1: Alarm Screen

2.2 Alarm Screen Details

The Alarm Screen details are divided into the following general categories.

- ◇ **Screen Navigation**
- ◇ **Recovery Option Popup Window**
- ◇ **Alarm Acknowledge/Reset**

2.2.1 Screen Navigation

Is performed by using the programmable Function Keys (FKeys) located down the left hand side of the OI Terminal (refer to Figure 2.2). The Operator may navigate to the ***Manual Screen*** and the ***Program Screen***. and of course the ***Main Screen*** using the *Menu* FKey.

- ◇ **GOTO MANUAL** Navigate to Manual Screen.
- ◇ **GOTO PROGRAM** Navigate to Cut Program Screen.

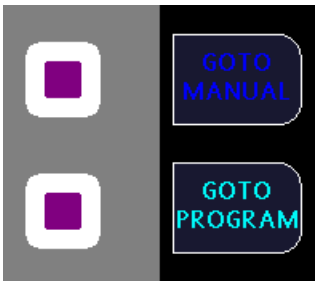

Figure 2.2: Alarm Screen Navigation

i The Menu Key located on the terminal at the lower left below the FKey's, will return the Operator to the Main Screen, from all other screens.

i The Menu Key is pictured as it looks on the Terminal.

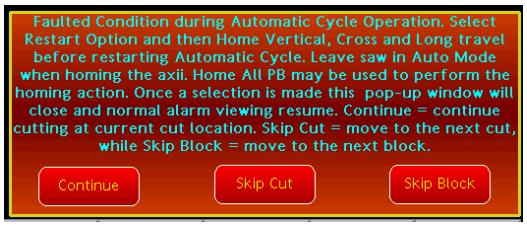

Figure 2.3: Alarm Recovery Popup Window

2.2.2 Alarm Recovery Popup Window

This window pops up if running in Automatic and an alarm condition occurs. It offers three choices to the Operator for recovery ...

- ◇ **Continue**
- ◇ **Skip Cut**
- ◇ **Skip Block**

The *Alarm Recovery Popup Window* shown in Figure 2.3 will offer the Operator options on how to proceed from the alarmed condition back into running in automatic. If *Continue* is chosen, the Operator would then reset the alarm and restart the automatic cycle and the saw will continue from the current location. This option relies on the Operator assessment of the safety to the equipment if starting from that particular state. By choosing to *Skip Cut* the Operator is deciding to move onto the next cut location for the existing block being worked on by the program. This option will skip to the next cut location of the slab size being cut at the time of the faulted condition occurring. *Skip Block* by extension is used to skip the current block and begin the cycle at the next block first cut location. This offers options to the Operator on how they wish to recover based on the condition of the bed of material and the saw itself.

2.2.3 Alarm Messages and Acknowledge/Reset

The ***Alarm Reset*** pushbutton or the ***Alarm Acknowledge Button*** are how the Operator acknowledges a Fault to clear it. The Operator **must** acknowledge **all** Faults in order to clear them. Faults must be cleared before the Operator can change the Saw into *Auto Mode*. A number of faults clear whenever the faulted condition(s) are no longer present, these will remain until Acknowledged/Reset, but will change colour to reflect their state (to blue from red). If the fault is acknowledged but still active it will display in amber/yellow. Currently 100 fault lines can be displayed at one time.

Figure 2.4: Alarm Acknowledge/Reset Pushbuttons

i The details of the Fault which is causing the Alarm will be displayed in the ***Alarm Message Display Area*** of the window (which stretches from the buttons at the bottom of the screen to the title). The most recent fault is displayed first (at the top) and the least recent at the bottom. The *PREV* and *NEXT* buttons are used to scroll through the alarm messages. The Operator can use this information as a guide to clearing the Faulted condition. Manual operation of the Saw is allowed under most Faulted conditions.

! A fault that is triggered must be cleared by an Operator acknowledge(**Ack**) and reset(**RESET ALARM**) (see Figure 2.4) in order to be able to run an automatic cut program on the saw. The ***RESET ALARM*** PB is programmed as an FKey in this case. All faults are programmed to help the Operator prevent damage to the saw through normal use. The surrounding work area, and it's upkeep and cleaning can have an affect on Saw operations. It is the Operators responsibility to ensure the area is kept clutter free and the equipment travel paths are relatively clean.

2.3 Alarms - Listing

Alarm Descriptions The following is a listing of the alarms that can be triggered and their potential cause. Most alarm conditions are self evident, but some can be masked by other related faults. This listing should help when troubleshooting the saw in an alarmed state.

- **Soft Start Overcurrent Alarm, Possible Blade Pinch** *Check Soft Start and reset it to continue. Check Saw Blade for pinched condition.*
- **Cross Travel Alarm** *Check the Cross Travel Drive and Reset if Faulted. This error may occur simultaneously along with other errors.*
- **Long Axis Error** *Check the Long Travel Drive and Reset if Faulted. This error may occur simultaneously along with other errors.*
- **Long Master Drive Mains Loss Alarm** *Check power supply to Long travel Drive(s), check fuses.*

- ◇ **Long Master Drive Overload Alarm** *Check Long travel Drive(s) and Reset Faults, check for obstructions on rails of Long Travel. Possible motor/drive failure pending if this fault continues with no obvious mechanical reason. An excessive load on the motor is generally the cause for this fault to occur.*

- ◇ **Long Master Drive Over Temperature Alarm** *Check the Drive(s) for faults and Reset them. This is potentially related to failing motor, motor termination issues, or cabling issues. Acceleration and Deceleration that exceeds the drives capabilities will also cause this error to happen.*

- ◇ **Long Master Drive Under Voltage Alarm** *Check the Drive(s) supply voltage to see if it is within acceptable limits. Correct power supply issues in order to continue.*

- ◇ **Long Master Drive Warning (Drive Error Exists)** *Check the Drive(s) to reset the error and continue. This error may happen when an unknown drive error has occurred.*

- ◇ **Operation Auto Cycle Overtime Sequence Step State Error** *This Alarm indicates the automatic sequence has taken too long to complete or start a sequence step. Since this should be seen as an unknown state for the machine, selecting continue from the recovery popup will force the current expected state to become active. While selecting skip cut or skip block, will force the expected state of moving from the current cut/block.*

- ◇ **Zero Height Block has been Loaded - Cycle Stop Initiated** *Check the Block Program for the current block. This fault will force a cycle complete state, which will stop the automatic cycle as if the cycle had completed. (The program is erased, auto sequence is reset)*

- ◇ **Zero Width Slab Size Loaded - Cycle Stop Initiated** *Similar to the Zero Height Block, there can't be a Zero Width Slab. Cycle Compete is forced, and the block program is erased, and auto cycle sequence is reset.*

- ◇ **Power Off Reset Emergency Stop PB** *Reset the Emergency Stop PB to turn on power to the machine.*

- ◇ **Cut Program has an Error in it, correct program to continue** *This feature is not active at this time.*

- ◇ **Safety Gate is Open, Close Gate to Run Auto Cycle** *The safety gate circuit is not active, check gate switch.*
- ◇ **Soft Start Overload Error** *Check the Soft Start and Reset to continue.*
- ◇ **Soft Start Current Monitor Sensing Alarm** *This alarm is triggered by faulty current sensing feedback. Check current sensing circuit and repair or calibrate as necessary.*
- ◇ **Cross Travel Drive General Error Alarm** *Check the Cross Travel Drive and Reset it to continue. This alarm may accompany other alarms for the drive.*
- ◇ **Cross Tavel Drive Mains Loss Alarm** *Check the supply to the drive and correct any faulty conditions found.*
- ◇ **Cross Travel Drive Overload Alarm** *Check the Cross Travel rails for obstructions. Check gearbox oil level to ensure it is full. This could be an indication of motor wear, or output stage failure of the drive if the problem persists and there is no mechanical reason found.*
- ◇ **Cross Travel Drive Over Temperature Alarm** *Check the Cross Travel Drive and Reset it to continue. This alarm can be due to Accel or Decel being set too low. It also can be due to higher than normal ambient environmental temperatures. There is also the potential it could relate to motor terminations or cabling.*
- ◇ **Cross Travel Motion Error! Encoder should be checked** *Check the the Cross Travel encoder and connections to it. This fault will only occur if the encoder has stopped providing pulses when the drive is being commanded to move. This same fault can occur if the Cross Travel motor is decoupled from the gearbox, like if a coupling fails.*
- ◇ **Vertical Axis Alarm** *Check the Vertical Travel drive and Reset it to continue. This fault can also occur while other faults are present on the drive.*
- ◇ **Vertical Drive general Error** *Check the Vertical Travel drive and Reset it to continue. This fault can also occur while other faults are present on the drive.*
- ◇ **Vertical Travel Drive Mains Loss Alarm** *Check the Vertical Travel Drive main supply voltage. Replace any blown fuses supplying the drive.*

- ◇ **Vertical Drive Overload Alarm** *Check the Vertical Travel Ball Screw and Rails for obstruction or lubrication needs. Check motor gear box to ensure adequate gear oil is present. This alarm indicates an overload condition of the drive/motor/load combination.*

- ◇ **Vertical Drive Over Temperature Alarm** *Check the Vertical Travel Drive and Reset it to continue. This alarm can be an indication of motor wear, loose terminations, aging cabling, or aging output transistors of the drive itself. Rapid acceleration and deceleration can also cause this alarm.*

- ◇ **Vertical Motion Error. Encoder should be checked.** *Check the Vertical Travel encoder and connections to it. This fault will only occur if the encoder has stopped providing pulses when the drive is being commanded to move. This same fault can occur if the Vertical Travel motor is decoupled from the gearbox, like if a coupling fails.*

- ◇ **Water is flowing and should not be, check water flow switch** *Check the Water Flow Switch. This alarm occurs when the switch is indicating water flow while no water should be flowing.*

- ◇ **Water is not Flowing and Should Be, Check Water Supply** *Check the Water Flow Switch. This alarm occurs when the switch is not indicating water flow while water should be flowing.*

2.4 Faulted Conditions, Alarms, and the Operator

A machine as complex as a gantry rock cut saw, can have Faulted conditions arise from many areas of it's operation envelope.The severity of an alarm is a direct result of the severity of the Faulted condition that triggered the alarm. Therefore, it should come as no surprise to the Operator that some Faulted conditions are severe enough to prevent manual operation of part or all of the saw. The drives that move the Long, Cross, and Vertical axii of the saw are one such set of components that can have Faulted conditions that cripple the saw operation. Rectifying the condition that triggered the Fault is the one sure fired method of ensuring problem free operation of the saw. The Gantry Rock Cut Saw is a machine that works under harsh conditions. As such, it is to be expected that components will wear as the saw is used. This includes electrical and electronic components as well as the mechanical parts. After time, heavily loaded electrical components, such as saw motors, will suffer

degradation of critical parts under stress. The Operator can note that there will be performance losses under such cases, and more frequent Faults of overload type, such as motor stalling. This will continue and usually worsen until failure of the weak components occurs. Understanding how the machine operates under well maintained normal conditions is a great benefit to the Operator when it isn't operating as expected. Faults, and their frequency of occurrence, can help the Operator note a trend towards component failure. This can lead to better maintenance cycles through preventative measures, reducing downtime and scrap as a direct consequence. Some Fault conditions may never be observed by the Operator directly, whether they are masked by another Fault condition or only occur under certain maintenance steps. An example of such a Fault condition is the Communication Network(s) used in the Control System Architecture. If the communication fails in a part that feeds information to the HMI (from the PLC), the error couldn't be displayed. This is a moot point under that specific Fault condition since there would be no screen navigation or control capabilities either, and the Operator would be aware a problem exists as a consequence. If communication is lost to the Drives Network for instance, the Faulted condition would be announced and the Operator would have *Manual* mode capabilities. Trying to ***Cycle Start*** an *Auto* cycle without first entering in a correct cut program, is a Faulted condition that will trigger an alarm. The Operator would acknowledge such an Alarm by pressing the ***Reset*** pushbutton on the ***Alarms Screen*** to continue, then enter a valid cut program before trying to start another automatic cycle. Just like the Operator Message Centre on the Main screen, the Alarm Message Centre on the Alarms Screen is there for the Operator Information to assist in daily operations. Alarms can be expected to occur regularly during normal use.

Chapter 3

Manual Screen

3.1 Overview

The ***Manual Screen*** is the screen the Operator navigates to in order to perform manual operations with the saw. The ***Manual Screen*** cannot hold controls and indicators for all controlled devices on one screen. Therefore, the manual controls are divided over several screens that are accessable from the ***Manual Screen***. This is described in detail below.

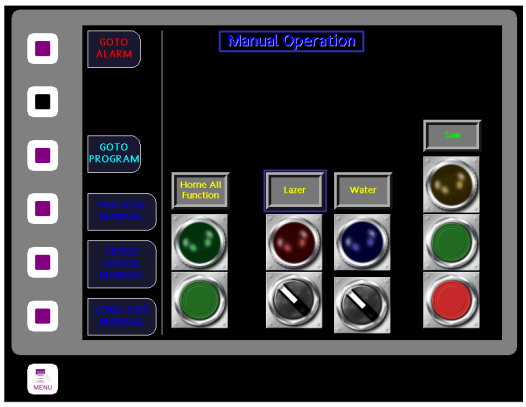

Figure 3.1: Manual Screen

Figure 3.2: Manual Screen Navigation

3.2 Manual Screen Details

The ***Manual Screen*** details are divided into the following categories.

- ◇ **Screen Navigation**
- ◇ **Home All**
- ◇ **Lazer**
- ◇ **Water**
- ◇ **Saw**

3.2.1 Screen Navigation

Is performed by using the programmable Function Keys (FKeys) located down the left hand side of the OI Terminal (refer to Figure 3.2). The Op-

erator may navigate to the ***Alarm Screen*** and the ***Program Screen*** and of course the ***Main Screen*** using the *Menu* FKey. As well, there are navigation keys programmed for going to the manual control screens for Long, Cross, and Vertical axii.

◇- **GOTO ALARM** Navigate to Manual Screen.

◇- **GOTO PROGRAM** Navigate to Cut Program Screen.

◇- **VERTICAL MANUAL** Navigate to Vertical Axis Manual Control Screen.

◇- **CROSS TRAVEL MANUAL** Navigate to Cross Travel Manual Control Screen.

◇- **LONG AXIS MANUAL** Navigate to the Long Axis Manual Control Screen.

i The Menu Key located on the terminal at the lower left below the FKey's, will return the Operator to the Main Screen, from all other screens.

i The Menu Key is pictured as it looks on the Terminal.

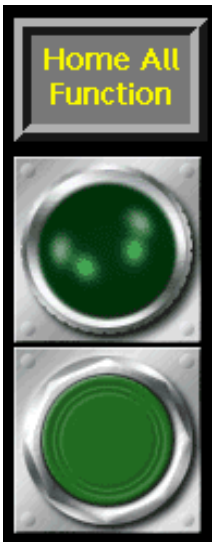

Figure 3.3: Manual Home All Function

3.2.2 Home All Function

Referring to Figure 3.3. The ***Home All Function*** is actually a state of the saw, and this has special ramifications over the control of the saw. When a Home All command is initiated, providing there are no critical Fault conditions preventing the state from changing, the saw control system changes to that state. This precludes *Hand/Auto* modes entirely, and prevents ***Cut Program*** entry until the ***Home All Function*** has completed. When initiated, the function will command the following ...

- ◇ **Saw Off** Turn Off Saw Motor.
- ◇ **Disable Drives** Disable Vertical, Cross, and Long Drives.
- ◇ **Water Off** Turn Off Water Solenoid.
- ◇ **Enable Vertical** Enable Vertical Axis.
- ◇ **Home Vertical** Home Vertical Axis.
- ◇ **Enable Cross Travel** Enable Cross Travel Axis.
- ◇ **Home Cross Travel** Home Cross Travel Axis.
- ◇ **Enable Long** Enable Long Axis.
- ◇ **Home Long Axis** Home Long Axis.

- ◇ **Home Complete** Home Complete Indication.

Once Homing has begun, it continues through a predetermined sequence, until all motion has stopped and completed. Then Home Complete is acquired, and indicated to the control program. At this time the Saw transitions from the Homing State into the At Rest state. The mode will be whatever mode was active when entering the Homing State, and since Home can only be initiated from *Hand* mode, this will always be *Hand* mode. The ***Home All Function*** is made up of the ***Home PB*** and the ***Home All Indicator***. When not homed completely (if homed by individual commands), or if ***Home All Function*** has not been completed, the ***Home All Indicator*** will be off. During the ***Home All Function*** executing, the ***Home All Indicator*** will be blinking. When all axii are at **Home** the ***Home All Indicator*** will be on solid.

i The ***Home All Function*** is a semi-automatic operation initiated by the Operator. Once initiated, it progresses through a predetermined sequence of operations to achieve the reference positions for all axii. This is irrespective of mode, and will only be stopped by completing the function, or a critical fault condition (including emergency stop), or a ***Machine Full Stop*** pushbutton press.

! While pressing the **Emergency Stop PB** will trigger a Faulted condition that would result in the ***Home All Function*** stopping, the **Safety Gate** Interlock circuit does not. Due to the nature of setting up and maintaining the Saw, it is necessary to have motion capabilities with the **Safety Gate** Interlock open. This includes the ***Home All Function*** which constitutes the first steps of setting up the saw. As a consequence, it is important for the Operator to be aware that the ***Home All Function*** may cause motion to occur automatically while the **Safety Gate** Interlock is open. The Operator **must** ensure the path of the Saw is unobstructed, and that no personnel are in the area of saw travel before initiating a ***Home All Function***.

Figure 3.4: Manual Lazer Control

3.2.3 Lazer

The ***Lazer*** Control is a selector switch that the Operator can use to turn on/off the Lazer. This is used during set up and entry of the cut program. Normally, the Lazer is off during operations. The red **Lazer Indicator** will turn on if the ***Lazer*** is on, otherwise it is off.

! The Lazer optics used on this Lazer are industrial rated optics. The Operator, and personell working in the vicinity, should **never** look directly at the lazer light without appropriate eye protection as this **will** result in damage to the eye. If using the Lazer for cut location, keep your back facing the Lazer light source, and turn it off when you're not needing to use it.

i The ***Lazer*** is a handy tool during cut program set up. If turned on in *Hand* mode, it will remain on until turned off by he Operator, or until the mode is switched to *Auto*. As the ***Lazer*** is not needed during cut program running, it does not run in *Auto* mode.

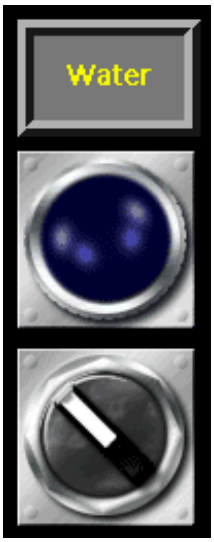

Figure 3.5: Manual Water Control

3.2.4 Water

The manual ***Water*** control is a selector switch and indicator light, please refer to Figure 3.5. When the selector switch is in the On position (right) the ***Water*** solenoid is turned on and once water flow is verified the **Indicator** will turn on. During *Hand* mode operation, it is useful to be able to turn the water On/Off to verify solenoid and flow sensor operation. During *Auto* mode operations, the water solenoid and the state of the flow switch monitoring, is controlled by the PLC.

i Turning the water on and off in the Manual Screen is an easy way to test solenoid and flow switch operation prior to starting an Auto Cycle.

! If the **Flow Switch** does not indicate water flow while the selector switch is on, verify there is actual water flow, if not verify solenoid operation. If solenoid operation is verified, and water is not flowing establish proper flow then continue. Once flow is verified, and switch is still not operating, check switch for correct operation and replace if necessary. Without water flow demand and indication, ***Cut Program*** automatic execution is inhibited.

Figure 3.6: Manual Saw Control

3.2.5 Saw

The manual ***Saw*** control is made up of a **Start** pushbutton, a **Stop** pushbutton, and an amber **Indicator** pilot light. In order to be able to **Start** the Saw motor, the **Safety Gate** interlocks **must** be closed, and the safety circuit satisfied. Pressing **Start** will begin start up of the saw motor. Since the blade is a rather large inertial load, start up is gradual and should be allowed for. Once the saw blade motor is running, the amber **Indicator** pilot light will turn on. The exact point at which the **Indicator** comes on is determined by the saw motor Soft Start **Run** contact, and may not repesent full motor speed. To stop the saw blade motor, press the **Stop** pushbutton. The **Indicator** pilot light will turn off.

! The saw blade motor does not have a brake on it, and since the saw blade is a large inertial load, the entire rotating mass will take some noticeable time to come to a complete stop. Personell **must** wait for the saw blade to come to a complete standstill before entering the saw work area.

i The saw motor operation in *Auto* mode is done by the program control, not by direct Operator input. When the *Auto* cycle is started, the motor is turned on and after a time delay and run confirmation, the water is turned on. Once flow is established the Automatic Run State is entered.

Chapter 4

Vertical Manual Screen

4.1 Overview

The Vertical Manual screen (Figure 4.1) is the *Hand* mode operation screen for control of the **Vertical** axis of the saw. On this screen are the controls to move the **Vertical** axis through it's travel limits as well as **Home** the axis. There is also an **Indicator** for **Home** position indication, and a display area for position feedback of the axis. The **Vertical Manual** screen is a sub-screen of the main **Manual** screen. As this is the case navigation is capable back to the main **Manual** screen, the **Cut Program** screen, and both the **Cross Travel** and **Long** manual screens. As always, the **Menu** FKey will return the Operator to the **Main** screen.

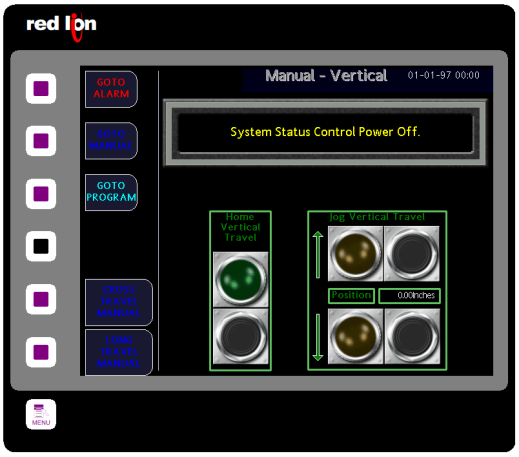

Figure 4.1: Vertical Manual Screen

4.2 Details

The Vertical Manual screen details are divided into the following categories ...

- ◇ **Screen Navigation**
- ◇ **Vertical Home**
- ◇ **Vertical Travel**

4.2.1 Screen Navigation

Is performed by using the programmable Function Keys (FKeys) located down the left hand side of the OI Terminal (refer to Figure 4.2). The Operator may navigate to the following screens ...

- ◇ **GOTO Alarm** Navigate to Alarm Screen.
- ◇ **GOTO MANUAL** Navigate to Manual Screen.
- ◇ **GOTO PROGRAM** Navigate to Cut Program Screen.
- ◇ **CROSS TRAVEL MANUAL** Navigate to Cross Travel Manual Control Screen.
- ◇ **LONG AXIS MANUAL** Navigate to the Long Axis Manual Control Screen.

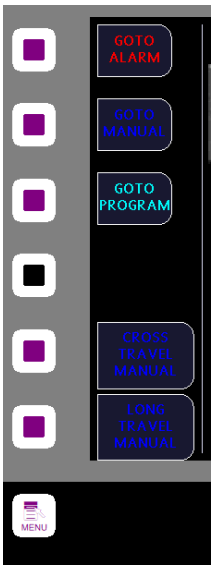

Figure 4.2: Vertical Manual Screen Navigation

i The Menu Key located on the terminal at the lower left below the FKey's, will return the Operator to the Main Screen, from all other screens.

i The Menu Key is pictured as it looks on the Terminal.

4.2.2 Vertical Home

Home Function is the stand alone homing routine for the **Vertical** axis. There is a **Control** pushbutton to initiate the homing function and an **Indicator** pilot light to indicate when the **Vertical** axis is in the **Home** position and has completed a homing function. On the saw the **Vertical** axis has it's **Home** position at the raised travel limit sensor. In fact the raised travel limit proximity sensor is the **Home** proximity sensor. A homing function will cause the axis to move in either direction depending upon the state of the **Home** sensor. If the **Home** sensor is off, the **Home** function will command the **Vertical** axis to raise up to the point the sensor comes on. The axis will then stop, reverse back off of the sensor, then creep back up until the sensor triggers again. By homing in this fashion, the repeatability of the **Vertical** axis is more consistent than homing until the sensor is triggered then stopping would be.

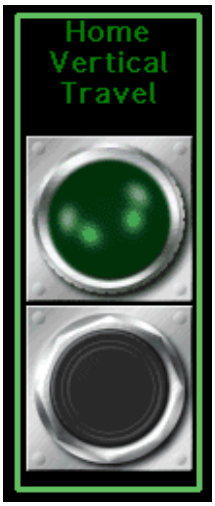

Figure 4.3: Vertical Manual Home Function

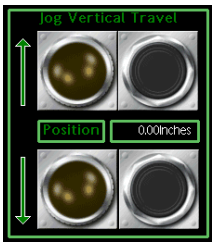

Figure 4.4: Vertical Manual Travel

4.2.3 Vertical Travel

Figure 4.4 shows the **Vertical Travel** function. The function is made up of a pushbutton to command **Vertical Travel Raise** with a corresponding **Indicator** pilot light that indicates motion commanded but not complete. There is also a corresponding **Vertical Travel Lower** pushbutton and **Indicator**. Finally, there is a position feedback display area which shows the current axis position in inches. This function is available in *Hand* mode and is intended for use by the Operator during Machine Setup and Maintenance activities.

i The position feedback should be considered invalid if the axis has not been homed yet, since the position encoder is an incremental encoder and does not retain position information on a power cycle. Therefore it is required to reference the axis feedback to zero on successful homing completion, in order to ensure positional accuracy and repeatability.

Chapter 5

Cross Travel Manual Screen

5.1 Overview

The Cross Travel manual screen (Figure 5.1) provides the Operator access to control the **Cross Travel** axis while in *Hand* mode. The Operator is able to initiate a homing function, and there are indicators for **At Home**, plus while in motion. Navigation is possible to the main **Manual** screen, the **Cut Program** screen, both the **Vertical** and **Long Axis** manual screens, and of course the **Main** operation screen.

5.2 Details

The Cross Travel Manual screen details are divided into the following categories ...

- ◇ **Screen Navigation**
- ◇ **Cross Travel Home**
- ◇ **Cross Travel Control**

5.2.1 Screen Navigation

Is performed by using the programmable Function Keys (FKeys) located down the left hand side of the OI Terminal (refer to Figure 5.2). The Operator may navigate to the following screens ...

- ◇ **GOTO Alarm** Navigate to Alarm Screen.

Figure 5.1: Cross Travel Manual Screen

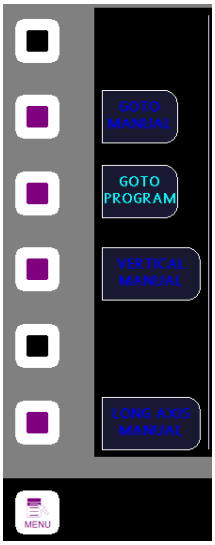

Figure 5.2: Cross Travel Manual Screen Navigation

Figure 5.3: Cross Travel Manual Home Function

- ◇ **GOTO MANUAL** Navigate to Manual Screen.
- ◇ **GOTO PROGRAM** Navigate to Cut Program Screen.
- ◇ **VERTICAL MANUAL** Navigate to Vertical Manual Control Screen.
- ◇ **LONG AXIS MANUAL** Navigate to the Long Axis Manual Control Screen.

i The Menu Key located on the terminal at the lower left below the FKey's, will return the Operator to the Main Screen, from all other screens.

i The Menu Key is pictured as it looks on the Terminal.

5.2.2 Cross Travel Home

Home Function is the stand alone homing routine for the **Cross Travel** axis. There is a **Control** pushbutton to initiate the homing function and an **Indicator** pilot light to indicate when the **Cross Travel** axis is in the **Home** position and has completed a homing function. On the saw the **Cross Travel** axis has it's **Home** position at the travel limit sensor closest to the Control Panel. A homing function will cause the axis to move in either direction depending upon the state of the **Home** sensor. If the **Home** sensor is off, the **Home** function will command the **Cross Travel** axis to move towards the operator up to the point the (home) sensor comes on.

Figure 5.4: Cross Travel Manual Command

Figure 5.5: Cross Travel Manual Feedback

5.2.3 Cross Travel Positioning

Figure 5.4 shows the **Cross Travel Command** function. The function is made up of a pushbutton to command **Cross Travel Forward** with a corresponding **Indicator** pilot light that indicates motion commanded but not complete. There is also a related **Cross Travel Reverse** pushbutton and **Indicator**. Finally, there is a position feedback display area which shows the current axis position in inches and it's velocity in feet per minute. This function is available in *Hand* mode and is intended for use by the Operator during Machine Setup and Maintenance activities.

i The position feedback should be considered invalid if the axis has not been homed yet, since the position encoder is an incremental encoder and does not retain position information on a power cycle. Therefore it is required to reference the axis feedback to zero on successful homing completion, in order to ensure positional accuracy and repeatability.

Chapter 6

Long Travel Manual Screen

6.1 Overview

The Long Travel manual screen (Figure 6.1) provides the Operator access to control the **Long Travel** axis while in *Hand* mode. The Operator is able to initiate a homing function or move to limit, and there are indicators for **At Home** and **At Limit**, plus for while in motion. Navigation is possible to the main **Manual** screen, the **Cut Program** screen, both the **Vertical Axis** and **Cross Travel Axis** manual screens, and of course the **Main** operation screen.

6.2 Details

The Long Travel Manual screen details are divided into the following categories ...

- ◇ **Screen Navigation**
- ◇ **Long Travel Home and To Limit**
- ◇ **Long Travel Control**

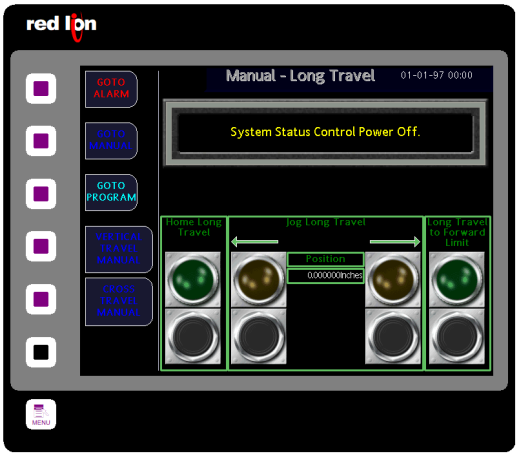

Figure 6.1: Long Travel Manual Screen

6.2.1 Screen Navigation

Is performed by using the programmable Function Keys (FKeys) located down the left hand side of the OI Terminal (refer to Figure 6.2). The Operator may navigate to the following screens ...

- **GOTO ALARM** Navigate to Alarm Screen.
- **GOTO MANUAL** Navigate to Manual Screen.
- **GOTO PROGRAM** Navigate to Cut Program Screen.
- **VERTICAL MANUAL** Navigate to Vertical Manual Control Screen.
- **LONG AXIS MANUAL** Navigate to the Long Axis Manual Control Screen.

i The Menu Key located on the terminal at the lower left below the FKey's, will return the Operator to the Main Screen, from all other screens.

i The Menu Key is pictured as it looks on the Terminal.

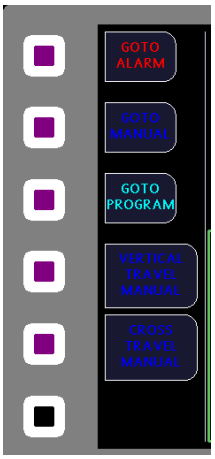

Figure 6.2: Long Travel Manual Screen Navigation

Figure 6.3: Long Travel Manual Home Function

6.2.2 Long Travel Home and To Limit

Home and To Limit Functions are the stand alone homing and move to limit routines for the **Long Travel** axis. There is a **Control** pushbutton to initiate the homing/to limit function and an **Indicator** pilot light to indicate when the **Long Travel** axis is in the **Home/Limit** position and has completed a homing/move to limit function. On the saw the **Long Travel** axis has it's **Home** position at the travel limit sensor target furthest to the left when facing the Control Panel. A homing function will initiate a homing program in the master drive of the axis to home the axis. While a move to limit function will move the Long axis towards it's forward limit target.

Figure 6.4: Long Travel Manual To Limit Function

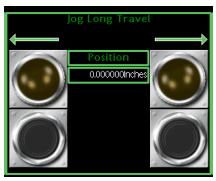

Figure 6.5: Cross Travel Manual Command

6.2.3 Long Travel Positioning

Figure 5.4 shows the **Long Travel Command** function. The function is made up of a pushbutton to command **Long Travel Forward** with a corresponding **Indicator** pilot light that indicates motion commanded but not complete. There is also a related **Long Travel Reverse** pushbutton and **Indicator**. Finally, there is a position feedback display area which shows the current axis position in inches. This function is available in *Hand* mode and is intended for use by the Operator during Machine Setup and Maintenance activities. This function uses inputs to the Master Drive of the axis to jog in either direction according to the parameters programmed into the drive for jogging.

i The position feedback should be considered invalid if the axis has not been homed yet. A Home command must be initiated in order to ensure positional accuracy and repeatability.

Chapter 7

Programming - Saw Parameters Screen

7.1 Overview

The Programming - Saw Parameters screen (Figure 7.1) provides the Operator programming access to the **Saw Operation Parameters** used while in *Auto* mode. The Operator is able to make immediately initiated changes to the *Cut Depth* the *Blade Kerf* and the *Motor Current Target*. Navigation is possible to the main **Manual** screen, the **Block Program** screen, both the **Vertical Axis** and **Cross Travel Axis** manual screens, and of course the **Main** operation screen. There is also an indicator for the Cross Travel Global Speed Override enabled state.

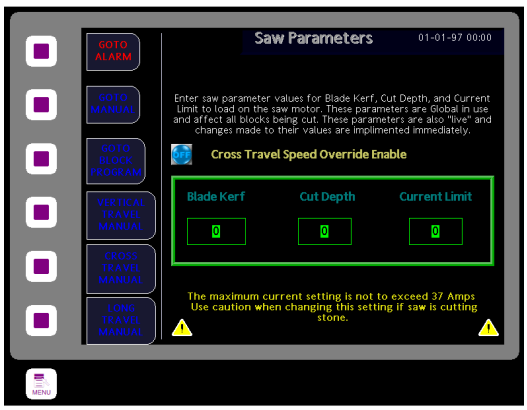

Figure 7.1: Programming - Saw Parameters Screen

7.2 Details

The Saw Parameters screen details are divided into the following categories ...

- **Screen Navigation**

- **Parameters**

- **Cross Travel Speed Override State**

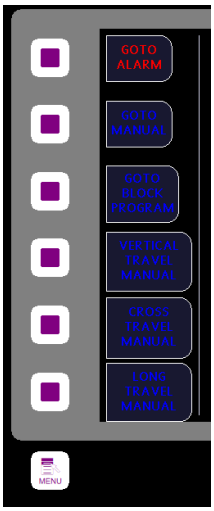

Figure 7.2: Saw Parameter Screen Navigation

7.2.1 Screen Navigation

Is performed by using the programmable Function Keys (FKeys) located down the left hand side of the OI Terminal (refer to Figure 7.2). The Operator may navigate to the following screens ...

- **GOTO Alarm** Navigate to Alarm Screen.
- **GOTO MANUAL** Navigate to Main Manual Screen.
- **GOTO BLOCK PROGRAM** Navigate to Block Program Screen.
- **VERTICAL MANUAL** Navigate to Vertical Manual Control Screen.
- **CROSS TRAVEL MANUAL** Navigate to Cross Travel Manual Control Screen.
- **LONG AXIS MANUAL** Navigate to the Long Axis Manual Control Screen.

i The Menu Key located on the terminal at the lower left below the FKey's, will return the Operator to the Main Screen, from all other screens.

i The Menu Key is pictured as it looks on the Terminal.

Figure 7.3: Saw Parameter Entry Fields

Figure 7.4: Saw Parameter Entry Fields

7.2.2 Saw Parameters

Parameters are "live" settings that take affect immediately after changing them. The Operator should exercise caution when changing them while running automatically. The ***Blade Kerf*** can be set to an accuracy of one thousandths of an inch by the Operator. The ***Target Current*** while cutting can be set within the stated limits specified on screen. Down to a tenth of an ampere in resolution. The ***Cut Depth*** can be set to any amount depending on Operator requirements, even decimal inches.

i The Operator should exercise caution when changing these parameters while running in auto mode. The change will be applied immediately. It is especially important when adjusting cut depth, not to make too aggressive of a drop amount.

7.2.3 Cross Travel Speed Override State

Cross Travel Speed Override State is an indicator that shows whether the ***Cross Travel Speed Override*** is in an enabled or disabled state. When the override is enabled the indicator will be "lit" and will have the word **On** instead of **Off**. The actual enabling and speed setting is accessed through the ***Program Check Screen***.

i The Operator can use this indicator to quickly see if the saw has the speed override enabled.

Chapter 8

Programming - Block Program

8.1 Overview

The Programming - Block Program screen (Figure 8.1) provides the Operator programming access to the **Block Program Details** used while in *Auto* mode. The Operator is able to create and edit block programs. Navigation is possible to the main **Alarm** screen, the **Saw Parameters** screen, the **Check Program** screen,the **Vertical Axis** and **Cross Travel Axis** and **Long Travel Axis** manual screens, and of course the **Main** operation screen.

8.2 Details

The Block Program screen details are divided into the following categories ...

- ◇ **Screen Navigation**
- ◇ **Block Details**
- ◇ **Slab Details**

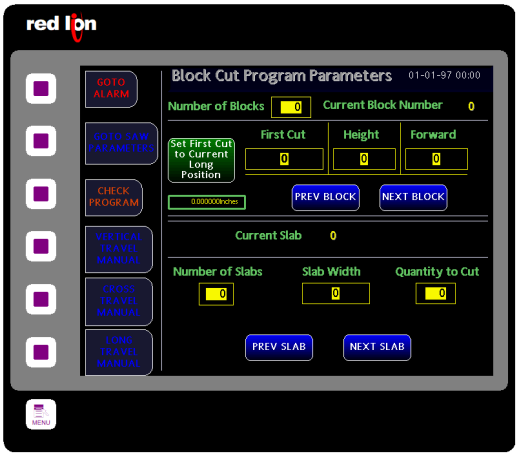

Figure 8.1: Programming - Block Program

8.2.1 Screen Navigation

Is performed by using the programmable Function Keys (FKeys) located down the left hand side of the OI Terminal (refer to Figure 5.2). The Operator may navigate to the following screens ...

- ◇ **GOTO ALARM** Navigate to Alarm Screen.
- ◇ **GOTO SAW PARAMETERS** Navigate to Saw Parameter Screen.
- ◇ **CHECK PROGRAM** Navigate to Block Program Check Screen.
- ◇ **VERTICAL MANUAL** Navigate to Vertical Manual Control Screen.
- ◇ **CROSS TRAVEL MANUAL** Navigate to Cross Travel Manual Control Screen.
- ◇ **LONG AXIS MANUAL** Navigate to the Long Axis Manual Control Screen.

i The Menu Key located on the terminal at the lower left below the FKey's, will return the Operator to the Main Screen, from all other screens.

i The Menu Key is pictured as it looks on the Terminal.

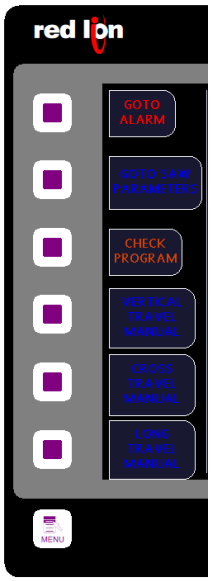

Figure 8.2: Block Program Screen Navigation

8.2.2 Block Details

Blocks are the actual stone blocks as laid out on the cutting floor by the Operator. The details about the block that are used in the program are shown in Figure 8.3. The ***Number of Blocks*** is set by the Operator according to the actual block count on the cutting bed. The ***Current Block Number*** indicates to the Operator which block they are actively programming, it is not settable. The PushButton ***Set First Cut to Current Long Position*** will set the First Cut for the active block to the actual Long Axis Position (displayed below the button). Of course, the Operator could just enter a desired ***First Cut*** in the entry field provided. The ***Block Height*** must be entered by the Operator, this determines where the depth of the first cut for the block ends up as a result of the equation *Block Height - Cut Depth*. The ***Forward Position*** for Cross Travel is entered by the Operator, to tell the saw when the blade is out of rock. Since the Cross Travel will drift a fair amount when stopping, this should be treated as the minimum distance desired to ensure the blade has left the rock safely. The ***PREV BLOCK*** and ***NEXT BLOCK*** buttons are used to scroll through the blocks to be programmed. They are only active if there is a next or previous block to view. If a block is desired to be cut with only a *First Cut* and no slabs, then the Operator would need to ensure that there is a zero (0) in the ***Number of Slabs*** entry field of the Slab Details (Section 8.2.3).

Figure 8.3: Block Details Entry Fields

i The Operator should use the Check Program pages to review the *Block Program* that was entered in a table form which shows details about each block and slab. Also, it is strongly advised to reset both the block program and the automatic sequence before entering a new block program. This can be done on the first ***CHECK PROGRAM*** screen.

! A fault will be triggered by the program logic if the Operator tries to begin an Automatic Cycle without first entering a valid cut program. The Block Height is a critical dimension, if not correct, it can result in damage to the saw blade.

Figure 8.4: Slab Details Entry Fields

8.2.3 Slab Details

Slabs are the actual slabs to cut from the blocks as laid out on the cutting floor by the Operator. The details about the slabs that are used in the program are shown in Figure 8.4. The ***Number of Slabs*** is set by the Operator according to the actual slab count of different sizes that are being cut from the active block. The ***Cut Width*** entry field is where the Operator sets the width of the slab or slab size. The ***Quantity to Cut*** is where the Operator enters the number of slabs of that particular size to cut from the selected block. The ***PREV SLAB*** and ***NEXT SLAB*** buttons are used to scroll through the slabs to be programmed for the active block. They are only active if there is a next or previous slab to view.

i The Operator should use the Check Program pages to review the *Block Program* that was entered in a table form which shows details about each block and slab. Also, it is strongly advised to **reset** both the block program and the automatic sequence **before** entering a new block program. This can be done on the first ***CHECK PROGRAM*** screen.

Chapter 9

Programming - Check Program

9.1 Overview

The Programming - Check Program screen 1 (Figure 9.1) provides the Operator a table view of the **Block Program Details** they entered to be used while in *Auto* mode. The Operator is able to ***Clear Program Contents*** and ***Reset Auto Sequence*** from this screen. Navigation is possible to the main **Alarm** screen, the **PREV** screen (Block Program), the **NEXT** screen (next Check Program), and of course the **Main** operation screen.

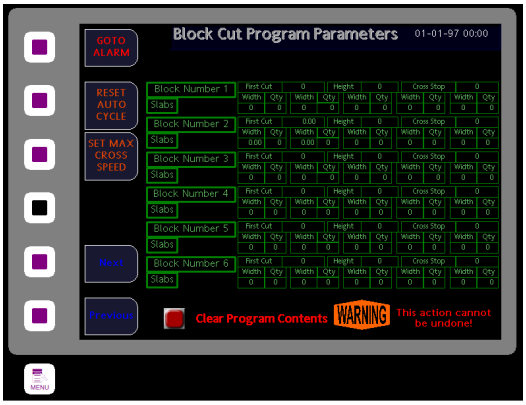

Figure 9.1: Programming - Check Program

9.2 Details

The Check Program screen details are divided into the following categories ...

- **Screen Navigation**

- **Block Details**

- **Cycle Reset and Program Clear**

- **Set Max Cross Speed**

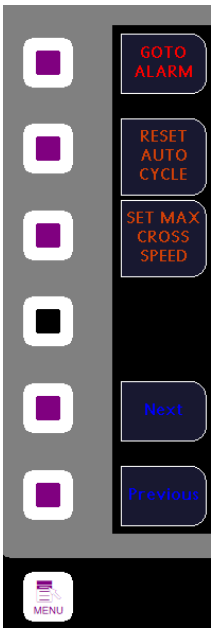

Figure 9.2: Block Program Screen Navigation

9.2.1 Screen Navigation

Is performed by using the programmable Function Keys (FKeys) located down the left hand side of the OI Terminal (refer to Figure 9.2). Since this screen, and subsequent ***CHECK PROGRAM*** screens are sub-screens of the ***BLOCK PROGRAM*** screen, except for navigating to the ***ALARM*** screen, navigation is from *current screen* to *next or previous screens*.The Operator may navigate to the following screens ...

- ◇ **GOTO ALARM** Navigate to Alarm Screen.
- ◇ **SET MAX CROSS SPEED** Navigate to Cross Travel Global Speed Override screen.
- ◇ **NEXT** Navigate to next Check Program Screen.
- ◇ **PREV** Navigate to Block Program Screen, or if on Check Program Screen num 2 or higher, return to previous Check Program Screen.

i The Menu Key located on the terminal at the lower left below the FKey's, will return the Operator to the Main Screen, from all other screens.

The Menu Key is pictured as it looks on the Terminal.

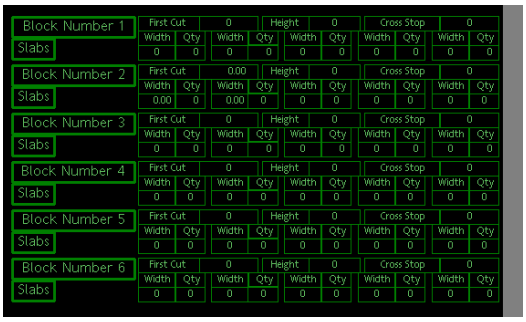

Figure 9.3: Block Details Check Program

9.2.2 Block Details

Blocks as programmed,are shown in a table form (Figure 9.3).If a block has been programmed (based on the ***Number of Blocks***) it will be displayed, even if the details haven't been fully entered in the Block Program screen yet. The same applies to the slabs associated with that block. There is the ability to view up to six (6) blocks per ***CHECK PROGRAM*** screen, and up to 5 different slab sizes per block. This allows viewing of up to 24 Blocks and up to 120 Slabs. In practical terms, it will likely never be used fully. The tabular form of the display of the block details, is similar in design to the paper forms currently used for machine setup details by the Operator. This should help when the Operator is reviewing the program details they entered for correctness, prior to running an automatic cycle using the programmed block data.

i The Check Program pages are a useful tool to review the *Block Program* that was entered in a table form which shows details about each block and slab. Also, it is **strongly advised** to **reset both** the *block program* **and** *the automatic sequence* **before** entering a new block program. This can be done on this ***CHECK PROGRAM*** screen.

! A fault will be triggered by the program logic if the Operator tries to begin an Automatic Cycle without first entering a valid cut program. The Block Height is a critical dimension, if not correct, it can result in damage to the saw blade.

Figure 9.4: Check Program - Auto Cycle Reset Button

Figure 9.5: Check Program - Clear Program Contents Button

9.2.3 Cycle Reset and Program Clear

RESET AUTO CYCLE PB is for the Operator to be able to reset the Automatic Sequence of Saw operation. This reset's control bit's that are used in tracking block completion, slab completion, and other intermediate operational data. This action should be performed even before entering a new block cutting program. By performing this operation, the Operator is ensuring the Saw is ready for a new program sequence to be run correctly.

PROGRAM CLEAR is for the Operator to clear out the Block Program Block and Slab data areas in the PLC (Controller). This wipes all data related to the Block Cutting Program that was currently in the Controller, reverting values to zero.

i The Operator will be prompted by an *accept or cancel popup*, to either *accept clearing the program*, or *resetting the sequence*, or *cancel the operation*. This is an **immediate action** and **cannot be undone**.

9.2.4 Set Max Cross Speed

Cross Travel Speed Override capability is intended to be used when the Operator desires to limit the cutting speed of the saw during automatic operation. It's primary function is to provide the ability to *run in* the newly installed segments of the saw blade. When selecting this navigation key it will open the ***Set Maximum Cross Travel Speed*** screen (Fig. 9.6).

i The Operator will be able to Enable/Disable the Cross Travel Speed Override and set the Maximum Cross Travel Speed from the ***Set Maximum Cross Travel Speed*** screen when they select this Navigation Key.

Figure 9.6: Cross Travel Speed Override Screen

9.2.5 Set Maximum Cross Travel Speed Screen

Enable/Disable Speed Override referring to Figure 9.6 Speed Override is achieved by pressing the toggle button provided on the screen. The toggle has a corresponding state indicator to show whether it is enabled or disabled at the present time. The Operator can also set the speed limit of the override which is represented in feet per minute. Simply pressing the number displayed will open a setting keypad onscreen to use for entry.

i The Operator will be able to use this setting to limit maximum speed of the Cross Travel motion during cutting operations. This is an *Immediate Acting* setting which directly affects the speed which the saw blade moves through the stone. The indicator takes time to update it's state on the display screen, even though it has changed state, this is a result of the communication between the PLC and HMI

Chapter 10

Programming - Automatic Cutting Sequence

10.1 Best Practices

Block cut programming can be a lengthy process, with frequent interruptions at times. Using the **CHECK PROGRAM** screens (Chapter 9, Check Program Screens) to verify where you left off is an easy way to continue programming from the correct spot. If you combine this with stroking out, or otherwise indicating completion point on your Operation Sheets, is a good double check practice to use. When starting a new program for cutting blocks with the saw, it is always a good idea to follow these few steps at first ...

- ◇ **Reset Automatic Sequence**
- ◇ **Clear Block Program**
- ◇ **Home Saw**

This will ensure the system is ready to start "fresh" with a new program to execute (once the Operator enters it).

10.2 Saw Program Details

Programming the Saw is done by the Operator through entering relevant data via the combination of screens provided. (Refer to chapters 7-9 for details on how to). The block data entered by the Operator is the cut program for the saw. The automatic execution of the block cutting program

is done by the saw, according to a sequence that combines the Block and Slab information as entered by the Operator, and executes the command sequence as described below. A repeating cycle of ...

- **Move (Long Travel) to cut location, whether *First Cut* or not**
- **Saw through block at this location using a repeating forward and backward motion of the Cross Travel while lowering vertical by the drop amount after each pass. Also maintaining at or below the current setting of the saw motor as set by the Operator**
- **Raise Vertical to Home**
- **Index Long to next cut position** (if there are more blocks, if not cycle is complete and the *Automatic Sequence* is stopped (*Cycle Stop*) and the *Block Program* data is cleared)
- **Repeat sawing operation**

The saw can be programmed to cut from one to two hundred blocks with zero to five hundred slabs total. While this is beyond the physical limits of the working envelope of the saw, it does afford flexibility to the Operator when programming. A block can have zero slabs, which is a block to be cut in two. A block can have up to five different sized slabs each with their own respective quantities, if it is large enough.

i It's also good practice to take the time during any settings changes, either program type, or operation type, to allow for the communication process between the PLC and HMI to complete. In the case of most settings there is a standard request for change then change complete response which takes place. This causes observable delays from the Operators point of view. Although this time is merely seconds at worst, when in the "heat" of work, and pressed for time, it may seem to drag on. Upon *Automatic Program* cycle completion, the *Block Program* data is cleared by having 0 written to every memory location where *Block and Slab Program* data is stored in the controller.

Programming the Saw - Vertical Travel Details Figure 10.1 is a simplistic diagram to show the relative dimensions that comprise the vertical axis travel limits. The Vertical Axis, Long Axis, and Cross Travel Axis, limits are combined to derive the working envelope of the saw. In Figure 10.1, the vertical travel is shown as the dimension b. While dimension a is

the maximum forward limit as set by the *Forward Limit Proximity Sensor*. Currently the home position of the Vertical Axis is hard set at 38.25 inches from the ground. The forward limit can change in order to accommodate variations in the wooden cribbing that supports the stone blocks being cut. As mentioned this change is accomplished by adjusting the *Forward Limit Proximity Sensor* to suit. The immediate thing of note, would be the actual block height that can be accommodated by this saw (dimension *b*) which would be 38.25"- *dim a - safety gap(if desired)*. In the notes above about the sequence of operation during automatic cycle, it is worth noting the first cut, from the Vertical Axis POV. When the Long Travel has completed moving to the position commanded, whether first or later cuts on the same block, the vertical will be commanded to move to the *Block Height*, then to the *current height - Cut Depth* as programmed by the operator. The second motion command is actually the beginning (in the Automatic Program) of the sawing motion loop. This will usually result in a noticeable pause when starting each new sawing motion. Subsequent Vertical Axis motion until the current cut location is completed, is determined by simply *Position = current height - Cut Depth*. At the end of each cut, when the final pass completes, the *Vertical Axis* is returned to it Home position, fully raised. This position, fully raised, is the only position of the vertical axis that the program will allow the Long travel to move.

i Each cut is a series of passes of the *Cross Travel Axis* **after** the *Vertical Axis* has lowered by the *Cut Depth* setting amount. when doing a first pass of the cutting motion at a new *Cut Location*, there are two *Vertical Axis* moves commanded ...

- **move to *Block Height*** then ...
- **move to (*Current Height - Cut Depth*)**

When programming *Block Height*, it is strongly recommended to pick the highest point of the block. It is worth noting that *Block Height* is the dimension from the floor (not the top of the cribbing) to the top of the block.

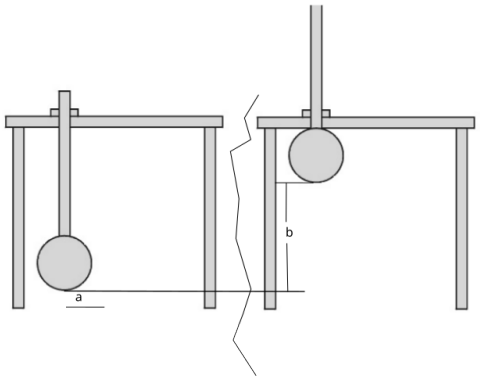

Figure 10.1: Programming - Vertical Travel

Programming the Saw - Cross Travel Details Figure 10.2 is a simplistic diagram to show the dimensions that comprise the cross travel axis travel limits. The *Cross Travel Axis*, during Automatic sequence, will travel to *Forward Position* then back to *Home* while the sawing action is being performed on the stone block. The *Forward Position* is the position where the saw blade will clear the stone block. The Maximum Speed of the *Cross Travel Axis* is determined by the *Cut Depth* the Operator has programmed and a formula based upon how much material the saw blade and segments can remove at nominal motor RPM. The speed through the stone, and the load on the saw blade, is further affected by adjusting the *Motor Current Setting*, which is directly tied to the PID process variable. This allows the Operator to make adjustments for stone hardness for example. There is also a programmable speed override which can be enabled which is intended to be used by the Operator when new segments have been installed and the blade needs to be run in at a low speed. This setting is password protected with a time limit on entry. When in automatic and running a program, the *Cross Travel Axis* will try to travel at the programmed speed as determined by the calculation that uses the *Cut Depth Setting*, also while trying to maintain the *Motor Current Setting*, and the *Speed Override* as the limit set by the Operator, will take precedence over all speed control while it is enabled.

i If the Operator finds the saw to be working too much while in the stone, lowering the *Motor Current Setting* may help. If the saw is moving through the stone without reaching the current setting, then increasing the *Cut Depth* may be required. It is important for longevity of the segments to make sure and disable the speed override once the segments have opened up after run in of new ones.

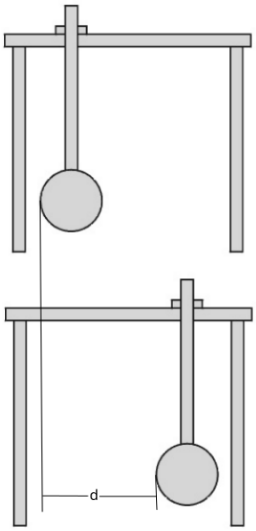

Figure 10.2: Programming - Cross Travel

Programming the Saw - Long Travel Details Figure 10.3 is a simplistic diagram to show the relative dimensions that comprise the long travel axis travel limits. The left hand side is representing the Home position of the Long Travel Axis, and the right hand shows the saw with it's Long Travel Axis in the forward limit position. The Long Travel Axis moves from the Home Position to towards the Forward Position during automatic block cutting in order to eliminate any potential backlash in the rack and pinion drive of the axis, which could introduce inaccuracies in position and or it's repeatable capabilities. The dimension e is the maximum forward travel in inches, for the Long Travel Axis. The Long Travel Axis, is commanded to move to the *First Cut* location of each block that is programmed by the Operator. The *Automatic Program* begins by loading the *First Cut* location for the (current) block, and instructing the Long Travel Axis to move to that location (which may be 0 for the first block). Once the first cut is completed, the *Automatic Program* will check to see if there are any slabs to cut for the currently loaded block. If there is one or more slabs (size) of one or more quantity, then the Automatic Program will add the *Slab Size* (Chapter 8, Block Program) plus the *Blade Kerf* (Chapter 7, Saw Parameters) to the *current Long Travel* position, and load the new position into the *Long Travel Axis* index command position and trigger the index move. If there are more than one of this size of slab, the quantity counter is reduced by one at this time. If there is no other slab quantity of this slab, then once the cut has completed the Automatic Program checks for more slabs for this block,

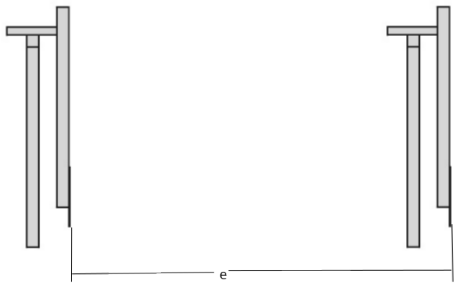

Figure 10.3: Programming - Long Travel

finding none will result in this block being *marked complete* in the program temporary memory. The *Automatic Program* will load the next *Slab Data* until there are no more slabs for this block. At that moment, at cut complete for the final slab of the current block, the *Automatic Program* will check for any more block data to load. If there are more blocks, the cycle returns to loading the next block data, then moving to *First Cut* of the (now current) block. If, however there are no more blocks to cut, the program is marked complete in internal memory storage once the *Vertical Axis* returns to it's home position.

i The *Long Travel Axis* is the axis that is most important to dimensional accuracy of the end product. It is therefore important to maintain the travel rails for this axis clean and debris free to ensure unimpeded movement. When programming positions into the *Block Program* it is very important to always start from the *Home* position moving towards the *Forward Limit* to ensure the rack and pinion drives backlash does not affect the position being set/recorded. Tape measures are great verification tools.

Appendix

.1 Control System Logic Diagram

Figure 4 represents the saw state behaviour in a logic flow diagram.

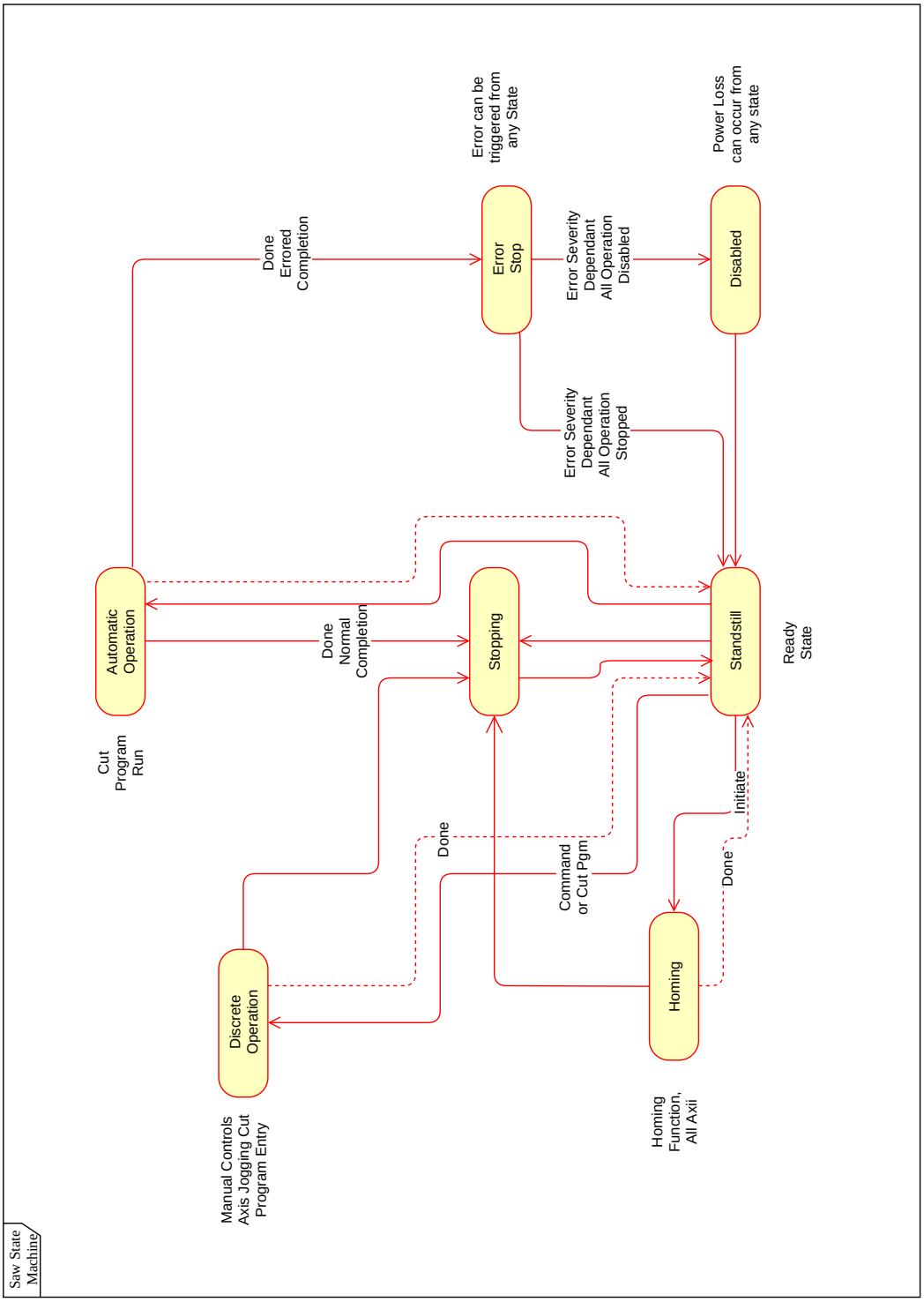

Figure 4: Saw Control Logic

.2 Control System Wiring Diagrams

The following drawings are the electrical drawings for the Saw Control System. They are included in the manual for quick reference.

Wiring Diagrams for the Saw Control System.

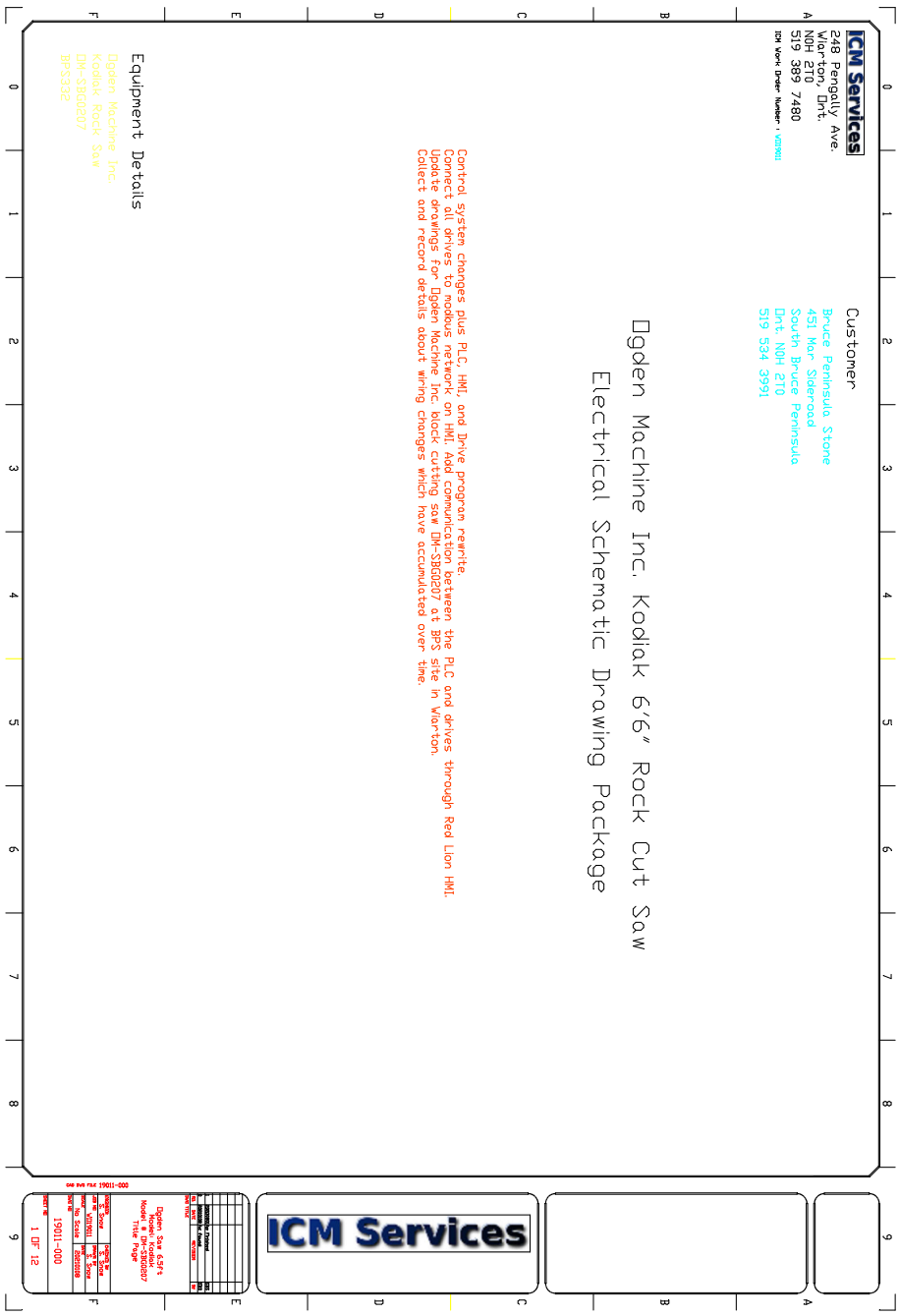
ICM Services
248 Pengally Ave.
Wiarton, Ont.
N0H 2T0
519 389 7480
Customer
Bruce Peninsula Stone
451 Mar Sideroad
South Bruce Peninsula
Ont. N0H 2T0
519 534 3991
Ogden Machine Inc. Kodiak 6'6" Rock Cut Saw
Electrical Schematic Drawing Package
Control system changes plus PLC, HMI, and Drive program rewrite.
Connect all drives to modbus network on HMI. Add communication between the PLC and drives through Red Lion HMI.
Update drawings for Ogden Machine Inc. block cutting saw OM-SBG0207 at BPS site in Wiarton.
Collect and record details about wiring changes which have accumulated over time.
Equipment Details
Ogden Machine Inc.
Kodiak Rock Saw
OM-SBG0207
BPS332
ICM Services
19011-000
1 OF 12

Figure 5

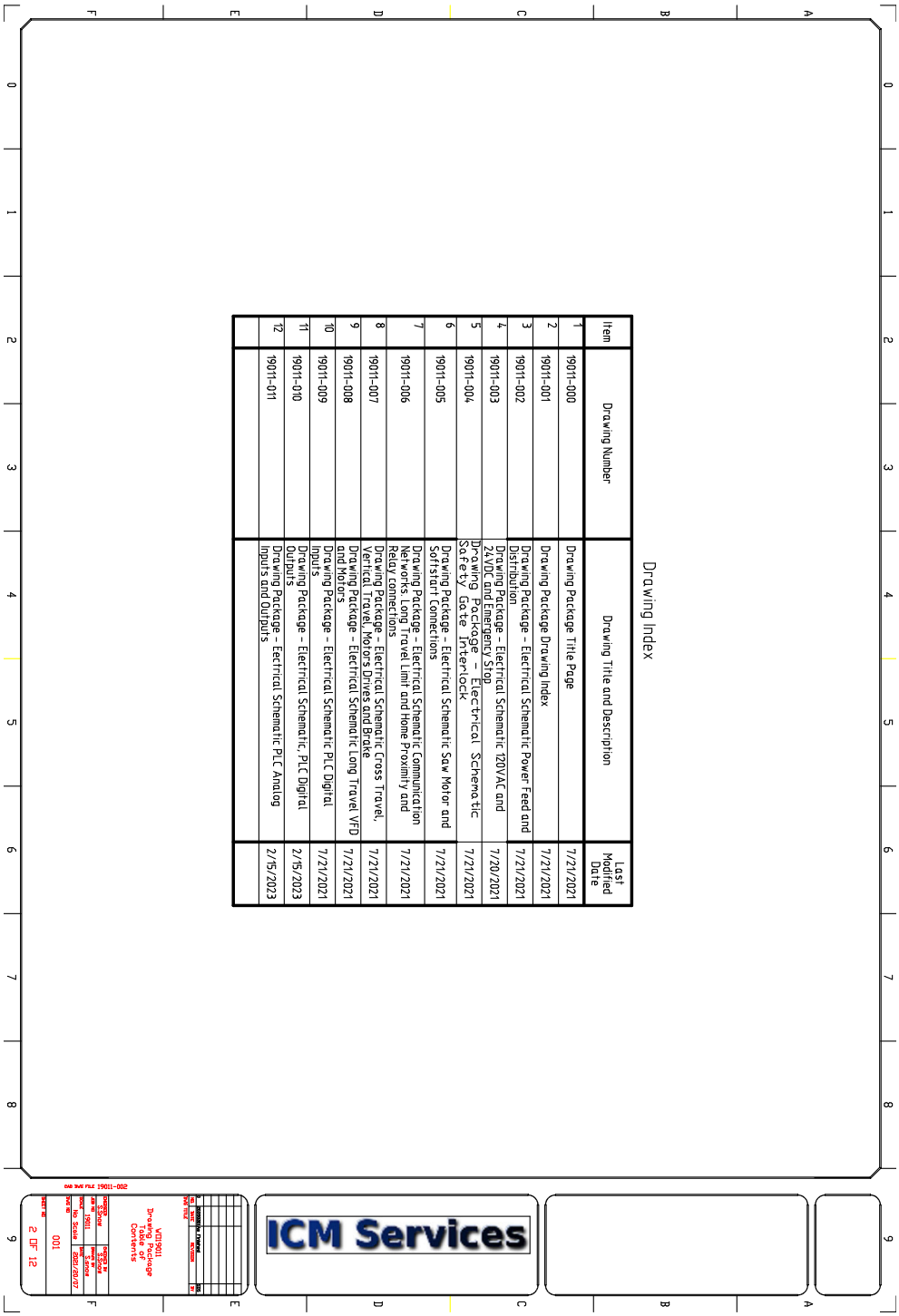

Figure 6: Drawing Listing

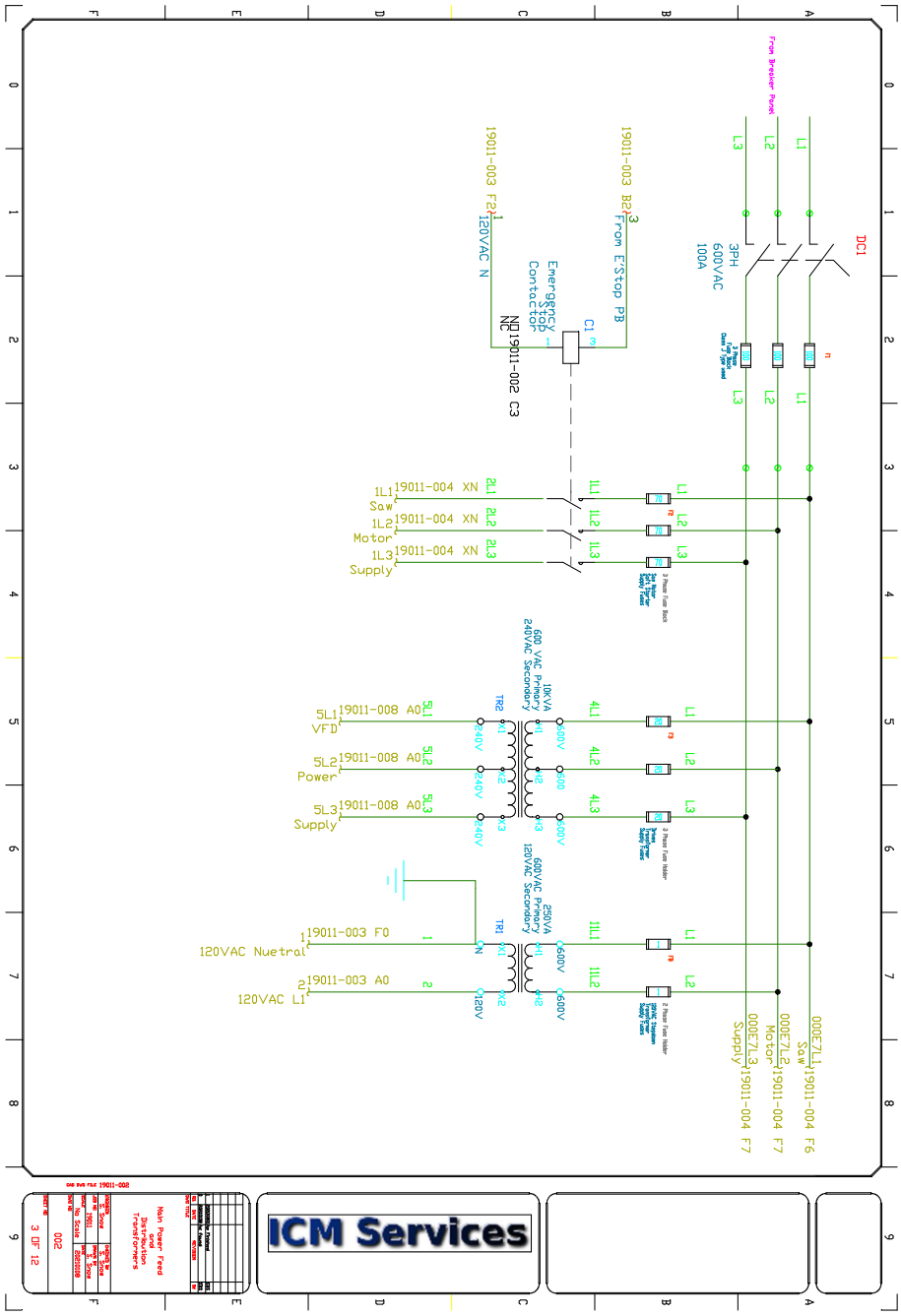

Figure 7: Main Power Connections

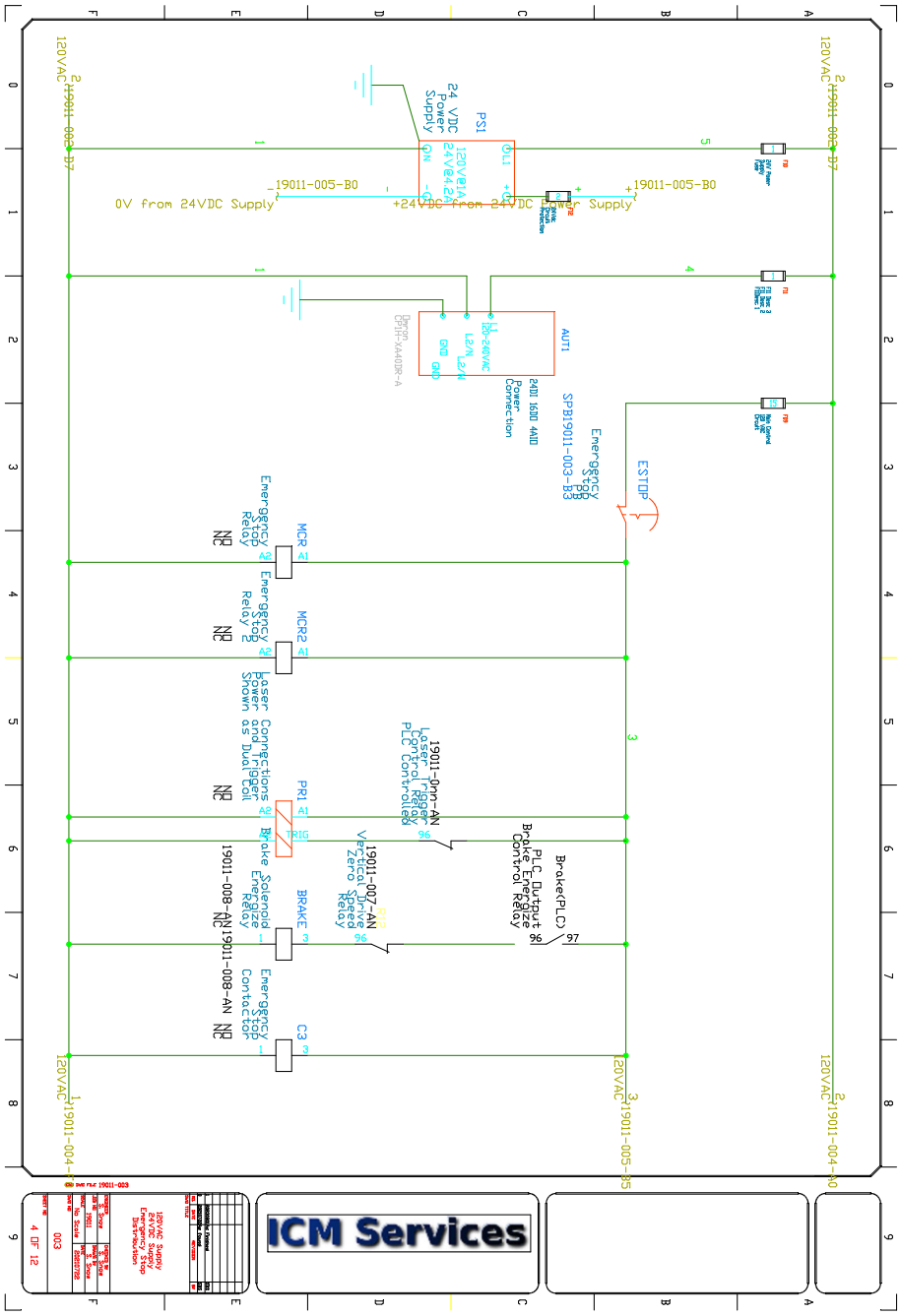

Figure 8: Emergency Stop, DC Power, PLC Power, MCR Circuit

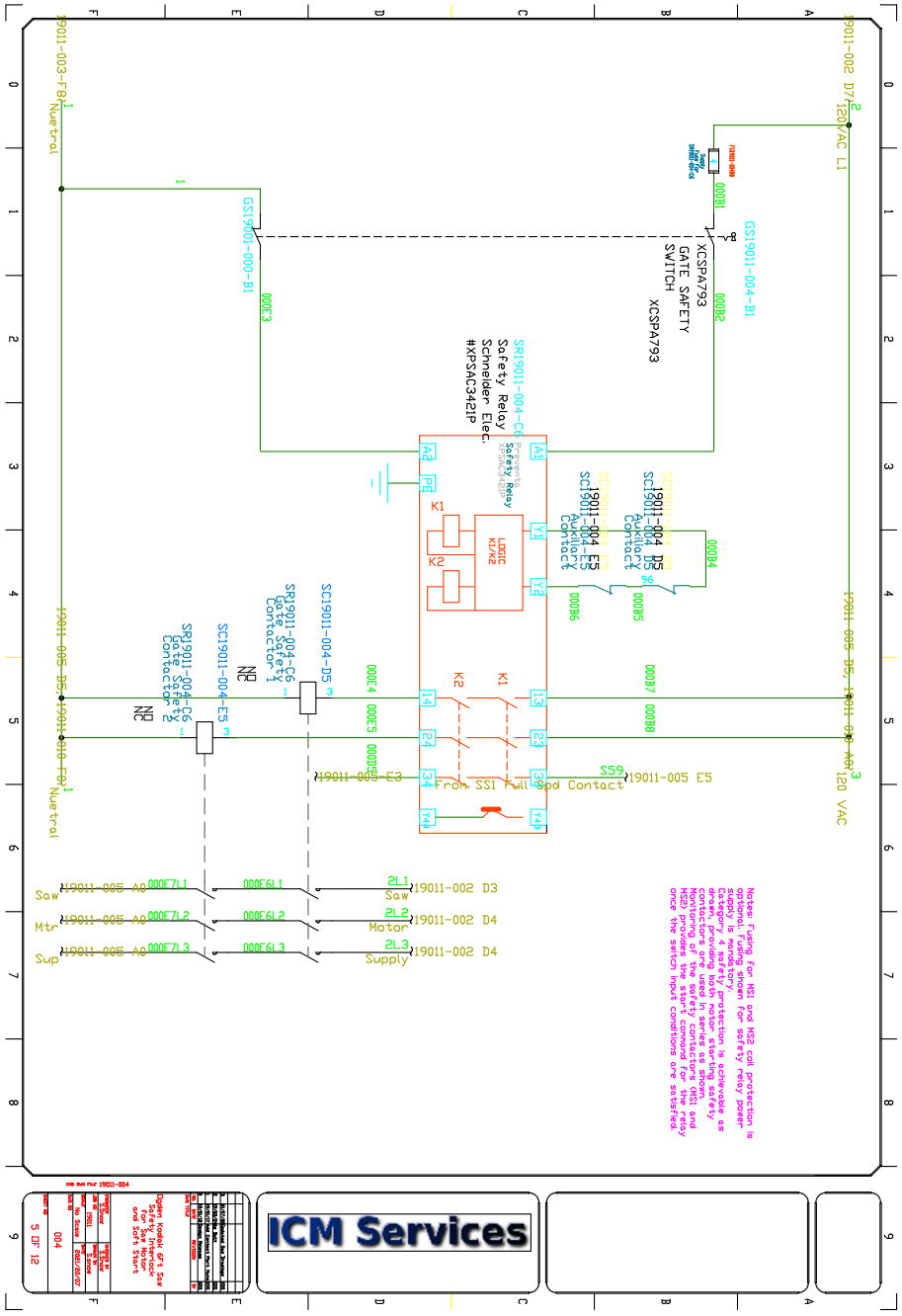

Figure 9: Safety Gate Interlock Connections

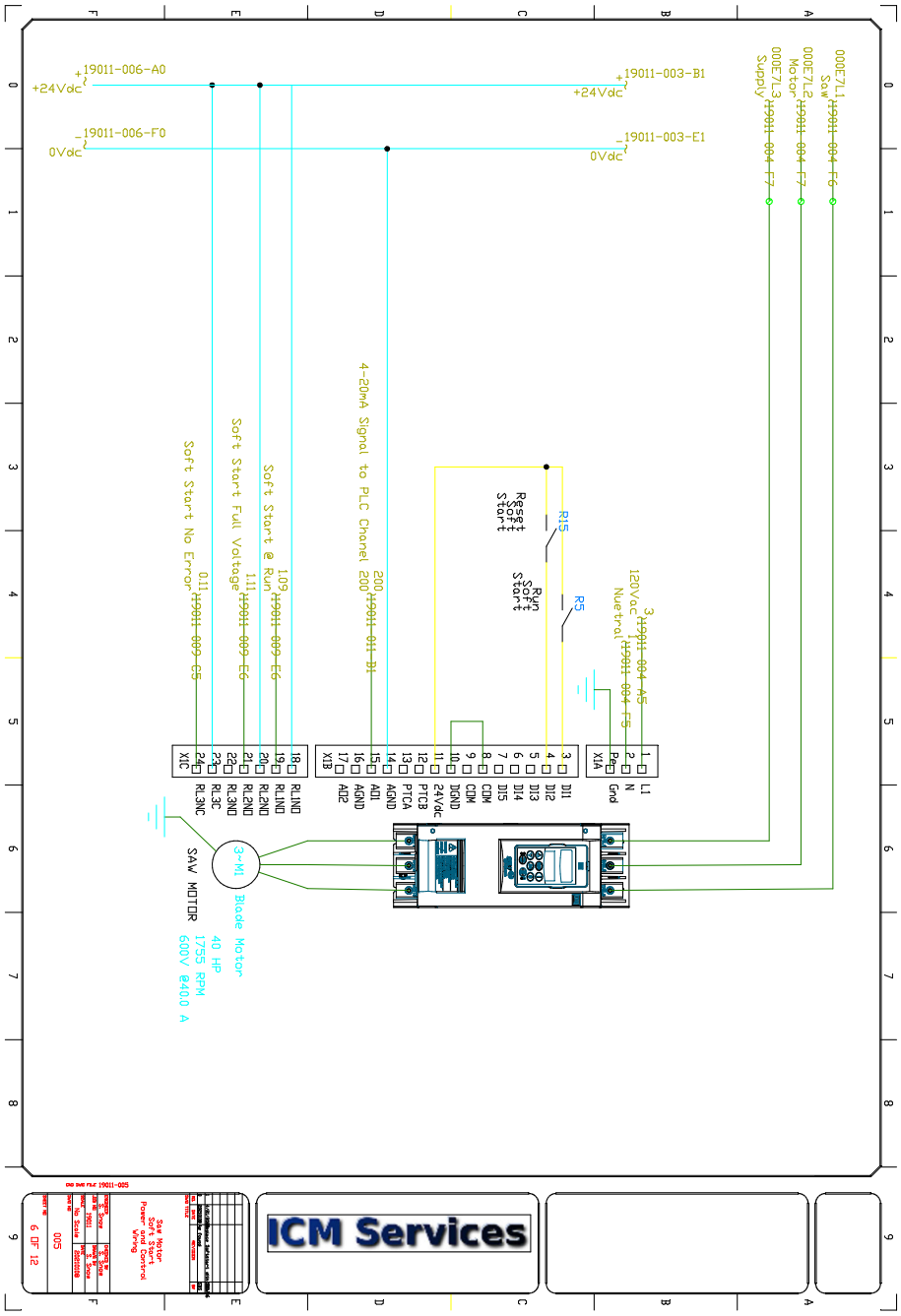

Figure 10: Saw Motor and Soft Starter Connections

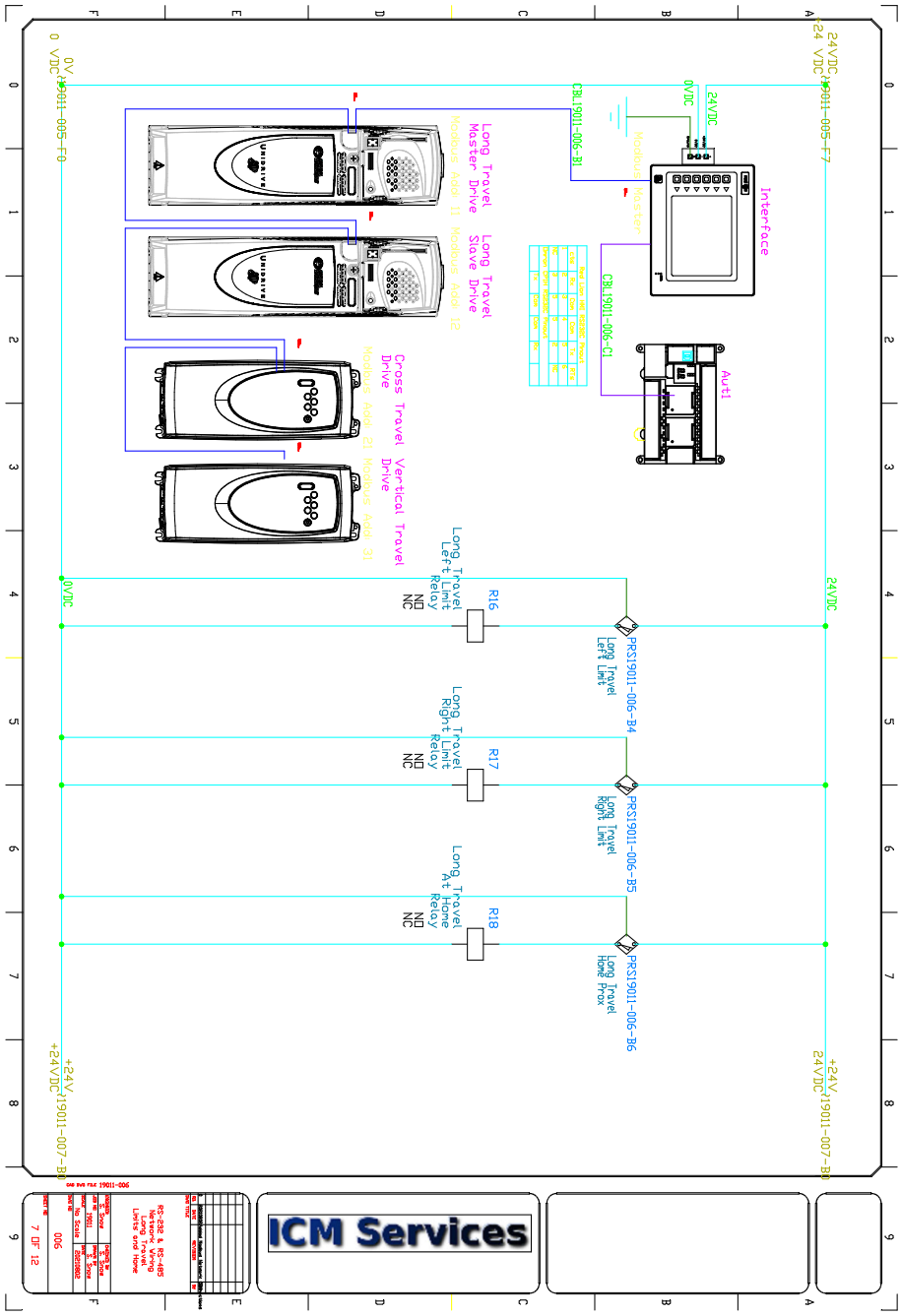

Figure 11: Control Communication Network, Long Axis Sensors

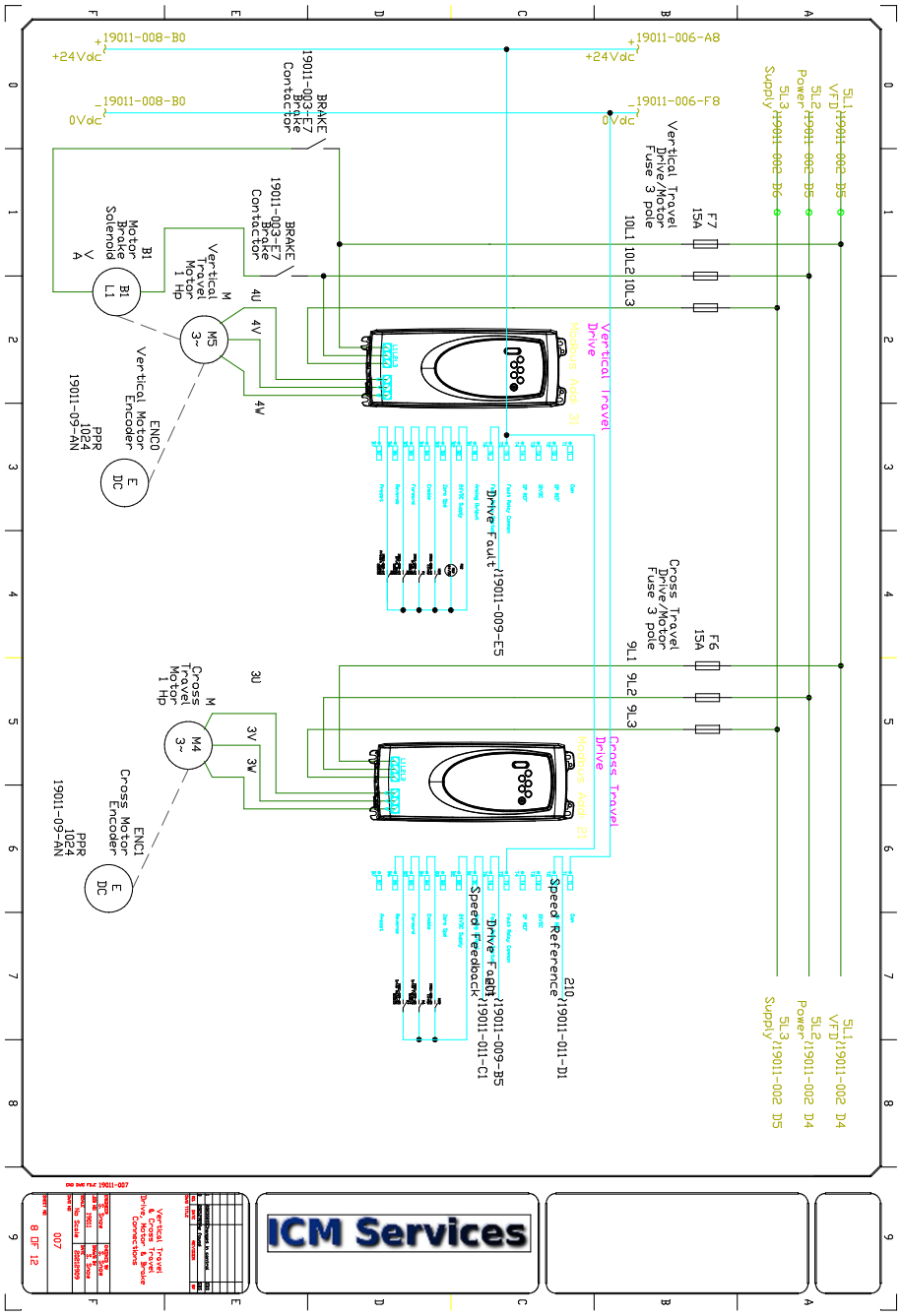

Figure 12: Vertical and Cross axii Drives and Motors Connections

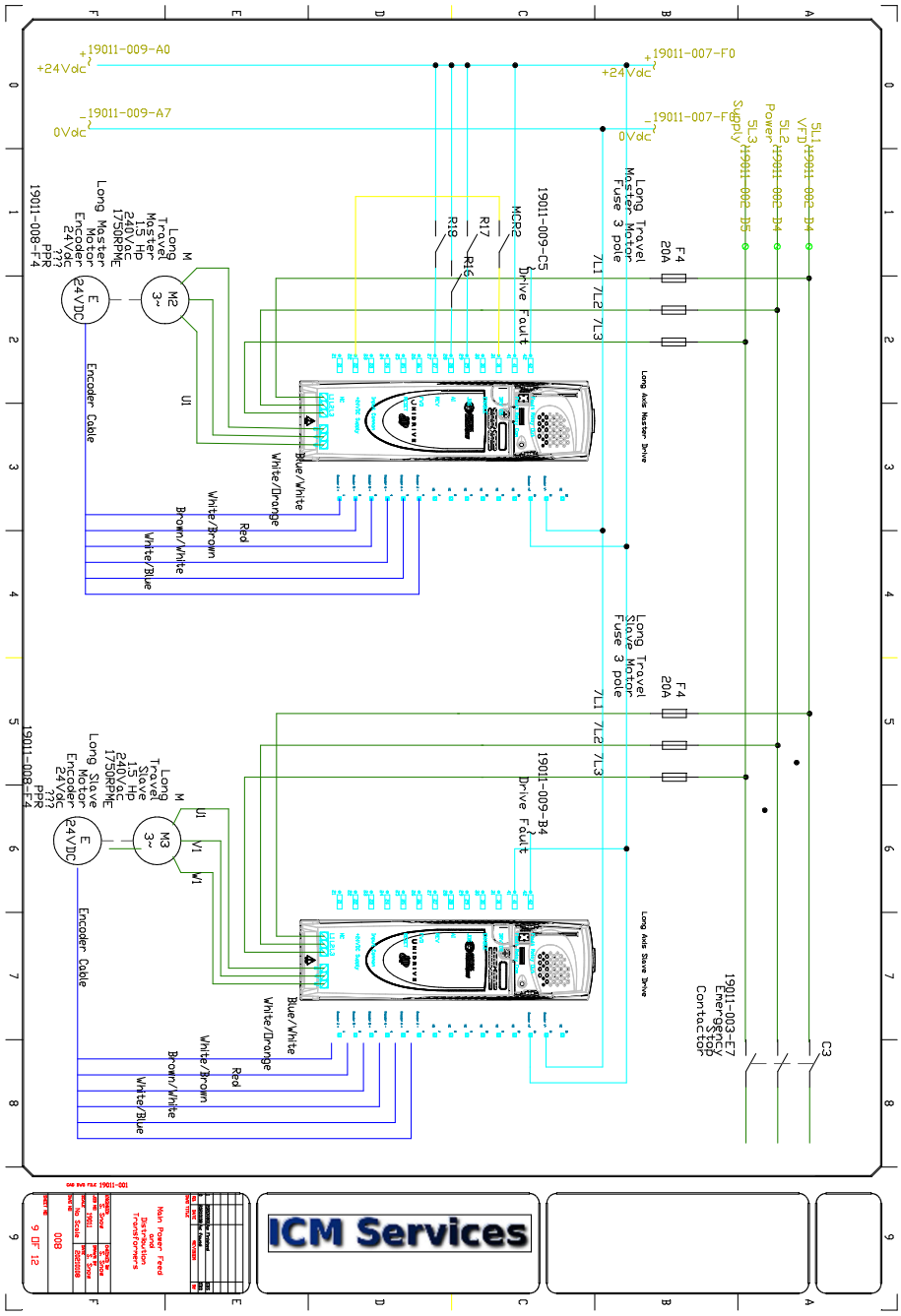

Figure 13: Long Travel Drives and Motors Connections

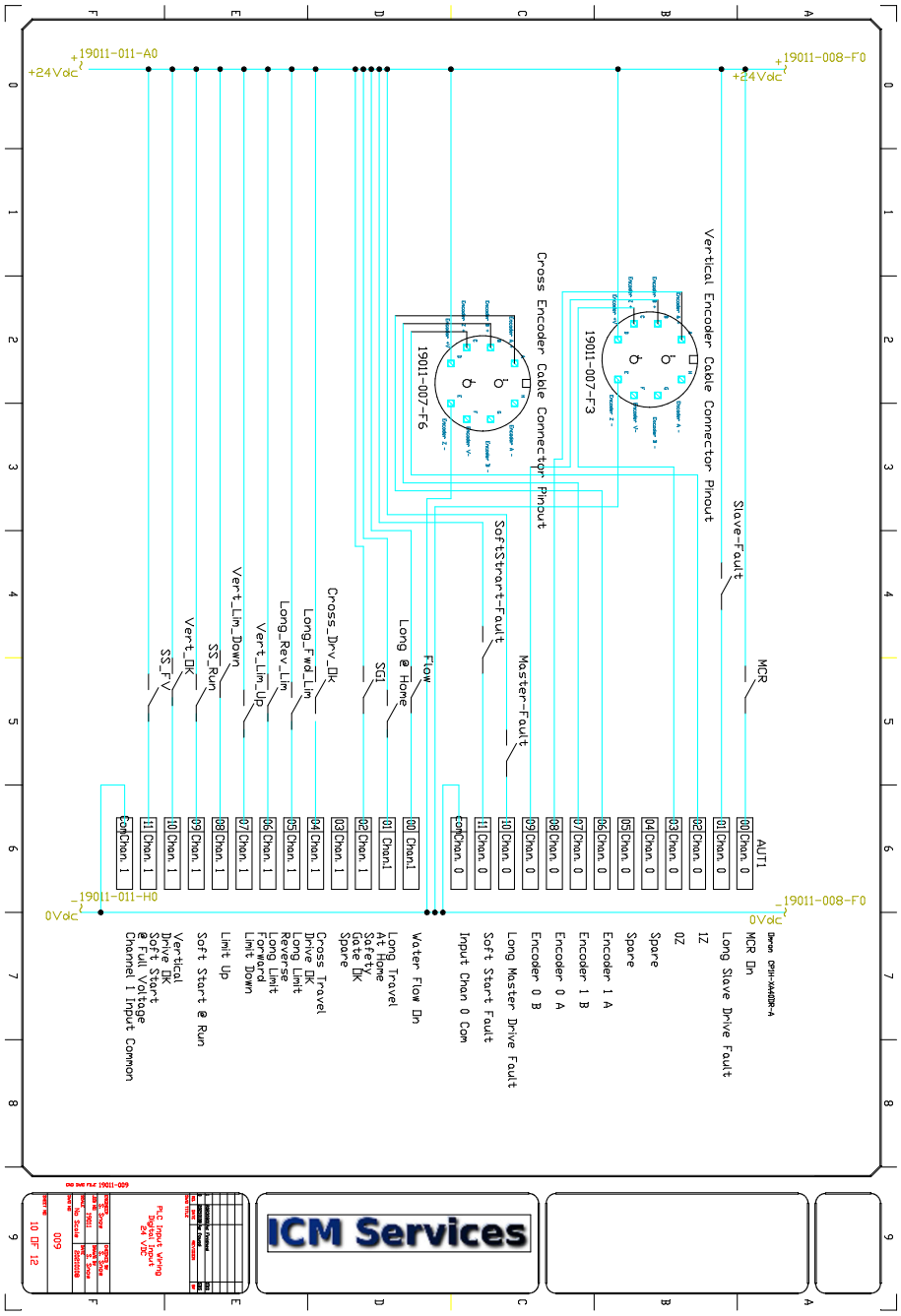

Figure 14: PLC Input Wiring

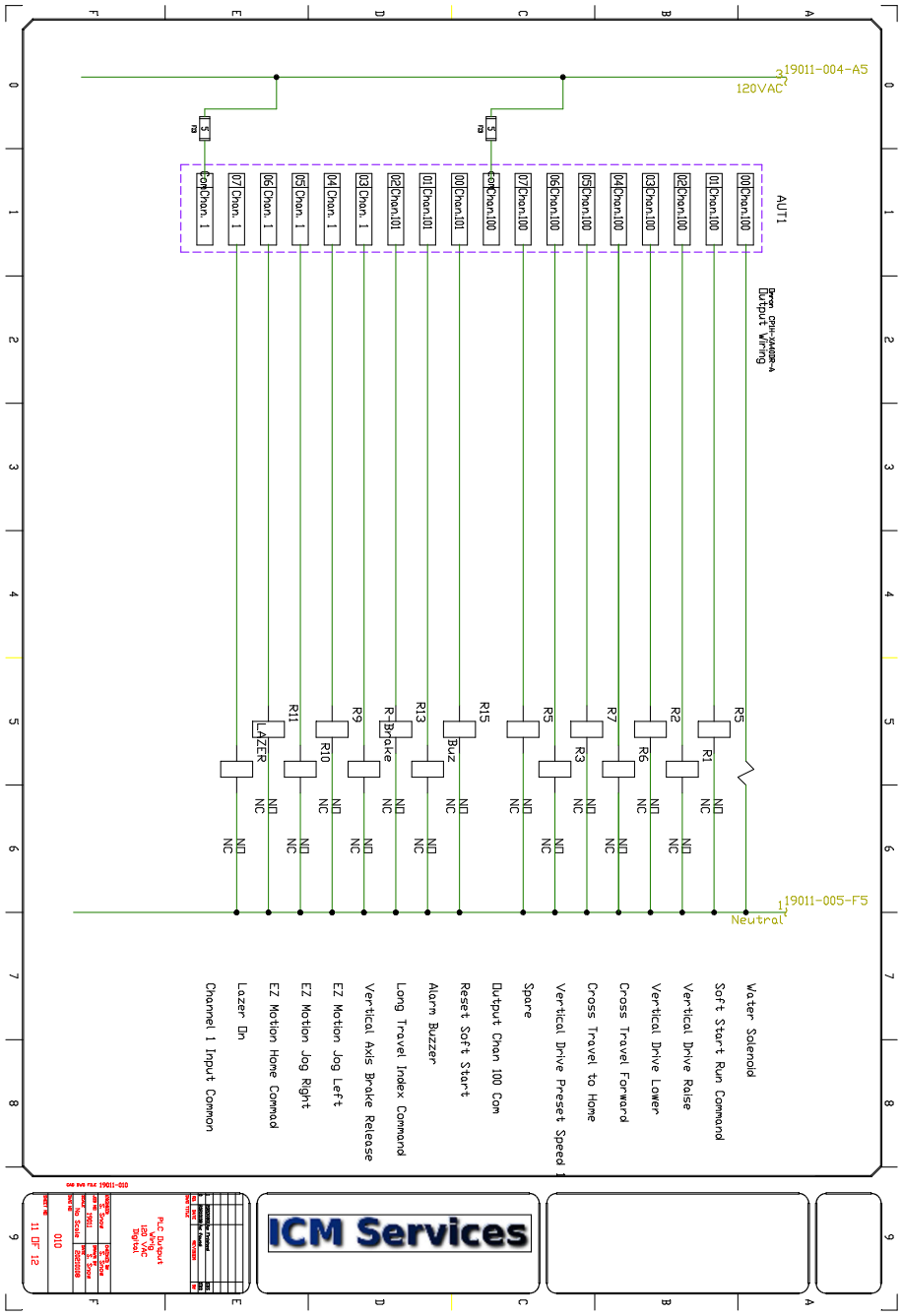

Figure 15: PLC Output Wiring

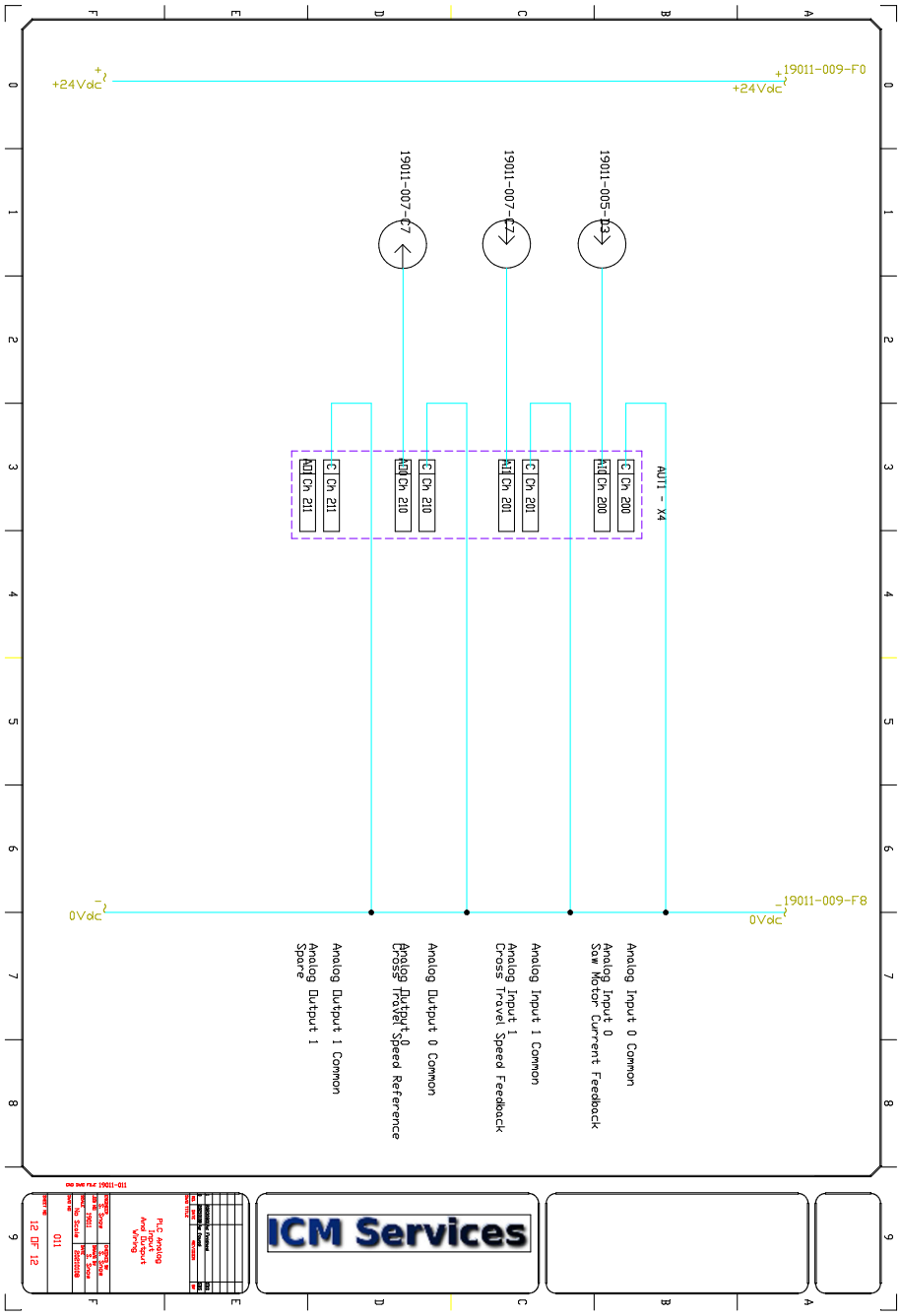

Figure 16: Analog Input and Output Wiring

.3 AV20 Encoder

Nidec-Avtron Makes the Most Reliable Encoders in the World
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TELEPHONE: (1) 216-642-1230 • **FAX:** (1) 216-642-6037
E-MAIL: tachs@nidec-avtron.com • **WEB:** www.avtronencoders.com

Encoder Instructions

AV20

SOLID SHAFT 1/4" - 10mm

DESCRIPTION

The Avtron Model AV20 Encoder is a light mill duty speed and position transducer (also known as tachometer or rotary pulse generator). When coupled to a motor or machine, its output is directly proportional to shaft position (pulse count) or speed (pulse rate).

Mechanically the AV20 mounts using industry standard 2" square or round flanges. The AV20 can also be mounted using an optional industry standard face mount bolt pattern.

The AV20 encoder offers 2Ø outputs (A,B) 90° apart for direction sensing. Optional complements ($\bar{A}$,$\bar{B}$) and marker pulse and complement (Z,$\bar{Z}$) are available; see channel options.

DRIVE INSTALLATION INSTRUCTIONS

The AV20 may be driven via a contact/friction wheel provided the axial spring force is modest, less than 25% of the 100 lb maximum radial load, or (preferably) the AV20 can be coupled to the load. The following means of coupling are acceptable when properly installed: Direct Coupling, Timing Belt/Pulleys.

With a direct drive, use a flexible, insulated disc coupling and align the shafts as accurately as possible. The encoder should not be subjected to any axial thrust. Overhung loads should also be minimized. Installations using timing belts/pulleys should have just enough belt tension to eliminate belt sag. Excessive tension will shorten belt and bearing service life. If a rubber slinger disc is used, position it on the shaft so it will rotate freely.

CAUTION
Do not force or drive the coupling onto the shaft or damage to the bearings may result. The coupling should slide easily on the shaft. Remove nicks and burrs if necessary. Consider driving shaft endplay when positioning coupling.

Equipment Needed for Installation		
Provided	**Optional**	**Not Provided**
AV20 Encoder	Mating MS Cable Connector	AV20 Face Mounting Screws (see table below and drawing on last page for sizes) Thread Locker (Loctite 242 recommended) Anti-Seize Adapter Flange Shaft Coupling (Insulated style recommended) Dial Indicator Gauge

For more details on alignment specifications, measurement techniques, and special considerations in specifying and installing drive components, refer to separate installation instructions in the Avtron ENCODER HANDBOOK.

FACE and FLANGE MOUNTING INSTRUCTIONS

1) Disconnect power from equipment and encoder cable.
2) Use dial indicator guage to verify the motor/load total indicated shaft runout <0.002" [0.05mm].
3) Apply anti-seize compound to inner circumference of coupling (both motor and encoder side).
4) Loosen set screws in coupling and apply thread locker to set screws.
5) Place coupling on motor/load shaft, inserting to depth per manufacturer's instructions.
6) Attach coupling to motor/load shaft using set screws per manufacturer's instructions.

AV20 PART NUMBERS AND AVAILABLE OPTIONS

Mount	PPR*	Line Driver	Shaft Size	Connector Options	Wiring	Mounting Style	Face/Bolt Pattern	Seals	Channels	Special Features
AV20	**A-** 1 **T-** 625 **C-** 25 **U-** 720 **F-** 60 **W-**1000 **G-** 100 **Y-** 1024 **H-** 120 **Z-** 1200 **K-** 200 **1-** 1250 **L-** 240 **2-** 1440 **M-** 250 **3-** 2000 **N-** 256 **4-** 2048 **P-** 300 **5-** 2500 **E-** 360 **6-** 2540 **Q-** 500 **7-** 3600 **R-** 512 **0-** Special **S-** 600	**1-** 5-28V (7272) **2-** 5-28V, open collector (7273) **4-** 5-28V in, 5V out (7272)	**0**-Non-std. With Flat **A-** 0.25" **B-** 0.375" **C-** 10mm Without Flat **N-** 0.25" **P-** 0.375" **R-** 10mm	**W-** 18" cable (pigtail)	**A-** Side	**1-** Sq. Flange 2.06" w/ 1.25" male pilot **2-** Rnd. Flange 2.0" w/ 1.25" male pilot **3-** Sq. Flange 2.06" w/ 1.181" female pilot **4-** Rnd. Flange 2.0"	**X-** None **5-** 4x 6-32 @ 2" **6-** 4x 10-32 @ 1.625" **7-** 3x 4-40 @ 1.5"	**A-** Shaft Sealed** **B-** Bearing Sealed **X-** None^^	With Comp. **A-** A,$\bar{A}$,B,$\bar{B}$ Z,$\bar{Z}$ *** **B-** A,$\bar{A}$,B,$\bar{B}$ **D-** A,$\bar{A}$ Without Comp. **E-** A, B, Z **F-** A, B	**000-** None **00W-** Connector on 18" cable: Use w/ Option "T"-"U" **9xx-** Specify cable length xx=feet (use w/ Option "W")

Connector Options

Mounted on Encoder			Mounted on 18" cable (00W)
10 Pin MS	**6 Pin MS**	**7 Pin MS**	**8 Pin M12**
A- w/o plug (std. phasing) **B-** w/o plug (reverse phasing) **C-** w/ plug (std. phasing) **D-** w/ plug (reverse phasing)	**E-** w/o plug (std. phasing) **F-** w/o plug (reverse phasing) **G-** w/ plug (std. phasing) **H-** w/ plug (reverse phasing)	**J-** w/o plug (std. phasing) **K-** w/o plug (reverse phasing) **M-** w/ plug (std. phasing) **N-** w/ plug (reverse phasing)	**T-** w/o plug (Turck Pinout) **U-** w/o plug (US Pinout)

* up to 16,384 PPR available
** recommended, N/A with Mounting Styles "3" & "4".
*** N/A with MS 6 or 7 Pin Connector.
^^ not recommended for industrial applications

All dimensions are in inches [millimeters].
Specifications and features are subject to change without notice.

7) Slide encoder shaft into other side of coupling. DO NOT FORCE.
8) Ensure face on mounting flange matches and aligns with encoder face precisely.
9) Apply thread locker to face mounting screws or flange mounting bolts.
10) Align bolt holes of encoder and flange, thread in screws.
11) Tighten set screws on encoder side of coupling.

WIRING INSTRUCTIONS

CAUTION
Be sure to remove power before wiring the AV20 Encoder.

Be sure to ground the cable shield: It can be connected to case ground at the encoder, or grounded at the receiving device, but should not be grounded on both ends.

If necessary, case ground can also be provided through a separate wire. (Not available for 6-pin connectors: options "E", "F", "G", "H"). Be certain not to ground the case ground wire if the encoder is already grounded by mechanical mounting or coupling.

For bidirectional operation of the AV20 Encoder, proper phasing of the two output channels is important. For models with A and B output channels, Phase A channel leads Phase B channel for clockwise shaft rotation as viewed from the rear of the encoder for the standard wiring options. Follow instructions under corrective installation as needed to reverse the direction of output or purchase AV20 with reverse phasing (options "B", "D", "F", "H", "K", "N").

CORRECTIVE ACTION FOR PHASE REVERSAL
1) Remove power.
2) Exchange wires on cable, either at encoder cable end, or at speed controller end (but not both):
   a.) Single Ended 2 Phase Wiring (see wiring diagram) Exchange A and B at the user end of the wires.
   b.) Differential 2 Phase Wiring (see wiring diagram) Exchange either A with $\overline{A}$ in the phase A pair OR B with $\overline{B}$ in the phase B pair but NOT both.
3) Apply power.
4) Verify encoder feedback is correct, using hand rotation of shaft, or jog mode of the speed controller.

Interconnecting cables specified in the wire selection chart below are based on typical applications. Refer to the system drawing for specific cable requirements where applicable.

Physical properties of cable such as abrasion, temperature, tensile strength, solvents, etc., are dictated by the specific application. General electrical requirements are: stranded copper, 22 thru 16 gauge, each wire pair individually shielded with braid or foil with drain wire, 0.05 uF maximum total mutual or direct capacitance, outer sheath insulator. See Wire Selection Chart below for some suggested cables.

*Maximum cable length (and line driver selection) is limited by several factors: line driver protection, maximum RPM, PPR, output voltage and cable capacitance. The open collector driver (option 2) is much more heavily limited by output frequency on long cable runs, and is not recommended for new applications.

SPECIFICATIONS

ELECTRICAL

A. Operating Power (Vin)
   1. Volts ..... See Line Driver Options
   2. Current ..... 50mA, no load
B. Output Format ..... See Channel Options (A,$\overline{A}$,B,$\overline{B}$,Z,$\overline{Z}$ available)
C. Signal Type ..... Incremental, Square Wave, 50% ±10% Duty Cycle
D. Direction Sensing ..... Phasing with respect to rotation as viewed from the back of the encoder (non-shaft side).
   Connector options "A", "C", "E", "G", "J", "M", "U", & "W": ØA leads ØB for CW rotation (Std. phasing).
   Connector options "B", "D", "F", "H", "K", "N", & "T": ØA leads ØB for CCW rotation (Reverse phasing).
E. Transition Separation .... 15% minimum
F. Frequency Range ..... 0 to 125kHz.
G. PPR ..... 1 - 3600 standard (for other PPR needs up to 16,384 consult factory)
H. Output ..... See Line Driver Options

MECHANICAL

A. Acceleration..... 6,000 RPM/Sec.
B. Speed..... 6,000 RPM max. (for higher RPM needs, Consult Factory).
C. Shaft Diameter..... 0.25" to 0.394" [6.35mm to 10mm]
D. Shaft Loading ..... up to 100 lbs [45 kg]. axial or radial
E. Starting Torque @ 25C .. 2.5oz in max. [0.018n-m] (1.0oz [0.007n-m] in w/o seals)
F. Weight..... 0.575 lbs. [260g]

ENVIRONMENTAL

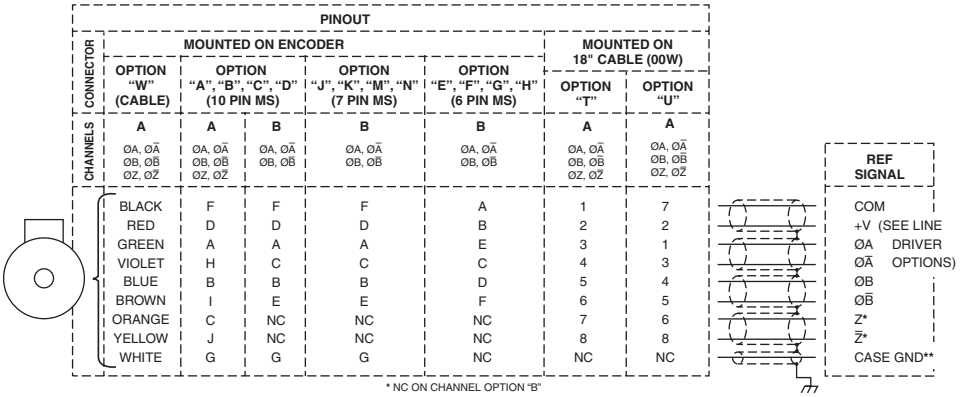
A. Enclosure Rating ..... NEMA 4, 13, IP65 (dust and water tight, not for immersion).
B. Operating Temp..... -40° to +100°C
C. Humidity..... 98% Non-condensing
D. Shock..... 50G, 11 ms Duration
E. Vibration..... 5-2000Hz @ 20G

LINE DRIVER OPTIONS

		Output Options		
		1	2	4
Output Type		Differential Line Driver	Open Collector	Differential Line Driver, 5V fixed
Line Driver		7272	7273	7272
Voltage Input (Vin)		5-28VDC	5-28VDC	5-28VDC
Protection	Reverse Voltage	Yes	Yes	Yes
	Transient	Yes	Yes	Yes
	Short Circuit	Yes	Yes	Yes
Maximum Cable length*		5V 1000 ft 12V 500 ft 24V 200 ft	see note*	200 ft

WIRING DIAGRAMS

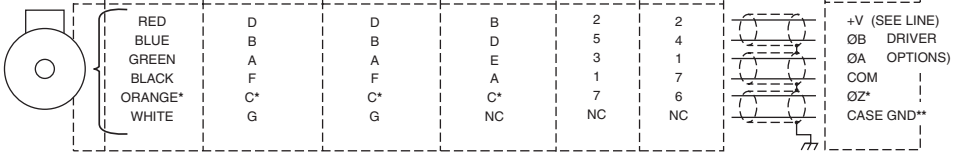
LINE DRIVER (Output Option 1 & 4)
DIFFERENTIAL TWO PHASE WIRING APPLICATIONS



PINOUT							
CONNECTOR	MOUNTED ON ENCODER				MOUNTED ON 18" CABLE (00W)		REF SIGNAL
	OPTION "W" (CABLE)	OPTION "A", "B", "C", "D" (10 PIN MS)	OPTION "J", "K", "M", "N" (7 PIN MS)	OPTION "E", "F", "G", "H" (6 PIN MS)	OPTION "T"	OPTION "U"	
CHANNELS	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄	B ØA, ØĀ ØB, ØB̄	B ØA, ØĀ ØB, ØB̄	B ØA, ØĀ ØB, ØB̄	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄	
BLACK	F	F	F	A	1	7	COM
RED	D	D	D	B	2	2	+V (SEE LINE
GREEN	A	A	A	E	3	1	ØA DRIVER
VIOLET	H	C	C	C	4	3	ØĀ OPTIONS)
BLUE	B	B	B	D	5	4	ØB
BROWN	I	E	E	F	6	5	ØB̄
ORANGE	C	NC	NC	NC	7	6	Z*
YELLOW	J	NC	NC	NC	8	8	Z̄*
WHITE	G	G	G	NC	NC	NC	CASE GND**

* NC ON CHANNEL OPTION "B"
** SEE WIRING INSTRUCTIONS REGARDING CASE GROUND.

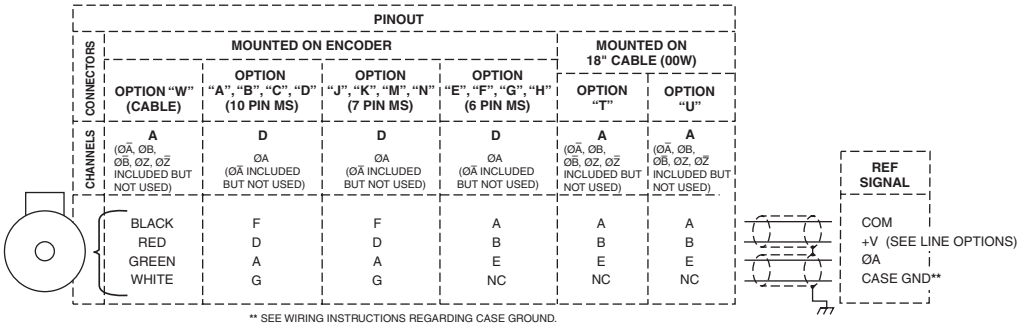
LINE DRIVER (Output Option 1, 2, & 4)
SINGLE ENDED TWO PHASE WIRING APPLICATIONS, WITH OR WITHOUT MARKER



PINOUT						
CONNECTORS	MOUNTED ON ENCODER				MOUNTED ON 18" CABLE (00W)		REF SIGNAL
	OPTION "W" (CABLE)	OPTION "A", "B", "C", "D" (10 PIN MS)	OPTION "J", "K", "M", "N" (7 PIN MS)	OPTION "E", "F", "G", "H" (6 PIN MS)	OPTION "T"	OPTION "U"	
CHANNELS	A ØA, ØĀ ØB, ØB̄ ØZ, ØZ̄	E, F ØA, ØB, ØZ	E, F ØA, ØB, ØZ	E, F ØA, ØB, ØZ	A ØA, ØĀ ^ ØB, ØB̄ ^ ØZ, ØZ̄ ^	A ØA, ØĀ ØB, ØB̄ ^ ØZ, ØZ̄ ^	
RED	D	D	B	2	2	+V (SEE LINE)
BLUE	B	B	D	5	4	ØB DRIVER
GREEN	A	A	E	3	1	ØA OPTIONS)
BLACK	F	F	A	1	7	COM
ORANGE*	C*	C*	C*	7	6	ØZ*
WHITE	G	G	NC	NC	NC	CASE GND**

* NC ON CHANNEL OPTION "F"
** SEE WIRING INSTRUCTIONS REGARDING CASE GROUND.
^ COMPLEMENTS INCLUDED BUT NOT USED

LINE DRIVER (Output Option 1, 2, & 4)
SINGLE ENDED SINGLE PHASE WIRING APPLICATIONS



PINOUT						
CONNECTORS	MOUNTED ON ENCODER				MOUNTED ON 18" CABLE (00W)		REF SIGNAL
	OPTION "W" (CABLE)	OPTION "A", "B", "C", "D" (10 PIN MS)	OPTION "J", "K", "M", "N" (7 PIN MS)	OPTION "E", "F", "G", "H" (6 PIN MS)	OPTION "T"	OPTION "U"	
CHANNELS	A (ØĀ, ØB, ØB̄, ØZ, ØZ̄ INCLUDED BUT NOT USED)	D ØA (ØĀ INCLUDED BUT NOT USED)	D ØA (ØĀ INCLUDED BUT NOT USED)	D ØA (ØĀ INCLUDED BUT NOT USED)	A (ØĀ, ØB, ØB̄, ØZ, ØZ̄ INCLUDED BUT NOT USED)	A (ØĀ, ØB, ØB̄, ØZ, ØZ̄ INCLUDED BUT NOT USED)	
BLACK	F	F	A	A	A	COM
RED	D	D	B	B	B	+V (SEE LINE OPTIONS)
GREEN	A	A	E	E	E	ØA
WHITE	G	G	NC	NC	NC	CASE GND**

** SEE WIRING INSTRUCTIONS REGARDING CASE GROUND.

Open Collector Line Driver Output Option 2 requires pull up resistors from each active output to a +V reference.

For Connector Option "W", unused connections must be insulated to prevent accidental contact.

*** NOTE:** Connecting Case Ground is optional, and is not recommended if the encoder is already grounded by mechanical means or coupling.

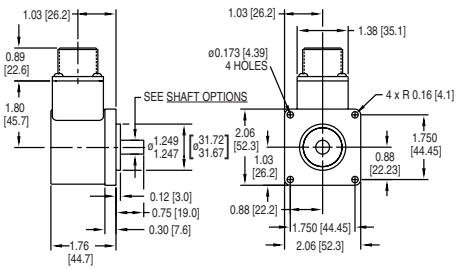
TYPICAL WIRE SELECTION CHART
for 18 AWG, multiple pair, individually shielded

	BELDEN	ALPHA
2 PAIR	9368	6062C
3 PAIR	9369	6063C
4 PAIR	9388	6064C
6 PAIR	9389	6066C

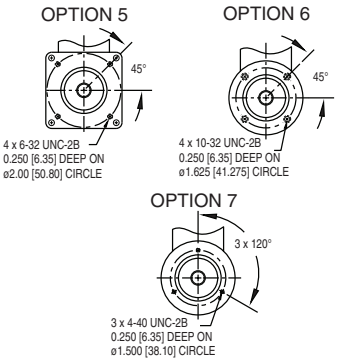
OUTLINE DRAWING

MOUNTING STYLE OPTION 1

SQUARE FLANGE (MALE PILOT)

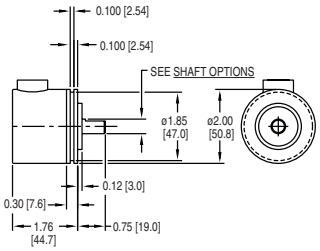


FACE / BOLT OPTIONS



MOUNTING STYLE OPTION 2

ROUND FLANGE (ø2.000 [ø50.80] SERVO MOUNT)

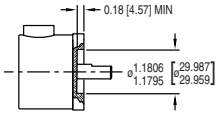


MOUNTING STYLE:

ø1.181 FEMALE PILOT (SHAFT SEAL OPTION "A" NOT AVAILABLE)

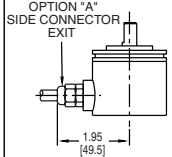
OPTION 3 (SQUARE FLANGE)

OPTION 4 (ROUND FLANGE)



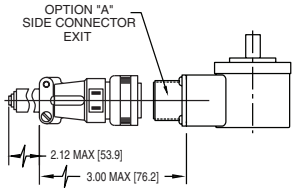
WIRING OPTIONS

CONNECTOR OPTION "W"
18" [457.2] CABLE (PIGTAIL)



CONNECTOR OPTIONS:
"A", "B", "E", "F", "J", "K"
MS BOX CONNECTOR ONLY

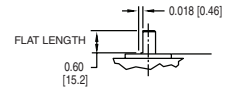
CONNECTOR OPTIONS:
"C", "D", "G", "H", "M", "N"
MS CONNECTOR WITH MATING PLUG



SHAFT OPTIONS

OPTIONS "A" "B" "C" WITH FLAT
(0.60 [15.24] LONG x 0.018 [0.46] DEEP)

OPTION "A" = SHAFT ø .2497/.2495 [6.342/6.337]
OPTION "B" = SHAFT ø .3747/.3745 [9.517/9.512]
OPTION "C" = SHAFT ø 10mm [.3942/.3935]



OPTIONS "N" "P" "R" NO FLAT

OPTION "N" = SHAFT ø .2497/.2495 [6.342/6.337]
OPTION "P" = SHAFT ø .3747/.3745 [9.517/9.512]
OPTION "R" = SHAFT ø 10mm [.3942/.3935]

NOTES:
3. Dimensions are in inches [millimeters].
2. All dimensions are approximate.
1. Weight: 0.575 lbs. [260 g]

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Avtron standard warranty applies. All dimensions are in inches [mm].

CE

REV: 06-11-15

.4 Dynapar Potential Encoder Replacements

LIGHT DUTY

SERIES E23

Dynapar™ brand

Miniature Encoder

Key Features

- **Up to 2540 PPR with Optional Index**
- **Optional Screw Terminal Connections**
- **Standard Size 23 (2.3" diameter)**

CE EN 61326-1 RoHS

SPECIFICATIONS

STANDARD OPERATING CHARACTERISTICS

Code: Incremental, Optical
Resolution: 1 to 2540 PPR (pulses/revolution)
Accuracy: (Worst case any edge to any other edge) ±2.5 arc-min.
Format: Two channel quadrature (AB) with optional Index (Z) outputs
Phase Sense: A leads B for CW or CCW shaft rotation as viewed from the shaft end of the encoder, see Ordering Information
Quadrature Phasing: 90° ± 18° electrical
Symmetry: 180° ± 9° electrical
Index: 180° ± 9° electrical, gated with B
Waveforms: Squarewave with rise and fall times less than 1 microsecond into a load capacitance of 1000 pf

ELECTRICAL

Input Power:
Open Collector or Totem Pole outputs: 5 to 26 VDC. at 200 mA max.;
Line Driver: 5 to 26 VDC at 80 mA max.
Outputs:
7272 Push-Pull: 40mA, sink or source
7272 Differential Line Driver: 40 mA, sink or source
7273 Open Collector: 40mA, sink max
4469 Differential Line Driver: 100 mA, sink or source
Frequency Response: 100 kHz min.
Noise Immunity: Tested to EN61326-1
Electrical Immunity: Reverse polarity and short circuit protected
Termination: Cable, Screw Terminals
Cable: PVC jacket, 105 °C rated, overall foil shield; 3 twisted pairs 26 AWG (output signals), plus 2 twisted pairs 24 AWG (input power)

MECHANICAL

Shaft Size: 1/4"
Shaft Loading: 5 lbs. max. radial and axial
Shaft Speed: 5,000 RPM max.
Starting Torque: 0.2 oz-in max. at 25 °C
Moment of Inertia: 3.7 x 10^{-4} oz–in–sec^2
Housing and Cover: Aluminum
Shaft Material: Stainless Steel
Disc Material: Glass
Weight: 13 oz. max.

ENVIRONMENTAL

Operating Temperature: 0 to +70° C
Storage Temperature: –40 to +80 °C
Shock: 50 G's for 11 msec duration
Vibration: 5 to 2000 Hz at 2 G's
Humidity: Up to 98% (non-condensing)
Enclosure Rating: NEMA12/IP54 (dirt tight, splashproof)

ELECTRICAL CONNECTIONS

Note: Wire color codes are referenced here for models that are specified with pre-wired cable.

Single Ended		
Term.	Function (If Used)	Wire Color Code
A	Signal A	BRN
B	Signal B	ORN
C	Signal Z	YEL
D	Power Source	RED
E	No Connection	—
F	Common	BLK
G	Case	GRN

Differential		
Term.	Function (If Used)	Wire Color Code
A	Signal A	BRN
B	Signal B	ORN
C	Signal Z	YEL
D	Power Source	RED
E	No Connection	—
F	Common	BLK
G	Case	GRN
H	Signal $\bar{A}$	BRN/WH
I	Signal $\bar{B}$	ORN/WH
J	Signal $\bar{Z}$	YEL/WH

.5 Schneider Electric Potential Encoder Replacements

Selection Guide

OsiSense™ XCC
Opto-electronic rotary encoders

Encoder type			**Incremental encoders**			
Applications			**Counting indication**			
						
Diameter of housing			Ø 40 mm	Ø 58 mm	Ø 58 mm parameterable (multi-resolution) *(1)*	Ø 90 mm
Shaft		Solid	Ø 6 mm	Ø 6 mm and Ø 10 mm	Ø 10 mm	Ø 12 mm
		Through	Ø 6 mm	Ø 14 mm Ø 6, 8, 10 and 12 mm (with reduction collar)	Ø 14 mm Ø 6, 8, 10 and 12 mm (with reduction collar)	Ø 30 mm Ø 12, 20 and 25 mm (with reduction collar)
Resolution	Incremental encoders	100 ppr	100 ppr	100 ppr	–	100 ppr
		256 ppr	–	–	256–4096 ppr	–
		360 ppr	360 ppr	360 ppr	360–5760 ppr	360 ppr
		500 ppr	500 ppr	500 ppr	500–8000 ppr	500 ppr
		1000 ppr	1000 ppr	1000 ppr	–	1000 ppr
		1024 ppr	1024 ppr	1024 ppr	1024–16,384 ppr	1024 ppr
		2500 ppr	–	2500 ppr	–	2500 ppr
		3600 ppr	–	–	–	3600 ppr
		4096 ppr	–	–	–	–
		5000 ppr	–	5000 ppr	5000–80,000 ppr	5000 ppr
		10,000 ppr	–	–	–	10,000 ppr
	Absolute encoders	4096 ppr/8192 turns (12-bit/13-bit)	–	–	–	–
		8192 ppr	–	–	–	–
		8192 ppr/4096 turns (13-bit/12-bit)	–	–	–	–
Output stage/supply *(2)*	Incremental encoders	Type R (N)	5 V, RS-422, 4.5–5.5 V	–	–	5 V, RS-422, 4.5–5.5 V
		Type K (N)	Push-pull, 11–30 V	–	–	Push-pull, 11–30 V
		Type X	–	5 V, RS-422, 4.75–30 V	5 V, RS-422, 4.75–30 V	–
		Type Y	–	Push-pull, 5–30 V	Push-pull, 5–30 V	–
	Absolute encoders	Type KB (N) or KG (N)	–	–	–	–
		Type SB (N) or SG (N)	–	–	–	–
		Type C	–	–	–	–
		Type F	–	–	–	–
Connection		Pre-cabled, radial	•	–	–	–
		Connector, radial, M23	–	•	•	•
		Terminal block, radial	–	–	–	–
Catalog Numbers			**XCC14●●●●●**	**XCC15●●●●●**	**XCC15●●●●M●●●**	**XCC19●●●●●**
Pages			12	14	17	18

(1) Parameterable version: multiplication of the basic resolution of the disc using DIP switches. The factory setting is the one with the lowest value.

(2) Specifications of the output stage/supply types:
- *Type R (N): 5 V output driver, RS-422, 4.5–5,5 V.*
- *Type K (N): push-pull output driver, 11–30 V.*
- *Type X: 5 V output driver, RS-422, 4.75–30 V.*
- *Type Y: push-pull output driver, 5–30 V.*
- *Type KB (N) or KG (N) output: push-pull output driver, 11–30 V, binary code KB (N) or Gray code KG (N).*