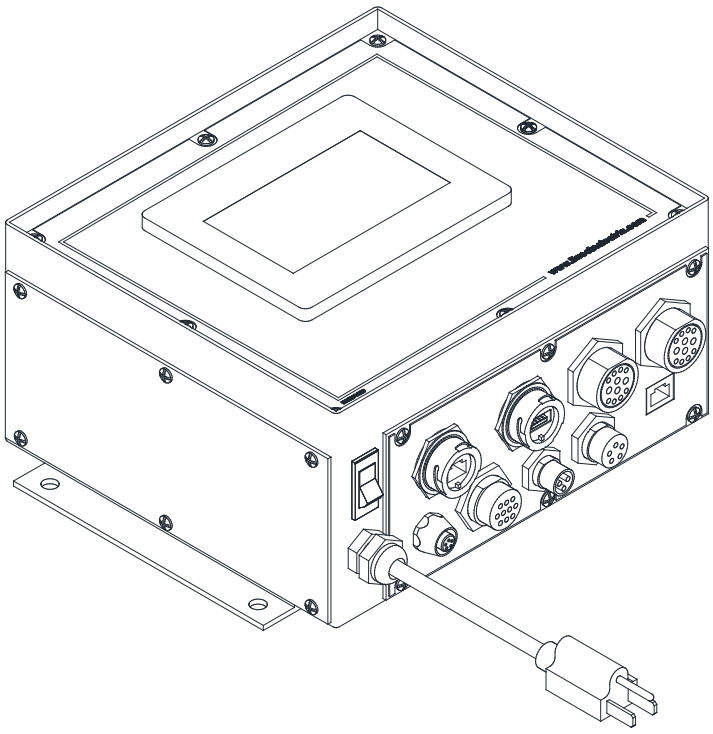
LINCOLN ELECTRIC

Operator's Manual

CWT MTS™ Mechanized Thru-ARC System



For use with machines having Numbers:

S0A5135, S0A5137, S0A5138

GENUINE LINCOLN PARTS™

Register your machine:
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THE LINCOLN ELECTRIC COMPANY
22801 St. Clair Avenue • Cleveland, OH • 44117-1199 • U.S.A.
Phone: +1.216.481.8100 • www.lincolnelectric.com

THANK YOU FOR SELECTING A QUALITY PRODUCT BY LINCOLN ELECTRIC.

PLEASE EXAMINE CARTON AND EQUIPMENT FOR DAMAGE IMMEDIATELY

When this equipment is shipped, title passes to the purchaser upon receipt by the carrier. Consequently, claims for material damaged in shipment must be made by the purchaser against the transportation company at the time the shipment is received.

SAFETY DEPENDS ON YOU

Lincoln arc welding and cutting equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation ... and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.

⚠ WARNING

This statement appears where the information must be followed exactly to avoid serious personal injury or loss of life.

⚠ CAUTION

This statement appears where the information must be followed to avoid minor personal injury or damage to this equipment.

KEEP YOUR HEAD OUT OF THE FUMES.

DON'T get too close to the arc. Use corrective lenses if necessary to stay a reasonable distance away from the arc.

READ and obey the Safety Data Sheet (SDS) and the warning label that appears on all containers of welding materials.

USE ENOUGH VENTILATION or exhaust at the arc, or both, to keep the fumes and gases from your breathing zone and the general area.

IN A LARGE ROOM OR OUTDOORS, natural ventilation may be adequate if you keep your head out of the fumes (See below).

USE NATURAL DRAFTS or fans to keep the fumes away from your face.

If you develop unusual symptoms, see your supervisor. Perhaps the welding atmosphere and ventilation system should be checked.

WEAR CORRECT EYE, EAR & BODY PROTECTION

PROTECT your eyes and face with welding helmet properly fitted and with proper grade of filter plate (See ANSI Z49.1).

PROTECT your body from welding spatter and arc flash with protective clothing including woolen clothing, flame-proof apron and gloves, leather leggings, and high boots.

PROTECT others from splatter, flash, and glare with protective screens or barriers.

IN SOME AREAS, protection from noise may be appropriate.

BE SURE protective equipment is in good condition.

Also, wear safety glasses in work area **AT ALL TIMES.**

SPECIAL SITUATIONS

DO NOT WELD OR CUT containers or materials which previously had been in contact with hazardous substances unless they are properly cleaned. This is extremely dangerous.

DO NOT WELD OR CUT painted or plated parts unless special precautions with ventilation have been taken. They can release highly toxic fumes or gases.

Additional precautionary measures

PROTECT compressed gas cylinders from excessive heat, mechanical shocks, and arcs; fasten cylinders so they cannot fall.

BE SURE cylinders are never grounded or part of an electrical circuit.

REMOVE all potential fire hazards from welding area.

ALWAYS HAVE FIRE FIGHTING EQUIPMENT READY FOR IMMEDIATE USE AND KNOW HOW TO USE IT.

SECTION A: WARNINGS

CALIFORNIA PROPOSITION 65 WARNINGS

WARNING: Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects, or other reproductive harm.

- Always start and operate the engine in a well-ventilated area.
- If in an exposed area, vent the exhaust to the outside.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to www.P65 warnings.ca.gov/diesel

WARNING: This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer. (California Health & Safety Code § 25249.5 *et seq.)*

WARNING: Cancer and Reproductive Harm www.P65warnings.ca.gov

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

FOR ENGINE POWERED EQUIPMENT.

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.

1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.

1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

1.d. Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.

1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.

ELECTRIC AND MAGNETIC FIELDS MAY BE DANGEROUS

2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines

2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

2.d.1. Route the electrode and work cables together - Secure them with tape when possible.

2.d.2. Never coil the electrode lead around your body.

2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.

2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.

2.d.5. Do not work next to welding power source.

ELECTRIC SHOCK CAN KILL.

3.a. The electrode and work (or ground) circuits are electrically “hot” when the welder is on. Do not touch these “hot” parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- Semiautomatic DC Constant Voltage (Wire) Welder.
- DC Manual (Stick) Welder.
- AC Welder with Reduced Voltage Control.

3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.

3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

3.e. Ground the work or metal to be welded to a good electrical (earth) ground.

3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

3.g. Never dip the electrode in water for cooling.

3.h. Never simultaneously touch electrically “hot” parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

3.j. Also see Items 6.c. and 8.

ARC RAYS CAN BURN.

4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87. I standards.

4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.

4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

FUMES AND GASES CAN BE DANGEROUS.

5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding hardfacing (see instructions on container or SDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and within applicable OSHA PEL and ACGIH TLV limits using local exhaust or mechanical ventilation unless exposure assessments indicate otherwise. In confined spaces or in some circumstances, outdoors, a respirator may also be required. Additional precautions are also required when welding on galvanized steel.**

5. b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.

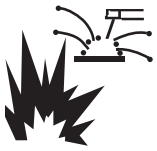
5.c. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

5.d. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

5.e. Read and understand the manufacturer’s instructions for this equipment and the consumables to be used, including the Safety Data Sheet (SDS) and follow your employer’s safety practices. SDS forms are available from your welding distributor or from the manufacturer.

5.f. Also see item 1.b.

WELDING AND CUTTING SPARKS CAN CAUSE FIRE OR EXPLOSION.



6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned". For information, purchase "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.

6.I. Read and follow NFPA 51B "Standard for Fire Prevention During Welding, Cutting and Other Hot Work", available from NFPA, 1 Batterymarch Park, PO box 9101, Quincy, MA 022690-9101.

6.j. Do not use a welding power source for pipe thawing.

CYLINDER MAY EXPLODE IF DAMAGED.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:

- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-I, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association, 14501 George Carter Way Chantilly, VA 20151.

FOR ELECTRICALLY POWERED EQUIPMENT.

8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer's recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer's recommendations.

Refer to http://www.lincolnelectric.com/safety for additional safety information.

ELECTROMAGNETIC COMPATIBILITY (EMC)

CONFORMANCE

Products displaying the CE mark are in conformity with European Community Council Directive. It was manufactured in conformity with a national standard that implements a harmonized standard: EN 60974-10 Electromagnetic Compatibility (EMC) Product Standard for Arc Welding Equipment. It is for use with other Lincoln Electric equipment. It is designed for industrial and professional use.

INTRODUCTION

All electrical equipment generates small amounts of electromagnetic emission. Electrical emission may be transmitted through power lines or radiated through space, similar to a radio transmitter. When emissions are received by other equipment, electrical interference may result. Electrical emissions may affect many kinds of electrical equipment; other nearby welding equipment, radio and TV reception, numerical controlled machines, telephone systems, computers, etc.

WARNING: This Class A equipment is not intended for use in residential locations where the electrical power is provided by the public low-voltage supply system. There may be potential difficulties in ensuring electro-magnetic compatibility in those locations, due to conducted as well as radiated disturbances.

INSTALLATION AND USE

The user is responsible for installing and using the welding equipment according to the manufacturer's instructions.

If electromagnetic disturbances are detected then it shall be the responsibility of the user of the welding equipment to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing (grounding) the welding circuit, see Note. In other cases it could involve constructing an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

NOTE: The welding circuit may or may not be earthed for safety reasons. Follow your local and national standards for installation and use. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will increase the risk of injury, e.g., by allowing parallel welding current return paths which may damage the earth circuits of other equipment.

ASSESSMENT OF AREA

Before installing welding equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

a) other supply cables, control cables, signaling and telephone cables; above, below and adjacent to the welding equipment;

b) radio and television transmitters and receivers;

c) computer and other control equipment;

d) safety critical equipment, e.g., guarding of industrial equipment;

e) the health of the people around, e.g., the use of pacemakers and hearing aids;

f) equipment used for calibration or measurement;

g) the immunity of other equipment in the environment. The user shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures;

h) the time of day that welding or other activities are to be carried out.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

METHODS OF REDUCING EMISSIONS

Public Supply System

Welding equipment should be connected to the public supply system according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the system. Consideration should be given to shielding the supply cable of permanently installed welding equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the welding power source so that good electrical contact is maintained between the conduit and the welding power source enclosure.

Maintenance of the Welding Equipment

The welding equipment should be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the welding equipment is in operation. The welding equipment should not be modified in any way except for those changes and adjustments covered in the manufacturer's instructions. In particular, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Welding Cables

The welding cables should be kept as short as possible and should be positioned close together, running at or close to the floor level.

Equipotential Bonding

Bonding of all metallic components in the welding installation and adjacent to it should be considered. However, metallic components bonded to the work piece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode at the same time. The operator should be insulated from all such bonded metallic components.

Earthing of the Workpiece

Where the workpiece is not bonded to earth for electrical safety, nor connected to earth because of its size and position, e.g., ship's hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitance, selected according to national regulations.

Screening and Shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire welding installation may be considered for special applications. [1]

1 Portions of the preceding text are contained in EN 60974-10 "Electromagnetic Compatibility (EMC) product standard for arc welding equipment."

Table of Contents

1.0 FUNCTIONAL DESCRIPTION

1.1 SYSTEM OVERVIEW

The Mechanized Thru-ARC System (MTS) is an add on Thru-Arc™ Tracking System that can be installed as an addition to a new or existing welding cell and can operate as a standalone component or interface with existing logic controls via MODBUS Communications protocol. The control is comprised of the following major components:

- Thru-Arc Tracking embedded micro controller assembly
- Two MSC II Micro Step controllers for X and Y Axis motion control
- 4" Operator Interface Panel
- CWT Vertical and Horizontal Slides
- CWT Volt Sensor and 1000 amp sensor assembly

The embedded micro controller assembly provides six isolated 24 VDC inputs, four isolated Solid State Relay outputs, one isolated RS422 Terminal serial control port, TTL level encoder input. The following is the system specifications:

Embedded Micro Controller:

Dimensions:	8.00"H (203mm) x 10.50"W (267mm) x 4.60"D (117mm) *Note: Allow an additional clearance of 3.5" (38mm) below for connectors.*
Weight:	9.8 lbs (4.44 kg)
Power Input:	115 vac @ 1 amp, 50/60 Hz
Relay Outputs:	Optically isolated 48 vdc @ 0.1 amp solid state relays
Logic Inputs:	Optically isolated 16 – 24 vdc @ 10 ma
Ethernet Port:	RJ45 Ethernet 10Base-T or 100Base-TX (auto-sensing)
Compatibility:	Ethernet: Version 2.0/IEEE 802.3 (electrical), Ethernet II frame type.
Protocols:	ARP, UDP/IP, TCP/IP, Telnet, ICMP, SNMP, DHCP, BOOTP, TFTP, Auto IP, SMTP, and HTTP
Security:	Password protection, locking feature.
Operating Temperature:	32° ~ 122°F (0° ~ 50°C)

Standard Clamp-On Current Sensor:

Dimensions:	1.625"H x 5.375"W x 5.875"L (41mm x 136mm x 149mm) *Note: Allow an Additional Clearance of 1.5" (38mm) below sensor for connector clearance. Max Welding Cable size 2.125 (54 mm).*

Weight:	2.8lbs (1.27kg)
Sensor Current:	0-1000 ADC; Accuracy: ±2.0% Full Scale ±3 digits
Sensor Voltage:	0-50 VDC; Accuracy: ±1% Full Scale ±2 digits
	0-100 VDC; Accuracy ±2.0 % Full Scale ±2 digits

1.2 THRU-ARC™ TRACKING MODES SUPPORTED

The MTS system is supplied in two versions. The first version is the **"Basic"** system and will support the following Thru-Arc™ tracking modes:

- ACC/AVC torch height control
- A=B centerline tracking with torch height control

The second version is the **"Adaptive"** system and will support the following Thru-Arc™ tracking modes:

- ACC/AVC torch height control
- A=B centerline tracking with torch height control
- Single side tracking with torch height control
- Width control with constant volume fill
- Inverted A=B centerline tracking with torch height

1.3 INTERFACE SPECIFICATION

For seam tracking application the MTS sensor requires a minimum of two Dwell Bit input signals (L-Dwell and R-Dwell) from the Horizontal Slide MSC II micro-step controller. The two Dwell Bit signals indicate the left and right most extreme position of the weave pattern. The dwell input bits share a single common and are configured for a 24 VDC sourcing output. If the MTS is used for Torch Height control only then the dwell bits are not required. The other inputs are defined as "TRACK ON", "SPARE 1", "SPARE 2" and "SPARE 3". The INP4-INP8 inputs also share a single common input and are configured for a 24 VDC sourcing output. In addition the MTS provides four outputs to the system controller that can be used to indicate the operational status of the embedded controller. The four outputs are defined as "READY", "ACTIVE", "FAULT" and "ARC ON". The MTS outputs share a common output and can be configured as sourcing or sinking outputs. A TTL level encoder input is provided for an optional CWT Travel speed sensor.

The MTS sensor is housed in a NEMA 12 enclosure designed for 35 MM DIN rail mount. The MTS enclosure has connectors for the following functions:

- Remote User I/O and control signals
- Remote Integrated Volt and Amp sensor
- Isolated Ethernet 10/100 port
- Vertical and Horizontal motor control
- Optional Wire speed encoder
- USB 2 connector for program update

The Modular enclosure has a RJ45 Ethernet Connector. This port will support a 10Base-T or 100Base-TX network connection with auto sensing. The port is compatible with IEEE 802.3 electrical specification and Ethernet II frame type. This port supports the following protocols: ARP, UDP/IP, TCP/IP, Telnet, ICMP, SNMP, DHCP, BOOTP, TFTP, Auto IP, SMTP, and HTTP.

1.4 OPERATOR INTERFACE PANEL SCREEN DESCRIPTIONS

The OPERATOR INTERFACE PANEL is a **"Touch Screen"** interface and provides all operator configurable tracking setup values, tracking feedback information and tracking control functions. The following is a description of the screens and functions.

MAIN SCREEN:

This button selects the tracking MODES. The button toggles to the next available mode when pressed. The possible selectable Tracking Modes depend on the tracking option and are:

STANDARD Mode: CENTERLINE, RIGHT SIDE, LEFT SIDE.

ADVANCE Mode: CENTERLINE, WIDTH, RIGHT SIDE, LEFT SIDE, AVC HEIGHT and ACC HEIGHT.

This panel provides buttons used to JOG the Vertical and Horizontal Slides. The Vertical Slide position is AUTO saved to the Torch Weld Position and the Horizontal Slide position is AUTO saved to the Torch Center Position when the Jog is halted. When the TRACKING Function is OFF the operator can use these buttons to guide the slides (Manual Slide Adjustment) while welding.

At Power UP the HOME slide buttons will pop-up to indicate that the slides must be initialized. Press each button to run the Initialize Routine and the Vertical and Horizontal Slide will move to the Home Position. Once completed the buttons will drop from view.

Use TRACK Button to turn the Tracking ON or OFF. Starting and stopping the tracking is a manual operation performed by the operator. If the Tracking Button is set to ON prior to the welding ARC Start the Tracking will AUTO Start after the welding ARC Active condition is established. The operator must set the tracking to OFF at the end of each weld.

The TORCH UP button moves the Torch to the UP position saved in the EDIT Screen Parameters and the TORCH WELD button moves the torch DOWN to the value in the EDIT Screen Parameters.

WARNING: If the TORCH WELD position is greater than the distance between the Torch and the Part the Torch will come in contact with the Part when the button is pushed.

The Bottom Banner displays the MTS Button which calls the MTS PARAMETER EDIT screen, the EDIT Button which calls the EDIT SETUP Parameters and the system status LED's.

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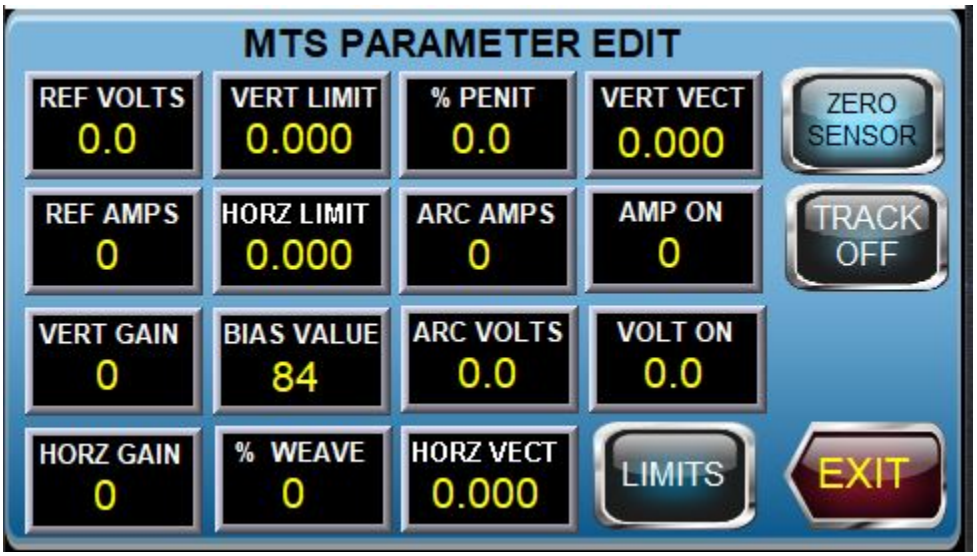
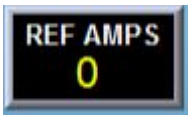
MTS SCREEN:

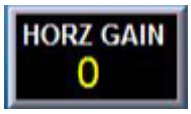


User specified reference used for Height Tracking Modes. If a value is not defined the MTS will extract the reference based on welding data.



User specified reference used for Height Tracking Modes. If a value is not defined the MTS will extract the reference based on welding data.

Vertical Tracking Gain value used to adjust Height Tracking Sensitivity for vertical tracking modes. A value of 0 will disable the Height Tracking. (Value range from 1 to 255 – Default value = 40)

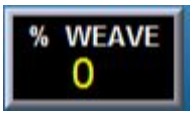


Horizontal Tracking Gain value used to adjust horizontal Tracking Sensitivity for Center, Width, R Side and L Side tracking modes. A value of 0 will disable the Centerline Tracking. (Value range from 1 to 255 – Default value = 20)

The Vertical Limit sets a MAXIMUM Correction limit for each correction generated by the AVC/ACC tracking modes. A value of 0 will disable the Height Tracking. (Value range from 1 to 255 – Default value = 0.50)

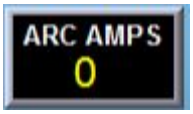
The Horizontal Limit sets a MAXIMUM Correction limit for each correction generated by the Centerline tracking modes. A value of 0 will disable the Centerline Tracking. (Value range from 1 to 255 – Default value = 0.20)

This BIAS value is for reference only. To enter or change the value use the EDIT button on the MAIN Screen to select the Edit Parameter screen.

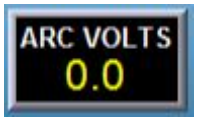


The % Weave is used to determine a percentage of weave pattern used to capture data for centerline tracking modes. (Default value = 100)

% Penetration is used in the WIDTH TRACKING Mode only. It defines a percentage of additional penetration into the joint sidewall for tracking width adjustments.



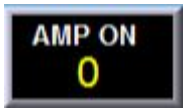
Displays the Actual ARC AMPS value as measured by the current sensor during welding.



Displays the Actual ARC Volts value as measured by the voltage sensor during welding.

Displays the calculated Horizontal Tracking Correction Vector value.

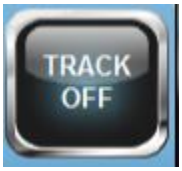
Displays the calculated Vertical Tracking Correction Vector value.



User entered ARC ON AMPS Value. The Welding amps exceed this value for an ARC ON Condition. Tracking will not start until AC ON Conditions are met. Used in conjunction with the ARC ON VOLTS.

User entered ARC ON VOLTS Value. The Welding volts exceed this value for an ARC ON Condition. Tracking will not start until ARC ON Conditions are met. Used in conjunction with the ARC ON AMPS.

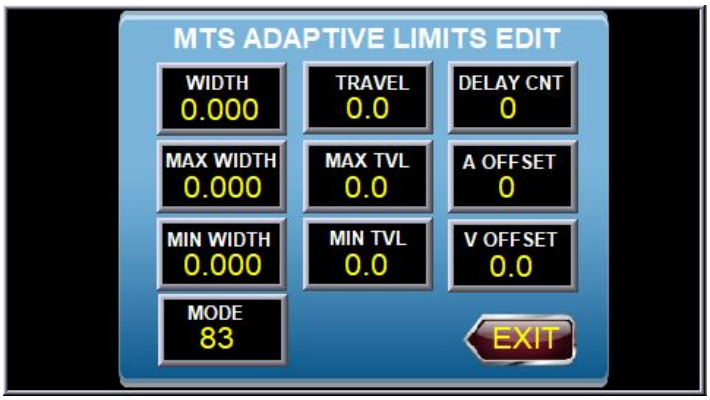
The MTS is programed to AUTO NULL and ZERO the Current Sensor every time the unit is powered on. The ZERO SENSOR button is used to provide and additional ZERO adjustment by the operator if necessary.



The TRACK ON/OFF button turns the tracking mode ON and OFF

Used to display the Adaptive Width Control tracking limits edit screen.

LIMITS SCEEN:

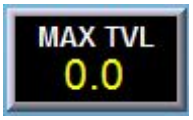


Oscillator Width value in 0.001 inch increments.

The Width Tracking Mode will adjust the oscillation width to accommodate joint width changes. This value sets the MAX Width Value that the tracking can adjust to.

The Width Tracking Mode will adjust the oscillation width to accommodate joint width changes. This value sets the MIN Width Value that the tracking can adjust to.

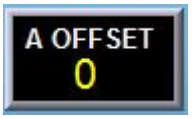
Starting Travel Speed value used for Width Tracking to calculate adaptive fill control values.



The Width Tracking Mode will adjust the Travel Speed to accommodate joint width changes. This is to provide a constant fill volume for the joint. This value sets the MAX Travel Speed Value that the tracking can adjust to.

The Width Tracking Mode will adjust the Travel Speed to accommodate joint width changes. This is to provide a constant fill volume for the joint. This value sets the MIN Travel Speed Value that the tracking can adjust to.

The Delay Count is used with the Width Tracking Mode. The Delay Count is a number of oscillations performed at the start of the weld before the Tracking Mode is activated. This delay is used by the Tracking system to develop a constant reference for width and fill before starting the tracking.



This value is used to OFFSET the AMP Reading displayed in the Weld On screen.

This value is used to OFFSET the VOLT Reading displayed in the Weld On screen.

The EXIT button returns to the previous screen

EDIT SCREEN:

OSCILLATOR PARAMETERS

This is the Oscillation Width Value in 0.001 inch increments

Right Dwell Timer

Left Dwell Timer

Oscillator Speed

Oscillator Center Position

Oscillator delay timer set the delay from arc on detection to when the oscillator will start.

The BIAS Value is not used with the SAW Process. Set this value to 0 (Zero)

VERTICAL PARAMETERS

This is the JOG Speed for the Vertical Slide when the JOG Buttons are used on the MAIN Screen.

The Vertical UP Position is a location above the Weld Position for moving the torch to when not welding. Value is in 0.001 inch increments from the HOME Position.

The Weld Position is the location for the torch to start a weld. Value is in 0.001 inch increments from the HOME Position.

This button moves the Vertical Slide to the UP POSITION Value.

This button moves the Vertical Slide to the WELD POSITION Value.

This button activates the OSCILLATOR. When set to ON the oscillator will run. When set to OFF the oscillator will stop.

WELD ON SCREEN:

This pop-up screen will display on the MAIN Screen when the ARC is ACTIVE.

2.0 INSTALLATION

The MTS Thru-Arc™ tracking system is comprised of the following three sub components.

2.1 CURRENT SENSOR INSTALLATION

The Current Sensor should be installed around the negative welding cable lead from the power supply. The two “RED DOTS” on the sensor should be oriented toward the most positive potential. The location of the sensor is not critical and the welding cables may be as long as required for the application.

The Current Sensor is supplied with a 25 foot cable. To connect the sensor cable to the unit, locate the connector labeled **“AMPS”** on the connector panel of the MTS Enclosure. Insert the plug into the **“AMPS”** connector and rotate cable connector so that the cable connector “KEY” matches the “KEY SLOT” in the MTS AMPS connector. Rotate the cable connector barrel clockwise to secure it into the MTS AMPS connector.

NOTE: Do Not Roll excess cable length in a circle. If the sensor cable is too long for the application loop excess cable in an “S” shape and tie it in the center. Install the sensor cable with as much distance from the Power Source Welding Cables as possible.

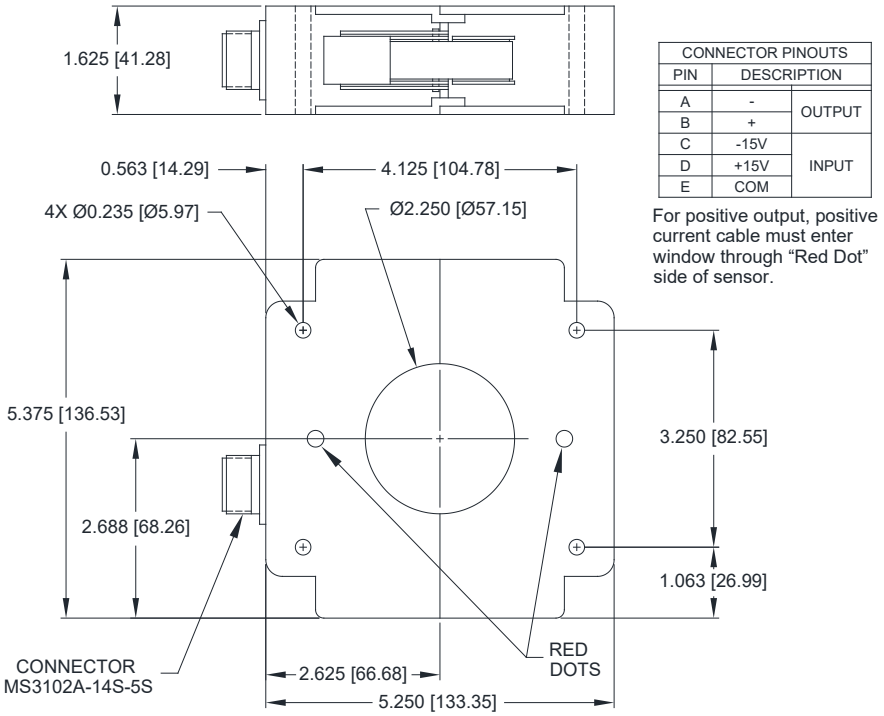


Figure 1: Clamp-On Current Sensor Dimensions

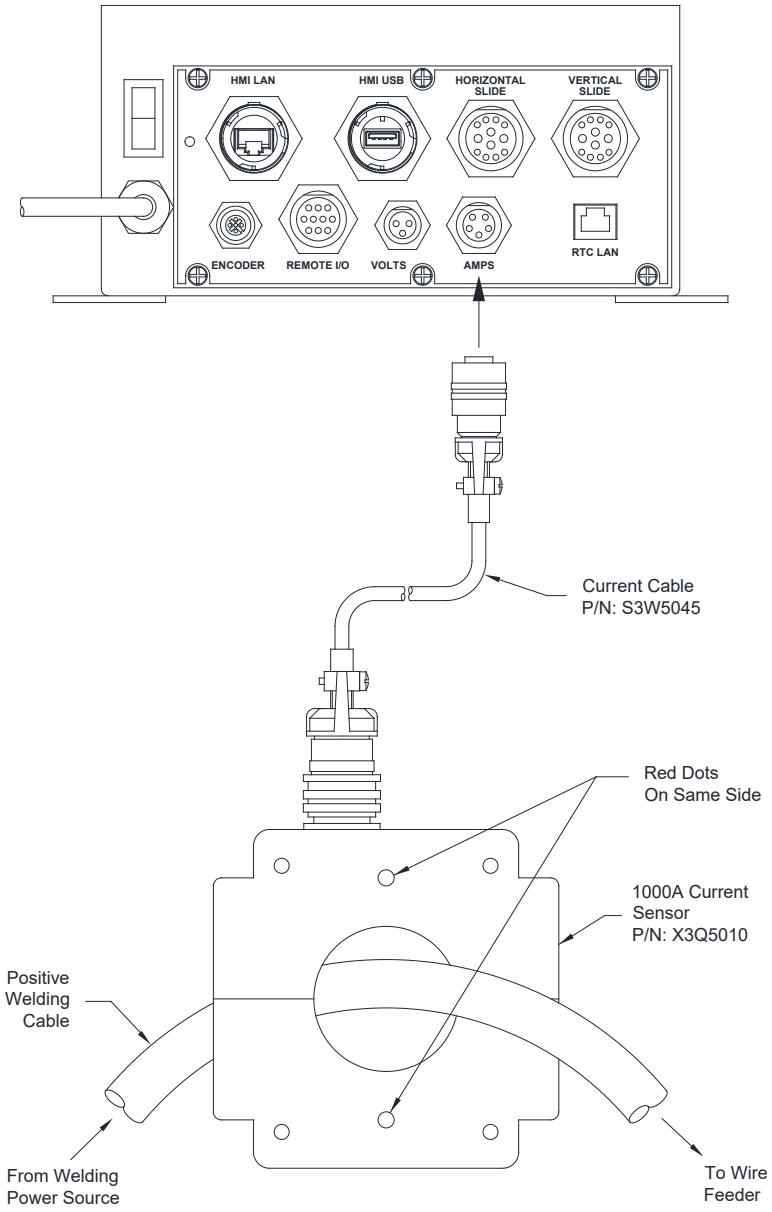


Figure 2: Clamp-On Current Sensor Installation Diagram

2.2 VOLTAGE SENSOR INSTALLATION

The Voltage Sense Cable has two leads, one **RED** and one **BLACK**, to facilitate the connection of the sensor to the welding system. Connect the **ELECTRODE** lead as close to the welding torch as possible in order to assure proper ARC Voltage measurement (See Application Table). Connect the leads to the appropriate location indicated in the table below. If the connections provided on the Voltage Sensor Cable leads are not suitable, any appropriate connector can be used. If the lead lengths are not the required length, they may be shortened or lengthened using the appropriate wire type.

Application Table

APPLICATIO	RED (+)	BLACK (-)
GMAW	Electrode	Work
P-GMAW	Electrode	Work
GTAW	Work	Electrode
P-GTAW	Work	Electrode
SMAW (Rev.	Electrode	Work
SMAW (St.	Work	Electrode
FCAW	Electrode	Work
PAW	Work	Electrode
P-PAW	Work	Electrode
SAW	Electrode	Work

To connect the Voltage Sense Cable to the MTS, locate the connector labeled **"VOLTS"** on the connector panel of the MTS Enclosure. Insert the cable plug into the **"VOLTS"** connector and rotate cable connector so that the cable connector "KEY" matches the "KEY SLOT" in the MTS VOLTS connector. Rotate the cable connector barrel clockwise to secure it into the MTS VOLTS connector.

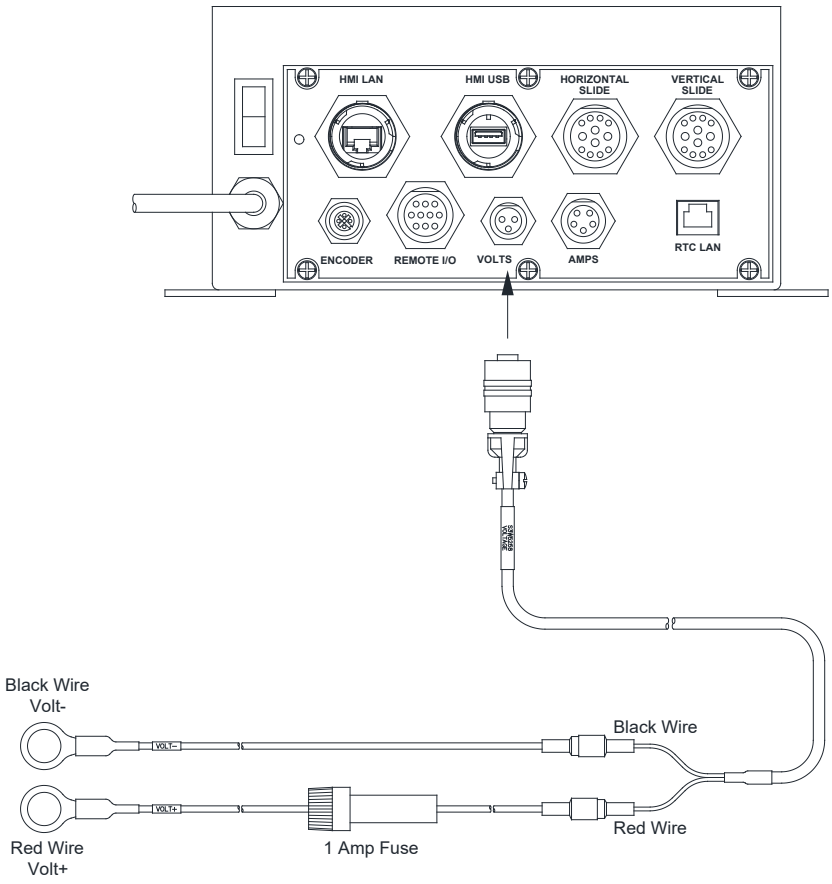


Figure 3: Voltage Sense Cable Installation Diagram

3.0 MTS MODBUS PROTOCOL

3.1 GENERAL DESCRIPTION

This document provides the basic Modbus memory map and command structure for the MTS Modbus TCP/IP communications port. The MTS supports the Modbus Protocol as specified in the Modicon Technical publications “Modbus Protocol” (intr7.html). The MTS control does not support the Broadcast mode. The controller provides the slave side communications routines for the RTU mode. The user must set the Slave ID to 1.

3.2 SUPPORTED MODBUS COMMANDS

The following Modbus commands are supported:

CODE	DESCRIPTION	ADDRESS RANGE
01	Read Coil Status	0-15
03	Read Holding Registers	0-30
05	Force Single Coil	0-15
06	Preset Single Holding Register	0-30
15	Force Multiple Coils	0-15
16	Preset Multiple Holding Registers	0-30
17	Report Slave ID	5 bytes

3.3 MEMORY MAP FOR SENSOR

The following is the Coil definitions address 0-15:

COIL	ADDRESS	DESCRIPTION
1	0	INP1 – Right Dwell Bit Input
2	1	INP2 – Left Dwell Bit Input
3	2	INP3 - Auto Zero Amp Sensor Input
4	3	INP4 - Null Current Sensor Input
5	4	INP5 – Not Used
6	5	INP6 – Not Used
7	6	INP7 – Not Used
8	7	INP8 – Tracker On input
9	8	CR1 – Tracker Ready Output
10	9	CR2 – Tracker Active Output
11	10	CR3 – Tracker Fault Output
12	11	CR4 - Arc Active Output
13	12	CR5 – Not used
14	13	CR6 – Not Used
15	14	CR7 – Not Used
16	15	CR8 – Not Used

The following is the Register definitions address 0-30:

REGISTER	ADDRESS	DESCRIPTION
1	0	Reference Voltage (##.#)
2	1	Reference Current (###)
3	2	Tracking Mode (0 – 5)
4	3	Vertical Gain (0 – 255)
5	4	Horizontal Gain (0 - 255)
6	5	Vertical Correction Limit (0 – 255)
7	6	Horizontal Correction Limit (0-255)
8	7	Centerline Bias (± 255) 2's Compliment
9	8	Percent Weave Width (1 – 99)
10	9	Percent Penetration (#.# %)
11	10	Oscillation Width (##.## mm)
12	11	Min Width (##.## mm)
13	12	Max Width (##.## mm)
14	13	Starting Travel Speed (###.#)
15	14	Min Travel Speed (###.#)
16	15	Max Travel Speed (###.#)
17	16	Arc On Volts (##.#)
18	17	Arc On Amps (###)
19	18	Adaptive Cycle Delay Count (0 – 255)
20	19	Spare 1
21	20	Spare 2
22	21	Spare 3
23	22	S/N MSB=Yr, LSB = Week
24	23	S/N Count/Week
25	24	Measured Arc Volts Offset (0- ±25.5)
26	25	Measured Arc Amps Offset (0 - ±255)
27	26	Device ID and Version Number
28	27	Horizontal Correction Vector (±##.## mm) 2's compliment
29	28	Vertical Correction Vector (±##.##mm) 2's compliment
30	29	Arc On Amps (###)
31	30	Arc On Volts (##.#)

The following is a summary of the Report Slave ID and Status (Code 17) Response Data fields:

Byte	Contents
1	Sensor ID Number =10 Hex (Version 1, Rev0)
2	Run Indicator (0=OFF, FF=On)
3	Status Byte Bit 0 = Ram Full Bit 1 = Battery Ok Bit 2 = Self Test Ok Bit 3-7 = 0

4	Firmware Version Number – BCD Format (MSB = Major: ISB = Minor)
5	Firmware Version Number – BCD Format (MSB+LSB = Release)

3.4 COIL DEFINITIONS AND OPERATION

The MTS has 16 simulated coils. These coils are used as internal bit flags to perform specific functions. The coils are used as input and output bit flags that allow the Robotic/PLC control to read and write specific bit functions. The Modbus Coils 1 - 8 are used to simulate and display sensor inputs. Modbus Coils 9 - 16 are used to simulate Sensor outputs. COIL 1 is the Right Dwell bit signal. COIL 2 is the left Dwell Bit signal. COIL 3 is the Auto Zero input. COIL 4 is used to perform the "Auto-Null" routine for the current sensor. COILS 5 - 7 are not used. COIL 8 is the Tracker On signal used to activate the sensor and begin generation of position correction vectors. CR1 - CR8 are the discrete outputs from the sensor. CR1 is the tracker READY output. CR2 is the tracker ACTIVE output and indicates when new correction vectors are being generated. CR3 is the Tracker FAULT output and indicates when fault has occurred in the sensor. CR4 is the ARC ACTIVE output and is set when a welding arc has been detected. CR5 is the current sensor OK output. CR6 - CR8 is not defined. The sensor I/O bits can be read and written by the Host controller. The sensor INP1, INP2 and INP5 - INP8 will be overwritten when the sensor discrete inputs are changed. CR1 - CR4 will be overwritten by the sensor.

3.5 MTS REGISTER DEFINITIONS

The MTS protocol allows the welding cell system controller to program and upload data from the MTS. The following is a brief description of the Sensor Register variables:

REG 1 - The user defined reference welding voltage used for Torch Height control. This variable should be set prior to starting the welding process. The units are in 0.1 volt increments. This value must be set when using the Automatic Voltage Control (AVC) tracking mode. When using the Centerline Tracking mode if this value is zero the sensor will generate an internal voltage reference using the historical centerline voltage trend over a 1.5 second time period. This parameter can be read and written by the Host controller. This parameter can be modified while the sensor is active.

REG 2 - The user defined reference welding current used for Torch Height control. This variable should be set prior to starting the welding process. The units are in 1 amp increments. This value must be set when using the Automatic Current Control (ACC) tracking mode. When using the Centerline Tracking mode if this value is zero the sensor will generate an internal current reference using the historical centerline current trend over a 1.5 second time period. This parameter can be read and written by the Host controller. This parameter can be modified while the sensor is active.

REG 3 - The Tracking Mode determines the method used to generate correction vectors. This parameter has a limited range from 0 to 5. V4=0 will enable the centerline tracking mode and both Vertical and Horizontal correction are calculated. This mode requires torch oscillation and Right/Left dwell bit signals. V4=1 provides adaptive width control tracking. V4=2 provides right side tracking with penetration control. V4=3 provides left side tracking

with penetration control. V4=4 will enable the AVC torch Height tracking mode. This mode will generate Vertical correction only. The vertical correction will be updated at a rate of 0.1 seconds. This mode does not require torch oscillation. V4=5 will enable the ACC torch Height tracking mode. This mode will generate Vertical correction only. The vertical correction will be updated at a rate of 0.1 seconds. This mode does not require torch oscillation. V4=256 will provide an inverted centerline tracking mode.

REG 4 - The Vertical Gain parameter sets the vertical gain used by the tracking routines. The range of this parameter is 0 to 255. V5=0 will force the vertical correction vector to 0.

REG 5 - The Horizontal Gain parameter sets the Horizontal gain used by the tracking routines. The range of this parameter is 0 to 255. V6=0 will force the horizontal correction vector to 0.

REG 6 - The Vertical Correction Limit parameter sets the maximum vertical correction value that the sensor can generate. The range of this parameter is 0 to 255 in 0.01 mm increments.

REG 7 - The Horizontal Correction Limit parameter sets the maximum horizontal correction value that the sensor can generate. The range of this parameter is 0 to 255 in 0.01 mm increments.

REG 8 - The Bias parameter allows the user to offset the centerline track to the right or left of the center position. This is a 2's compliment value and has a range of ±125. Setting the bias to a negative value will move the weld bead toward the Left dwell position. Setting a positive value will move the weld bead toward the Right Dwell position. V9=0 will disable the bias value.

REG 9 - The percent of weave value used to establish the Right/Left Dwell bits signals. When the system controller motion reaches the percent of weave value the dwell bit is set. When the system controller weave position moves below the percent of weave, the dwell bit is reset.

REG 10 - The percent Depth of Penetration Value is used to control the position of the arc into a side wall. Increasing this value will move the arc harder into the sidewall. Decreasing this value will move the arc further away from the side wall. This value is used in tracking Modes 1, 2 and 3. The default value 1.0%.

REG 11 - The Oscillation Width is used by the width control and should be set prior to the start of the weld cycle. Value should be read by the system controller when width control mode is active

REG 12 - The Min Oscillation Width is used in the width mode and should be set to the minimum allowed weave width prior to start of weld cycle.

REG 13 - The Max Oscillation Width is used in the width mode and should be set to the maximum allowed weave width prior to start of weld cycle

REG 14 - The Travel Speed is used in the width mode for adaptive fill control and should be set prior to the start of the weld cycle. Value should be read by the system Robotic/PLC controller when width control mode is active.

REG 15 - The Min Travel Speed is used in the width mode and should be set to the minimum allowed travel speed prior to start of weld cycle.

REG 16 - The Max Travel Speed is used in the width mode and should be set to the maximum allowed travel speed prior to start of weld cycle.

REG 17 - The Arc Volts parameter is the actual voltage sample. This value is updated at a 3 HZ rate. The units of measure is 0.1 volt/increment.

REG 18 - The Arc Current parameter is the actual current sample. This value is updated at a 3 HZ rate. The units of measure is 1 amp/increment.

REG 19 - Adaptive Travel Speed delay cycle counter. This value is used and should be set prior to the start of the weld cycle.

REG 20 - Spare 1 not defined

REG 21 - Spare 2 not defined

REG 22 - Spare 3 not defined

REG 23 - Serial number where MSB = Year and LSB=Week of Year

REG 24 - Serial Number count per week

REG 25 - Arc Volts offset value. 2's compliment value added to the current voltage reading. (Default =0.0)

REG 26 - Arc Current offset value. 2's compliment value added to the current voltage reading. (Default = 0)

REG 27 - The Device Code provides information regarding the type of device and the current firmware version number. The data is in a BCD format and the MSB byte is the Device ID and the LSB byte is the firmware version number. The MSB Device ID is divided into two nibbles. The Upper nibble is the Family ID and the lower nibble indicates a specific device within the family. The Thru-Arc™ Device is indicated by the upper nibble = 3. The Basic seam tracking system is indicated by the lower nibble = 0 (example: MSB=30 (hex) = Thru-Arc basic seam tracking). The adaptive width control device is indicted by the lower nibble = 1.

REG 28 - The Horizontal Correction is the calculated distance to move the center of oscillation in a horizontal direction from the welding surface. This is a 2's compliment value and the sign indicates the direction of the vector. A negative value indicates a motion towards the left dwell position and a positive value indicates a motion towards the right dwell position. The units are in 0.01 mm increments. The sensor assumes that the horizontal corrections are always parallel to the welding surface.

REG 29 - The Vertical Correction is the calculated distance to move the torch in a vertical direction from the welding surface. This is a 2's compliment value and the sign indicates the direction of the vector. A negative value indicates a torch motion towards the welding surface and a positive value indicates a motion away from the welding surface. The units are in 0.01 mm increments. The sensor assumes that the vertical corrections are always perpendicular to the welding surface.

REG 30 - The Arc Active current level that must be exceeded to set a arc on condition. Units are in 1 amp increments. (Only in T5I5015 VER 1.5 and above)

REG 31 - The Arc Active voltage that must be exceeded to establish a Arc Active condition Units are in 01 volt increments. (Only in T5I5015 VER 1.5 and above)

4.0 MTS OFF-LINE SERIAL TERMINAL PORT PROTOCOL

4.1 SERIAL TERMINAL PORT INTERFACE

The RS-422 communications port is used to off-line program the operating parameters for the MTS. The Protocol is simple ASCII command strings that allows the user to up-load or download the various parameters. The RS-422 serial port is configured for the following data format:

Baud Rate: *9600, Full Duplex*
Word Length: *8 Data Bits, One Stop and no parity*
Hand Shaking: *None*

4.2 PORT PROTOCOL

The Protocol consists of a command string and optional data bytes. The command string is an Alpha character an option number followed by a “=" or "?" followed by optional data and terminated with an ASCII "cr" (0dh). The "=“ will indicate that data is being sent to the select parameter by the host controller. The "?" will indicate a request for data from the MTS to the Host controller. If the host is up-loading data to the MTS the data will be placed after the "=" character and will be an ASCII string terminated with an ASCII "cr" (0dh). The following is an example of sending a new V1 value to the MTS:

V1=1000(cr) - Sent from Host

To read the V1 parameter in the MTS, send the following command:

V1?(cr) *- Sent from Host*
1000(cr) *- Received from MTS*

If an invalid command or value is entered then one of the following error messages will be sent to the host terminal.

Error - Invalid Command *- Sent from Host*
Error - Invalid Parameter *- Sent from Host*
Error - Invalid Command Value *- Sent from Host*

4.3 TERMINAL COMMANDS

The following is a summary of the Ethernet serial Commands supported by the MTS:

COMMAND **DESCRIPTION**

A1-A8 Analog Command Table:
A1 = Read Actual Amp value
A2 = Read Actual Voltage Value
A3 = Left to Right Cross Seam Time (sec)
A4 = Right to Left Cross Seam Time (sec)

A5 = Right Dwell Bit Timer (sec)
A6 = Left Dwell Bit Time (sec)
A7 = Calculated 0.3 HZ AMP internal reference value
A8 = Calculated 0.3 HZ Volt internal reference value
A9 = Amp Auto zero value
A10 = Volt auto zero value
A11 = ANL2 – Amp sensor input
A12 = ANL3 - Auto Null DAC reference value
A13 = ANL4 – Auto Null DAC output value
A14 = ANL5 – Amp Sensor reference Voltage
A15 = ANL6 – User supplied I/O voltage
A16 = ANL7 – System supply voltage
A17 = Measured Oscillation Weave frequency
A18 = DAC reference value for sensor 1
A19 = DAC reference value for sensor 2
A20 = Arc On current reference value
A21 = Arc On voltage reference value

M0-M3 Mode Read Write Commands

M0 = Read Event status

M1 = Read/Write User Input status

Bit	Function
0	Right Dwell Bit
1	Left Dwell Bit
2	Auto zero Volts/Amps
3	Auto zero Amp Sensor
4	Not Used
5	Not Used
6	Not Used
7	Tracker On

M2 = Read/Write User Outputs

BIT	Function
0	Tracker Ready
1	Tracker Active
2	Tracker Fault
3	Sensor Fault
4	Not used
5	Not used
6	Not Used
7	Not used

M3 = Oscillation event counter
M4 = Digital Filter time constant (Default = 64)

V1 – V29 Variable Command Parameter:

V1 = Reference Run Time Volts
V2 = Reference Run Time Current
V3 = Tracking Mode
V4 = Vertical Correction Gain
V5 = Horizontal Correction gain
V6 = Vertical Correction Limit (#.#mm)

V7 = Horizontal Correction Limit (#.#mm)
V8 = Horizontal 2's Compliment Bias Value
V9 = Dwell Bit Percent of Weave
V10 = Percent Depth of Penetration
V11 = Oscillation Width for Adaptive Width
V12 = Min Width for Adaptive Width
V13 = Max Width for Adaptive Width
V14 = Start Travel Speed for Adaptive Width
V15 = Min Travel Speed for Adaptive Width
V16 = Max Travel speed for Adaptive Width
V17 = Actual Arc Volts
V18 = Actual Arc Amps
V19 = Adaptive Travel delay sweep counter
V21 = Spare 1
V22 = Spare 2
V23 = Spare 2
V24 = Spare 2
V25 = Measured Arc Volt offset correction value 2's compliment
V26 = Measured Arc Amp Offset correction value 2's compliment
V27 = BCD Device code and Version (MSB=Device; LSB=Rev)
V28 = Horizontal Correction 2's Compliment
V29 = Vertical Correction 2's Compliment
V30 = Dwell Bit sample delay time
V31 = CWT Serial Number Product Code
V32 = CWT Serial Number count per week

W1-W3 Read Write Weld Mode Commands

W1 = Operational Mode
1=Upload enabled
9= Upload Tracking data with Data Header
W2 = Process Configuration Flag = 0
W3 = Tracking Mode
0 = Centerline
1 = Not implemented
2 = Not implemented
3 = Not Implemented
4 = AVC torch height control
5 = ACC Torch height control
W4 = Digital Filter Time Constant (Default 64)

5.0 MTS Thru-Arc™ Tracking Setup

5.1 OVERVIEW

The Mechanized Thru-ARC System (MTS) provides a Thru-Arc Tracking option that allows the system to perform automatic torch height control and cross-seam tracking. The complete MTS tracking system utilizes a vertical and horizontal slide with stepper motors which are controlled by Micro-Step Controls that are built into the MTS. When the system is utilized for Torch Height Tracking only (normally associated with Overlay Welding) the Horizontal slide is used for manual torch positioning, weld bead alignment adjustments while welding and indexing of the weld bead if required.

5.2 OPERATIONAL CONDITIONS

The Thru-ARC Tracking technology utilizes the Welding ARC to identify changes in a defined weld seam or weld groove. As a general consideration the tracking system requires a minimum weld groove definition of at least 2X the diameter of the welding electrode.

NOTE: Thru-ARC Tracking will not work on a Butt-Joint Weld.

The weld groove shape can be of almost any acceptable design for welding as long as the weld parameters are stable and the root has support. Open root seam tracking is possible with a correctly developed process and weld procedure.

With Thru-ARC Seam Tracking the welding ARC must oscillate across the weld joint to identify changes in the direction of the seam/joint. Use the following equation to calculate a base line for oscillator development:

For **SAW** weld process:

OSC WIDTH = Wire Dia.
OSC SPEED = 100 x Width/Travel Speed in inches per minute
R and L DWELL = .01

For **GMAW / FCAW** weld process:

OSC WIDTH = 1.5 x Wire Dia.
OSC SPEED = 420 x Width/Travel Speed in inches per minute
R and L DWELL = .01

NOTE: Oscillation is not required for Torch Height Tracking ONLY

During the development of the welding parameters the Oscillator must be use. Adjustments to the oscillation width and speed may be required to provide correct weld bead shape and side wall tie-in.

The first step in establishing Thru-Arc Tracking is to set up good stable welding parameters that prevent harsh arc conditions to include the ARC start and end of weld. The technology requires stable arc conditions to derive proper correction vector information. This may include having to place the Welding Torch Push Angle at 3 to 5 degrees so that the welding ARC is at the front of weld pool.

If the welding conditions are not under control the system will respond to the adverse conditions produced by an unstable welding process rather than to the actual change in the weld joint/groove direction.

If there are drastic changes in the weld process caused by instability or operator driven (radical Weld Schedule parameter changes by the operator) the system will react in a drastic manor (i.e. the torch dives into the part or the torch loses the seam and wanders all over the welding surface).

5.3 TRACKING MODES

The MTS has 5 Thru-ARC Tracking Modes:

BASIC MTS Version only has two modes

- ACC / AVC Torch Height Tracking Control
- Centerline A=B Tracking with Torch Height Control

ADVANCED MTS Version

- ACC / AVC Torch Height Tracking Control
- Centerline A=B Tracking with Torch Height Control
- LEFT or RIGHT Side Tracking with Torch Height Control
- WIDTH Control A=B Tracking with Constant Fill and Torch Height Control (MTS Travel Speed Control required for Constant Fill applications)
- INVERTED Centerline A=B Tracking with Torch Height Control

The Tracking Mode is selected using the MODE Button on the MTS Touch Screen.

Automatic Voltage Control (AVC) Torch Height control tracking is for use with Constant Current Power Source Modes. The AVC Height Tracking is used to provide torch height control when no oscillation is required. The vertical corrections are generated on a fixed time basis. The following variables are used in this mode:

VERT GAIN
VERT LIMIT

Automatic Current Control (ACC) Torch Height control tracking is for use with Constant Voltage Power Source Modes. This mode is used to provide torch height control when no oscillation is required. The vertical corrections are generated on a fixed time basis. The following variables are used in this mode:

VERT GAIN
VERT LIMIT

Centerline A=B with Torch Height Tracking mode provides both horizontal and vertical correction vectors to maintain the proper torch path and contact tip to work relationship. Oscillation of the welding ARC is required for this Mode. The oscillation width is fixed and the oscillation center will move based on tracking information from the welding arc. The center position is corrected at each oscillator extreme. The torch height is measured at the

center of the oscillation pattern. The torch vertical position is corrected at the oscillator extreme. The following variables are used in this mode:

VERT GAIN
VERT LIMIT
HORZ GAIN
HORZ LIMIT

WIDTH Control A=B Tracking with Constant Fill and Torch Height Tracking: In this mode the MTS will provide constant volume fill if the control has the connection to adjust torch travel speed. This mode uses a Depth-of-Penetration value to determine ARC position as related to the sidewall position. The sidewall position is determined by a percent change in arc impedance with respect to the oscillation center position. This method allows the oscillation width to increase/decrease to obtain the specified penetration value into the groove side wall. The following variables are used with this mode:

VERT GAIN
VERT LIMIT
HORZ GAIN
HORZ LIMIT
%PENIT
MAX WIDTH
MIN WIDTH
MAX TVL
MIN TVL

Right Side Tracking with **Torch Height** Tracking (single side tracking). In this mode, the Depth-of-Penetration (%PENIT) control is used to determine the location of the right side wall. The oscillator will move to the right to obtain the depth-of-penetration value. This percent change is based on the centerline impedance. When a new sidewall position is determined the mode will determine the left position by subtracting the oscillation width from the new right most position. The following variables are used in this mode:

VERT GAIN
HORZ LIMIT
%PENIT

Note: *Right is determined by looking at the horizontal slide from the front. Larger values in the Oscillator "CENTER" position represent a movement to the Right (away from the location of the motor on the slide).*

Left Side Tracking with **Torch Height** Tracking (single side tracking). This mode uses the Depth-of-Penetration control method to determine the location of the Left sidewall position. The oscillator to move to the left to obtain the depth-of-penetration value. This percent change is based on the centerline impedance. When a new sidewall position is determined the mode will determine the right position by adding the oscillation width to the new left most position. The following variables are used in this mode:

VERT GAIN
VERT LIMIT

HORZ GAIN
HORZ LIMIT
%PENIT VALUE

Note: *The Left is determined by looking at the horizontal slide from the front. Smaller values in "OSC CENTER" position represent a movement to the Left (toward the location of the motor on the slide).*

5.4 TRACKING PARAMETERS

There are several parameters that affect the way the system responds to the welding ARC conditions and provide the ability to "TUNE" the tracking to provide optimal performance. These variables are:

HORZ GAIN – The recommended starting value is 10. This gain is used to increase or decrease the response of the Centerline (Horizontal) Tracking. The Lower the number the slower the system will respond to a change of seam direction and the Higher the number the faster the system will respond to change or seam direction. This variable impacts the stability of weld bead center. If the weld bead center position is oscillating (snake shape weld bead) decrease this parameter by 2 (if at 10 change value to 8). If the center position is slow to respond to a change in the center position, increase this parameter by 2 (if at 10 change value to 12).

VERT GAIN – The recommended starting value is 15. This gain is used to increase or decrease the response of the Torch Height (Vertical) tracking. The Lower the number the slower the system will respond to changes to the work surface change in height and the Higher the number the faster the system will respond to changes to the work surface change in height. This variable impacts the stability of torch height. If the torch position is oscillating (moving up and down constantly) decrease this parameter by 5 (if at 15 change to 10). If the torch position is slow to respond to a change in position, increase this parameter by 5 (if at 15 change to 20).

%PENIT – This variable is only used with WIDTH, RIGHT and LEFT Side Tracking Modes. This variable set's the percent change from the weld oscillation center that the MTS will use to detect arc movement into a sidewall position. The percent change from center will determine the new extreme oscillation position for each oscillation cycle. The unit of measure is in 0.1% increments (i.e. %PENIT=10 equals 1.0% change). Increasing this value will cause the arc to move harder into the sidewall. Decreasing this value will move the arc away from the sidewall.

VERT LIMIT – The default value is 250. This parameter is used to set the maximum distance, in 0.001 - inch increments, the torch can move per correction cycle. The default value of 250 is the maximum distance (0.250) the torch could move per correction cycle.

HORZ LIMIT – The default value is 250. . This parameter is used to set the maximum distance, in 0.001 - inch increments, oscillator center position can move per correction cycle. The default value of 250 is the maximum distance (0.250) the oscillator center position will move per correction cycle.

BIAS VALUE – This Parameter is not used with standard MTS Tracking.

5.5 TRACKING SETUP

To configure the system for proper seam tracking follow these basic steps:

STEP 1 - With the Tracking OFF set welding conditions for proper bead shape and required weld specifications using the initial oscillation parameters derived from the base line equations. Use the OSC ON/OFF button in the “EDIT SCREEN” to Start/Stop the Oscillation for this step. Adjust the oscillation and weld parameters to provide acceptable bead appearance.

STEP 2 - Once an acceptable weld parameters are established observe the Weld Voltage and Current displayed on the MTS Weld Screen. Note the Apparent Average Volt and Current reading displayed.

STEP 3 - Enter the observed values into the “REF VOLT” and “REF AMP” parameters in the MTS “PARAMETER EDIT” screen.

STEP 4 - Start a weld. Once the ARC is stable turn the Tracking ON. Observe the torch vertical motion. The torch will move to adjust the troch height to the required reverence. Note the direction of motion.

If the Torch Height moves down and the Contact Tip to Work Distance (CTWD) is too low stop the weld and make the following adjustment:

NOTE: These changes can be made while welding once you are familiar with the procedure.

Power Source is in Constant Current (CC) Mode: If torch height is too low increase the “REF VOLT” value in 0.50 to 1.00 volt increments until the desired CTWD is achieved.

Power Source is in Constant Voltage (CV) Mode: If torch height is too low decrease the “REF AMP” value in 5 to10 AMP increments until the desired CTWD is achieved.

If the Torch Height moves up and the Contact Tip to Work Distance (CTWD) is too high stop the weld and make the following adjustment:

Power Source is in Constant Current (CC) Mode: If torch height is too high decrease the “REF VOLT” value in 0.50 to 1.00 volt increments until the desired CTWD is achieved.

Power Source is in Constant Voltage (CV) Mode: If torch height is too high increase the “REF AMP” value in 5 to10 AMP increments until the desired CTWD is achieved.

If the Torch Height (CTWD) is correct but the torch is oscillating Up and Down in a faster than desired motion reduce the VERT GAIN in increments of 2 until you achieve a smooth the torch movement. Remember that the torch movement is based on changes while welding and should always move some.

CAUTION: Setting the GAIN Value to 0 (Zero) will disable the Tracking.

CENTERLINE A=B TRACKING MODE

STEP 1 - Make sure that the Torch Height tracking is set up correctly. Use the MODE Select button to set the tracking mode to “CENTER”.

STEP 2 - Set the “HORZ GAIN” to ½ of the value used for “VERT GAIN” (i.e. VERT GAIN = 10 then HORZ GAIN = 5).

STEP 3 - Set the “HORZ LIMIT” to ½ the value of the “HORZ GAIN” (i.e. HORZ GAIN = 5 then HORZ LIMIT = 0.25).

STEP 4 - Enable the tracking by touching the TRACK ON/OFF button. Make a weld and observe the torch motion for both height and center position. The torch will move some on both axes. If the torch is correcting its position in small increments and staying in position in the center of the weld joint it is operating correctly.

If the torch is oscillating Up and Down reduce the VERT GAIN Value.

Centerline issues and corrections:
These corrections are based on the assumption that the welding ARC is leading the weld pool.

- Weld Bead appearance is oscillating (snaking the bead).
    1. Reduce HORZ GAIN Value
    2. Increase Oscillator WIDTH
    3. Increase Oscillator Speed
- Torch Moves UP and Tracking moves out of the weld seam.
    1. Welding ARC may be riding in the weld pool and unable to locate a wall or side of the joint. Add additional torch push angle; increase travel speed; increase Oscillator Width.

WIDTH CONTROL TRACKING MODE

STEP 1 - Make sure that the Torch Height tracking is set up correctly. Use the MODE Select button to set the tracking mode to “WIDTH”.

STEP 2 - Set the “HORZ GAIN” to ½ of the value used for “VERT GAIN” (i.e. VERT GAIN = 10 then HORZ GAIN = 5).

STEP 3 - Set the “HORZ LIMIT” to ½ the value of the “HORZ GAIN” (i.e. HORZ GAIN = 5 then HORZ LIMIT = 0.25).

STEP 4 – In the “PARAMETER EDIT” screen touch the “LIMITS” button and the “ADAPTIVE LIMITS EDIT” screen will open. This tracking Mode has the ability to change the OSCILLATION WIDTH and TRAVEL SPEED. In order to provide control of the adjustments made while tracking you must set LIMITS for the MINIMUM and MAXIMUM amount of change allowed for the weld seam.

Set the Oscillation MAX WIDTH and MIN WIDTH value equal to the minimum and maximum width for the weld seam opening.

For initial setup or for using the Width Tracking without Travel Speed adjustment set the TRAVEL, MAX TVL and MIN TVL to the same value as the Weld Travel Speed (i.e. If welding Travel Speed is 20 IPM, enter 20.0 into the TRAVEL, MAX TVL and MIN TVL windows)
In the “PARAMETER EDIT” screen set the “%PENIT” to a value of 0.5.

STEP 5 - Enable the tracking by touching the TRACK ON/OFF button. Make a weld and observe the torch motion for both height and center position. The torch will move some on both axes. If the torch is correcting its position in small increments and staying in position in the center of the weld joint it is operating correctly.

If the torch is oscillating Up and Down reduce the VERT GAIN Value.

WIDTH Tracking issues and corrections:
These corrections are based on the assumption that the welding ARC is leading the weld pool.

- Weld Bead appearance is oscillating (snaking the bead).
    1. Reduce HORZ GAIN Value
    2. Increase Oscillator WIDTH
    3. Increase Oscillator Speed
- Torch Moves UP and Tracking moves out of the weld seam.
    1. Welding ARC may be riding in the weld pool and unable to locate a wall or side of the joint. Add additional torch push angle; increase travel speed; increase Oscillator Width.
    2. If the width decreases to the minimum width set in the MIN WIDTH value and is not reaching the sidewalls, increase the %PENIT value.
    3. If the width increases to the maximum width or the arc is riding to high on the sidewalls, decrease the %PENIT Value.

RIGHT SIDE TRACKING MODE

STEP 1 - Make sure that the Torch Height tracking is set up correctly. Use the MODE Select button to set the tracking mode to “RIGHT”.

STEP 2 - Set the “HORZ GAIN” to ½ of the value used for “VERT GAIN” (i.e. VERT GAIN = 10 then HORZ GAIN = 5).

STEP 3 - Set the “HORZ LIMIT” to ½ the value of the “HORZ GAIN” (i.e. HORZ GAIN = 5 then HORZ LIMIT = 0.25).
Set the “%PENIT” **to a value of 0.5.**
STEP 4 - Enable the tracking by touching the TRACK ON/OFF button. Make a weld and observe the torch motion for both height and position. The torch will move some on both axes. If the torch is correcting its position in small increments and staying in position to the RIGHT Side of the weld joint it is operating correctly.

If the torch is oscillating Up and Down reduce the VERT GAIN Value.

RIGH SIDE Tracking issues and corrections:
These corrections are based on the assumption that the welding ARC is leading the weld pool.

- **If the** Torch Moves UP and the Tracking moves out of the weld seam.
    1. Welding ARC may be riding in the weld pool and unable to locate the side of the joint. Add additional torch push angle; increase travel speed; increase Oscillator Width.
    2. If the weld is low in the side wall, increase the %PENIT value.
    3. If the weld is high on the sidewalls, decrease the %PENIT Value.

LEFT SIDE TRACKING MODE

STEP 1 - Make sure that the Torch Height tracking is set up correctly. Use the MODE Select button to set the tracking mode to “LEFT”.

STEP 2 - Set the “HORZ GAIN” to ½ of the value used for “VERT GAIN” (i.e. VERT GAIN = 10 then HORZ GAIN = 5).

STEP 3 - Set the “HORZ LIMIT” to ½ the value of the “HORZ GAIN” (i.e. HORZ GAIN = 5 then HORZ LIMIT = 0.25).
Set the “%PENIT” to a value of 0.5.

STEP 4 - Enable the tracking by touching the TRACK ON/OFF button. Make a weld and observe the torch motion for both height and position. The torch will move some on both axes. If the torch is correcting its position in small increments and staying in position to the LEFT Side of the weld joint it is operating correctly.

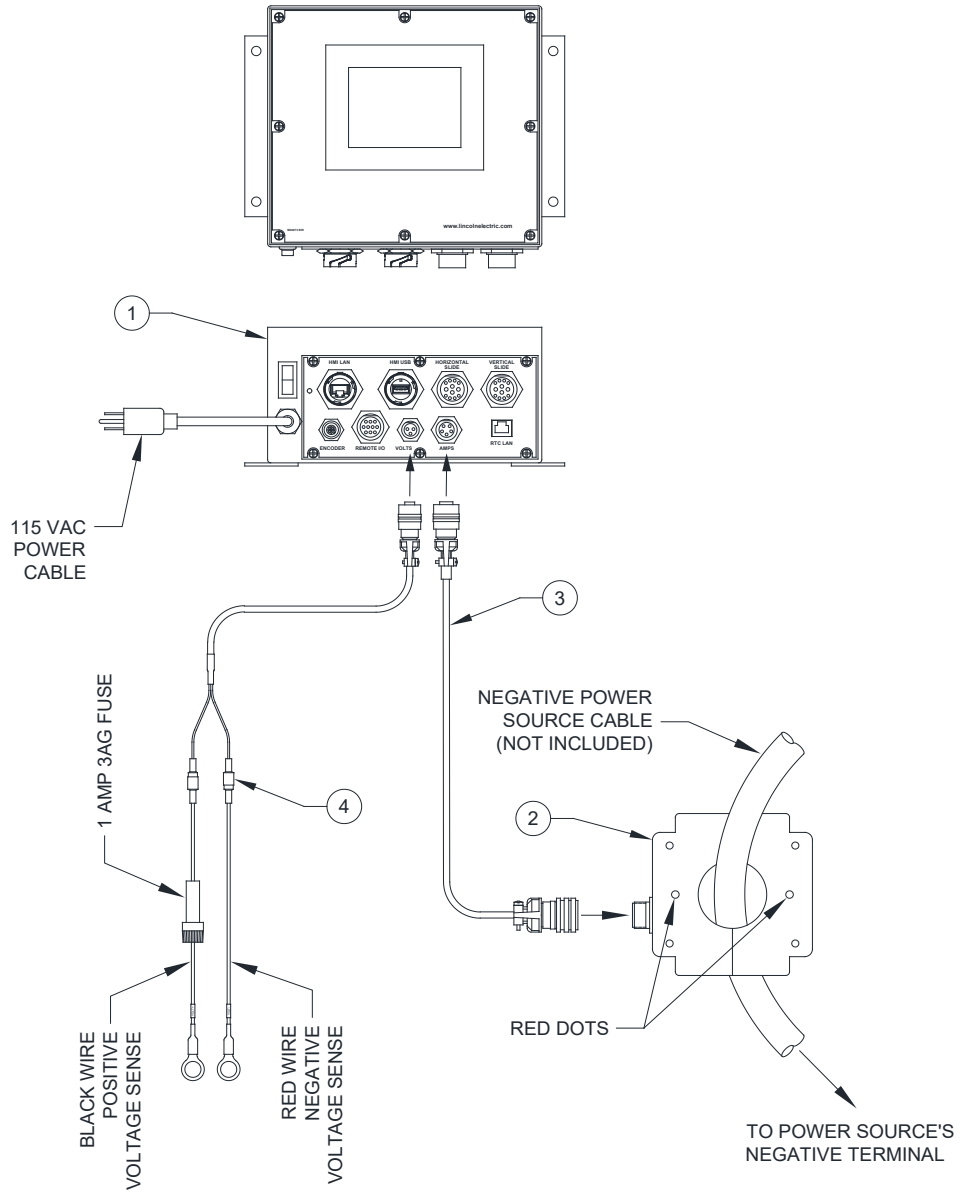
If the torch is oscillating Up and Down reduce the VERT GAIN Value.

LEFT SIDE Tracking issues and corrections:
These corrections are based on the assumption that the welding ARC is leading the weld pool.

- Torch Moves UP and the Tracking moves out of the weld seam.
    1. Welding ARC may be riding in the weld pool and unable to locate the side of the joint. Add additional torch push angle; increase travel speed; increase Oscillator Width.
    2. If the weld is low in the side wall, increase the %PENIT value.
    3. **If** the weld is high on the sidewalls, decrease the %PENIT **value**.

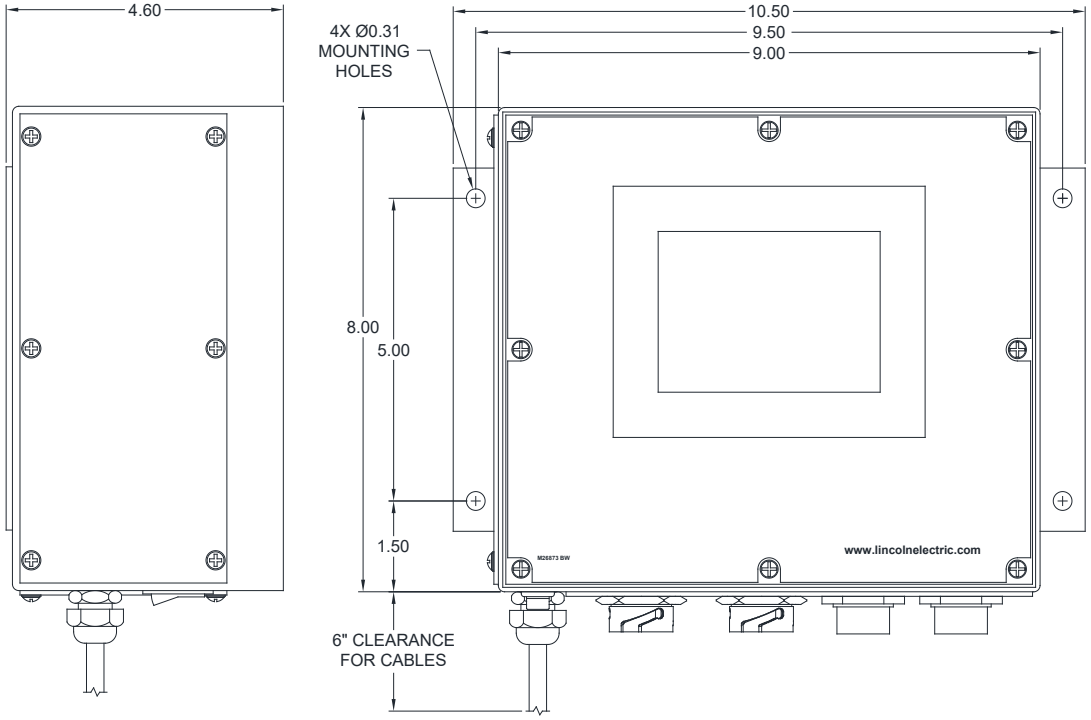
APENDIX A – System Drawings

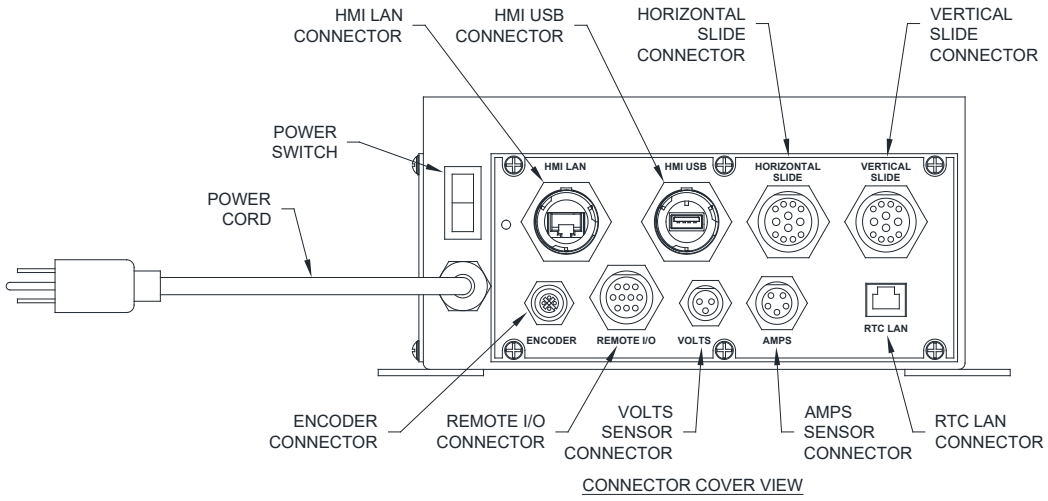
A-1 MTS SYSTEM – P/N: S0A5135

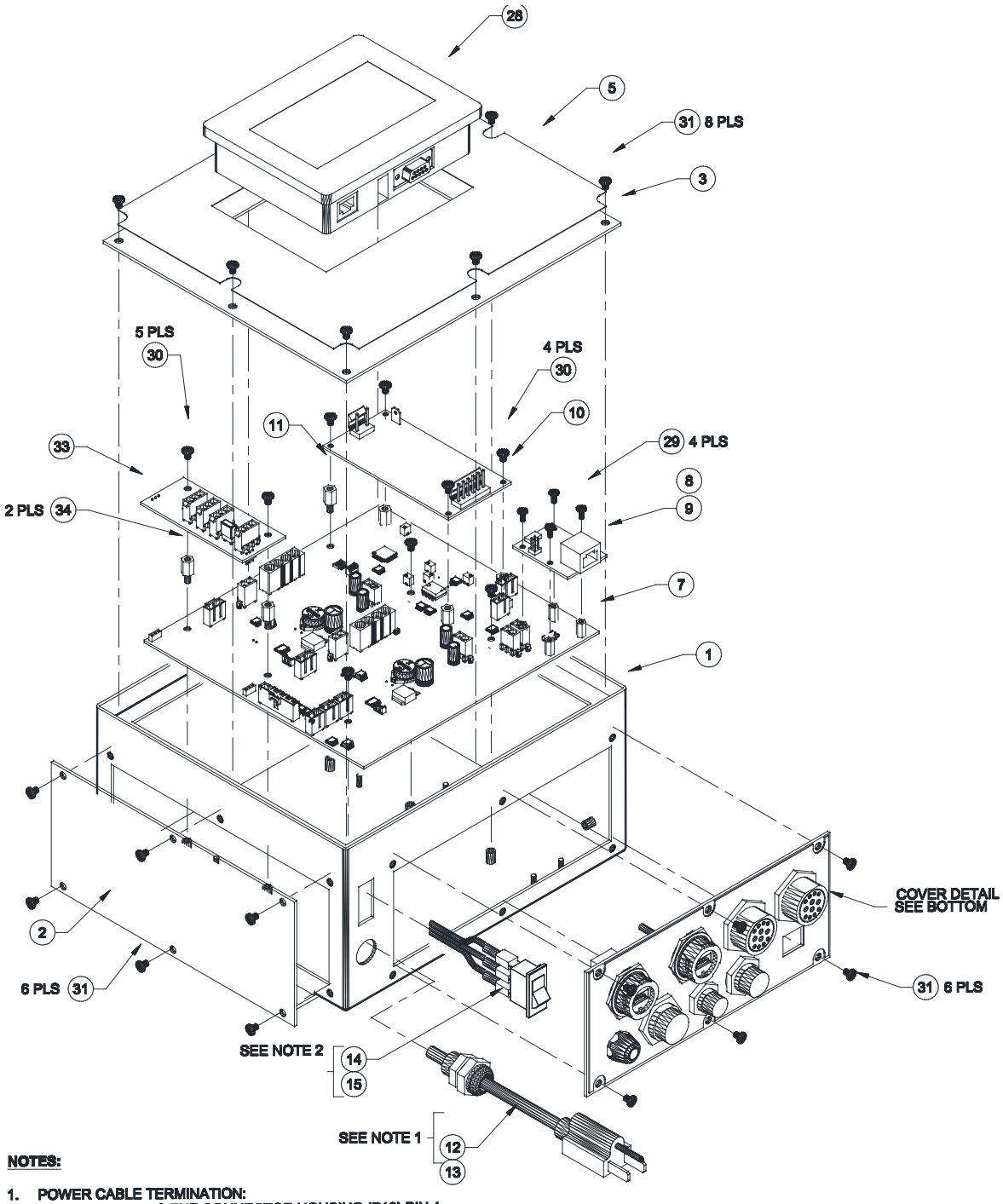


Item	Qty	CWT P/N	Description
1	1	M26872	Enclosure Assembly, MTS
2	1	X3Q5010	Sensor, 1000 Amp Current
3	1	S3W5045	Cable, Current
4	1	S3W5238	Cable, Voltage Sense
5	1	IM10543	Manual, MTS User

A-2 MTS ENCLOSURE ASSEMBLY – P/N: S3A5232

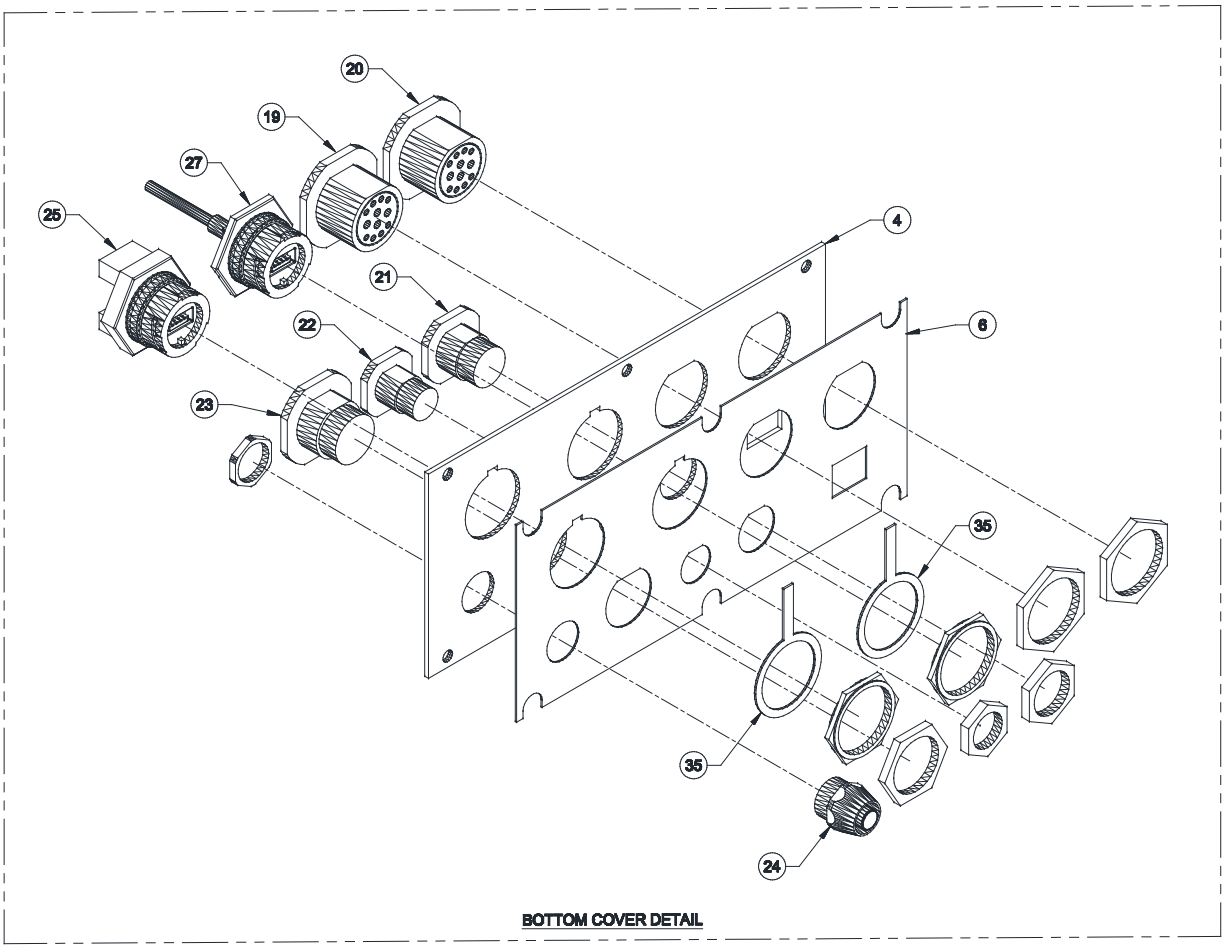




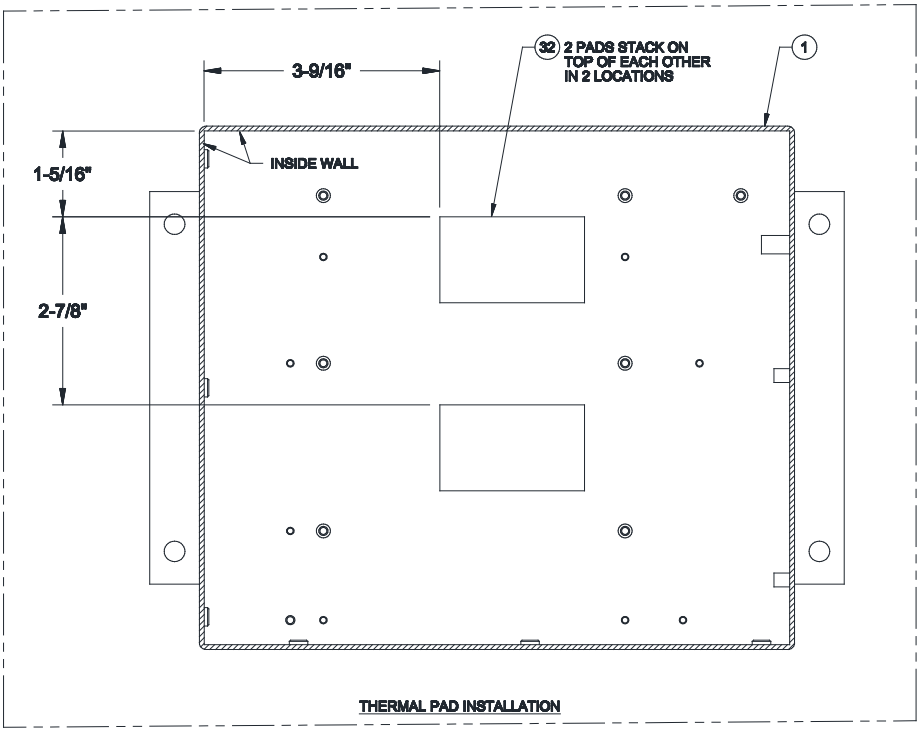


NOTES:

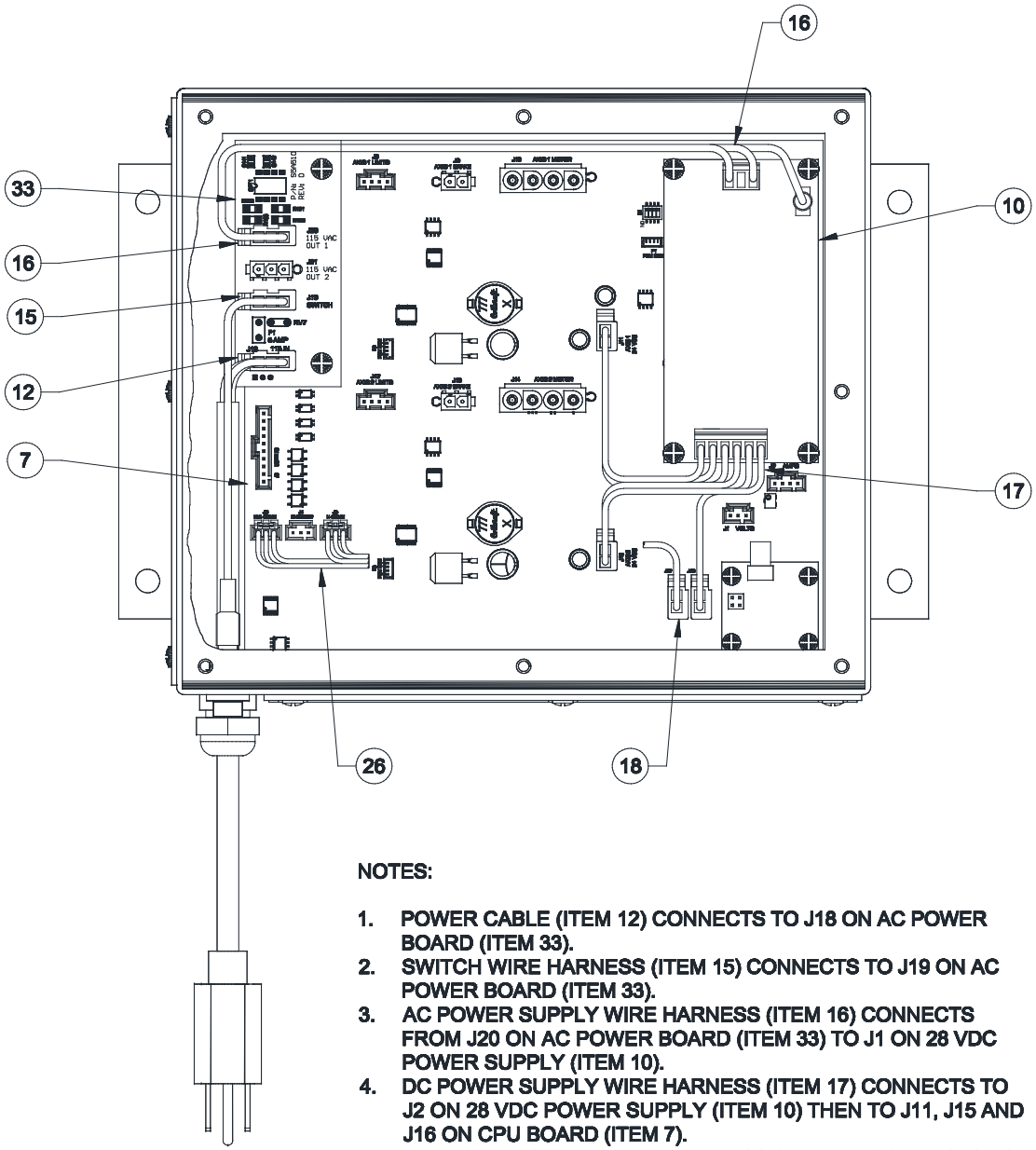
1. POWER CABLE TERMINATION:
   BROWN WIRE TO THE CONNECTOR HOUSING (P18) PIN 1
   BLUE WIRE TO THE CONNECTOR HOUSING (P18) PIN 2
   GREEN/YELLOW WIRE TO THE CONNECTOR HOUSING (P18) PIN 3
2. SWITCH TERMINATION:
   YELLOW WIRE CONNECTS TO THE SWITCH'S COPPER TERMINAL (TOP)
   BROWN WIRE CONNECTS TO THE SWITCH'S SILVER TERMINAL (MIDDLE)
   BLUE WIRE CONNECTS TO THE SWITCH'S BRASS TERMINAL (BOTTOM)



BOTTOM COVER DETAIL



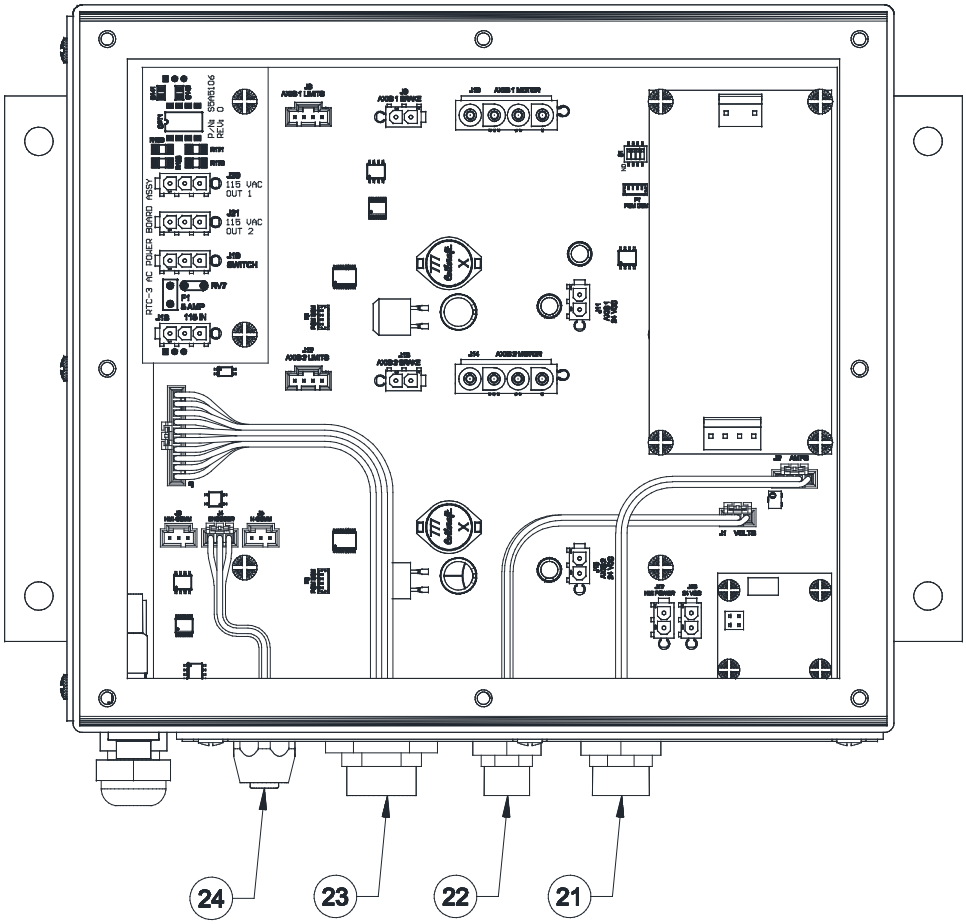
THERMAL PAD INSTALLATION



NOTES:

1. POWER CABLE (ITEM 12) CONNECTS TO J18 ON AC POWER BOARD (ITEM 33).
2. SWITCH WIRE HARNESS (ITEM 15) CONNECTS TO J19 ON AC POWER BOARD (ITEM 33).
3. AC POWER SUPPLY WIRE HARNESS (ITEM 16) CONNECTS FROM J20 ON AC POWER BOARD (ITEM 33) TO J1 ON 28 VDC POWER SUPPLY (ITEM 10).
4. DC POWER SUPPLY WIRE HARNESS (ITEM 17) CONNECTS TO J2 ON 28 VDC POWER SUPPLY (ITEM 10) THEN TO J11, J15 AND J16 ON CPU BOARD (ITEM 7).
5. HMI POWER SUPPLY WIRE HARNESS (ITEM 18) CONNECTS TO J17 ON CPU BOARD (ITEM7) TO HMI (ITEM 28).
6. HMI COMM WIRE HARNESS (ITEM 26) CONNECTS TO J5 AND J6 ON CPU BOARD (ITEM 7) TO HMI (ITEM 28).

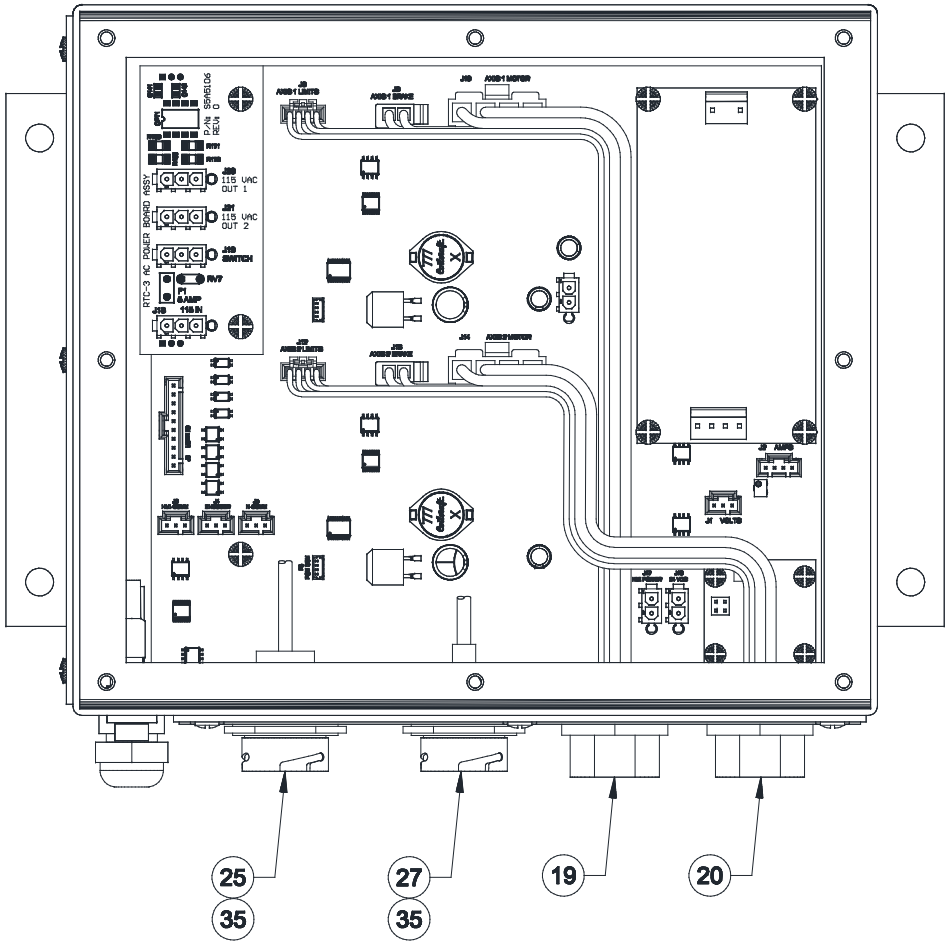
WIRING DETAIL "A"



NOTES:

1. AMP WIRE HARNESS (ITEM 21) CONNECTS TO J2 ON CPU BOARD (ITEM 7).
2. VOLT WIRE HARNESS (ITEM 22) CONNECTS TO J1 ON CPU BOARD (ITEM 7).
3. REMOTE I/O WIRE HARNESS (ITEM 23) CONNECTS TO J3 ON CPU BOARD (ITEM 7).
4. ENCODER WIRE HARNESS (ITEM 24) CONNECTS TO J4 ON CPU BOARD (ITEM 7).

WIRING DETAIL "B"

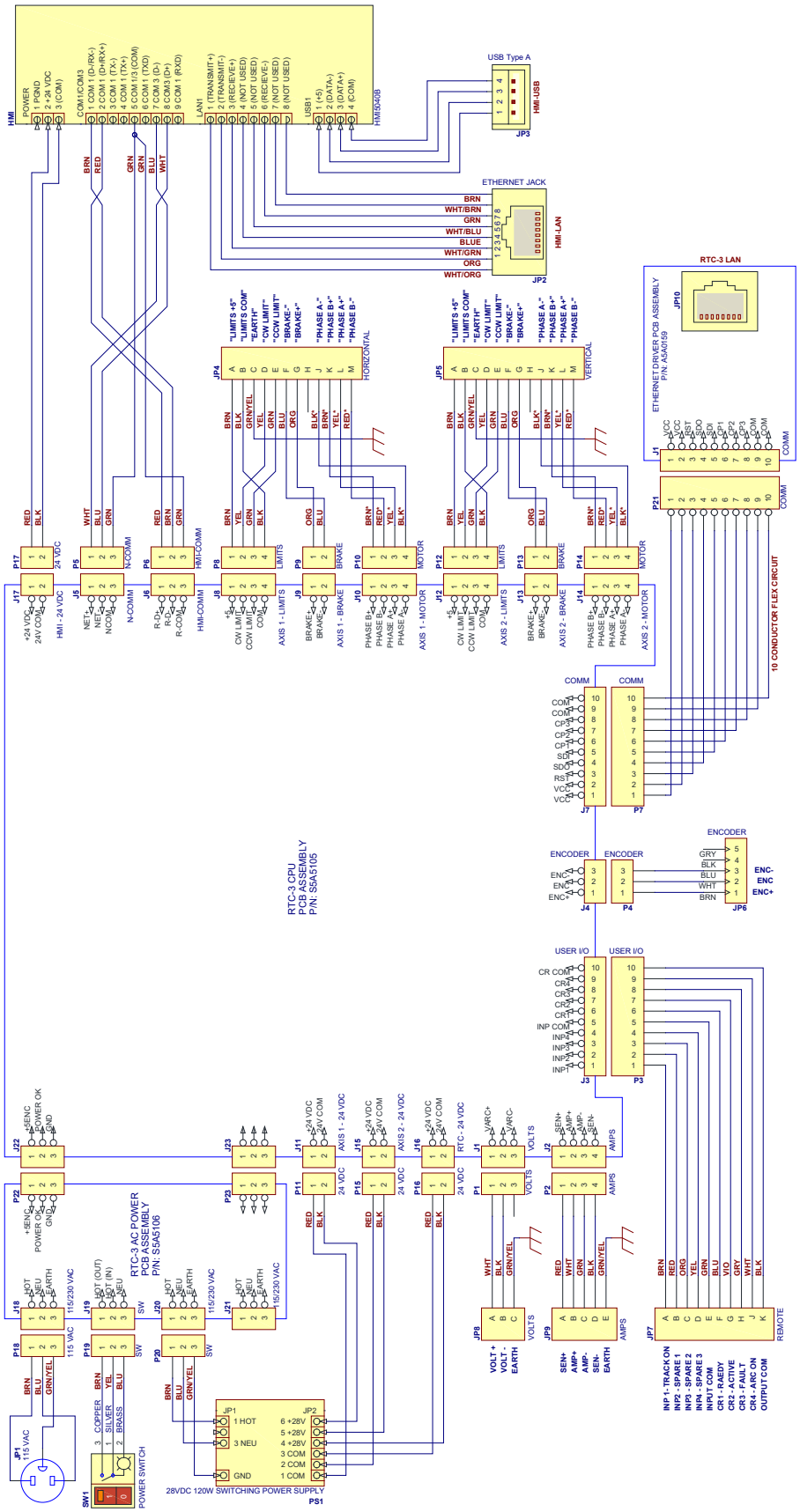


NOTES:

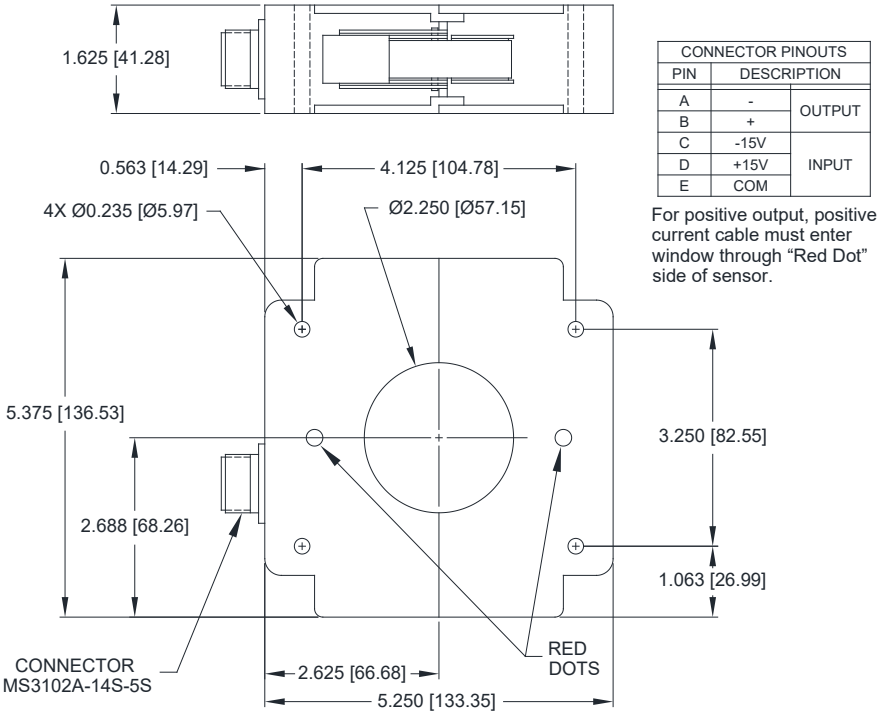
1. AXIS 1 WIRE HARNESS (ITEM 19) CONNECTS TO J8, J9 AND J104 ON CPU BOARD (ITEM 7).
2. AXIS 2 WIRE HARNESS (ITEM 20) CONNECTS TO J12, J13, AND J14 ON CPU BOARD (ITEM 7).
3. HMI LAN WIRE HARNESS (ITEM 25) CONNECTS TO HMI (ITEM 28).
4. USB CABLE (ITEM 27) CONNECTS TO HMI (ITEM 28).

WIRING DETAIL "C"

Item	Qty	CWT P/N	Description
1	1	S3E5160	ENCLOSURE, 9" X 8" X 4-1/2" - BLACK
2	1	S3E5163	COVER, LARGE BLANK - BLACK
3	1	S3E5173	COVER, UWC II HMI FRONT COVER
4	1	S3E5190	COVER, MTS BOTTOM
5	1	M26873	OVERLAY, MTS FRONT COVER
6	1	M26874	OVERLAY, MTS BOTTOM COVER
7	1	S5A5105	PCB ASSY, MTS CPU
8	1	A5A0159	PCB ASSY, ETHERNET DRIVER
9	1	X3W5132	CABLE, FFC/FPC JUMPER 0.5MM 10 CIRCUIT 50MM
10	1	X3T5096	SUPPLY, POWER AC-DC 28VDC 120W
11	1	X6S5064	SPACER, #6-40 X 3/8" LONG 3/16" HEX MALE-FEMALE
12	1	S3W5159	CABLE, 115VAC POWER
13	1	X3P5875	CONNECTOR, HOUSING 3 CIRCUIT
14	1	X3S5078	SWITCH, POWER 110VAC
15	1	S3W5161	HARNESS, MTS POWER SWITCH WIRE
16	1	S3W5162	HARNESS, MTS AC POWER SUPPLY WIRE
17	1	S3W5163	HARNESS, MTS DC POWER SUPPLY WIRE
18	1	S3W5164	HARNESS, MTS HMI POWER SUPPLY WIRE
19	1	S3W5165	HARNESS, MTS AXIS 1 WIRE
20	1	S3W5166	HARNESS, MTS AXIS 2 WIRE
21	1	S3W5167	HARNESS, MTS AMP WIRE
22	1	S3W5168	HARNESS, MTS VOLT WIRE
23	1	S3W5169	HARNESS, MTS REMOTE I/O WIRE
24	1	S3W5170	HARNESS, MTS ENCODER WIRE
25	1	S3W5171	HARNESS, MTS HMI LAN WIRE
26	1	S3W5172	HARNESS, MTS HMI COMM WIRE
27	1	X3P6026	CONN, RCPT USB-A TO PLUG USB-A SEALED PANEL MOUNT 6"
28	1	X3L5035	HMI, 4.3" SCREEN - MAPLE SYSTEMS
29	4		SCREW, 4-40 X 1/4" PAN HEAD WITH INTERNAL LOCK WASHER
30	9		SCREW, 6-32 X 1/4" PAN HEAD WITH INTERNAL LOCK WASHER
31	20		SCREW, 6-32 X 1/2" PAN HEAD WITH INTERNAL LOCK WASHER
32	4	S2M5212	PAD, DMC-2/MSC-2 THERMAL
33	1	S5A5106	PCB ASSY, MTS AC POWER
34	2	X6S5057	SPACER, #6-40 X 1/4" LONG 3/16" HEX MALE-FEMALE
35	2	X3P5957	CAP, DUST SEALED


HMI
POWER
1 PGND
2 +24 VDC
3 (COM)
COM1/COM3
1 COM 1 (D-/RX-)
2 COM 1 (D+/RX+)
3 COM 1 (TX-)
4 COM 1 (TX+)
5 COM 1 (COM)
6 COM 3 (TD-)
7 COM 3 (D-)
8 COM 3 (D+)
9 COM 1 (RXD)
LAN1
1 (TRANSMIT+)
2 (TRANSMIT-)
3 (RECEIVE+)
4 (NOT USED)
5 (NOT USED)
6 (RECIEVE-)
7 (NOT USED)
8 (NOT USED)
USB1
1 (+5)
2 (DATA-)
3 (DATA+)
4 (COM)
HMI5040B
USB Type A
HMI-USB
JP3
ETHERNET JACK
HMI-LAN
JP2
BRN
WHT/BRN
GRN
WHT/BLU
BLUE
WHT/GRN
ORG
WHT/ORG
RTC-3 LAN
ETHERNET DRIVER PCB ASSEMBLY
P/N: ASA0159
JP10
J1
COMM
P21
10 CONDUCTOR FLEX CIRCUIT
"LIMITS +5"
"LIMITS COM"
"EARTH"
"CW LIMIT"
"CCW LIMIT"
"BRAKE-"
"BRAKE+"
"PHASE A-"
"PHASE B+"
"PHASE A+"
"PHASE B-"
JP4
HORIZONTAL
JP5
VERTICAL
P17
24 VDC
J17
HMI - 24 VDC
P6
N-COMM
J6
HMI-COMM
J8
LIMITS
AXIS 1 - LIMITS
P9
BRAKE
J9
AXIS 1 - BRAKE
P10
MOTOR
J10
AXIS 1 - MOTOR
P12
J12
AXIS 2 - LIMITS
P13
J13
AXIS 2 - BRAKE
P14
J14
AXIS 2 - MOTOR
COMM
J7
P7
ENCODER
J4
P4
JP6
ENC-
ENC
ENC+
USER I/O
J3
P3
RTC-3 CPU
PCB ASSEMBLY
P/N: SSA5105
RTC-3 AC POWER
PCB ASSEMBLY
P/N: SSA5106
115/230 VAC
115 VAC
SW
J18
J19
J20
J21
P18
P19
P20
JP1
115 VAC
COPPER
SILVER
BRASS
SW1
POWER SWITCH
JP1
1 HOT
3 NEU
GND
JP2
6 +28V
5 +28V
4 +28V
3 COM
2 COM
1 COM
28VDC 120W SWITCHING POWER SUPPLY
PS1
J22
J23
P22
P23
+5ENC
POWER OK
GND
J11
J15
J16
J1
P11
P15
P16
P1
24 VDC
24V COM
AXIS 1 - 24 VDC
AXIS 2 - 24 VDC
RTC - 24 VDC
VOLTS
+VARC+
-VARC-
J2
P2
AMPS
SEN+
AMP+
AMP-
SEN-
JP8
JP9
VOLT +
VOLT -
EARTH
SEN+
AMP+
AMP-
SEN-
EARTH
JP7
REMOTE
INP 1 - TRACK ON
INP2 - SPARE 1
INP3 - SPARE 2
INP4 - SPARE 3
INPUT COM
CR1 - RAEDY
CR2 - ACTIVE
CR3 - FAULT
CR4 - ARC ON
OUTPUT COM

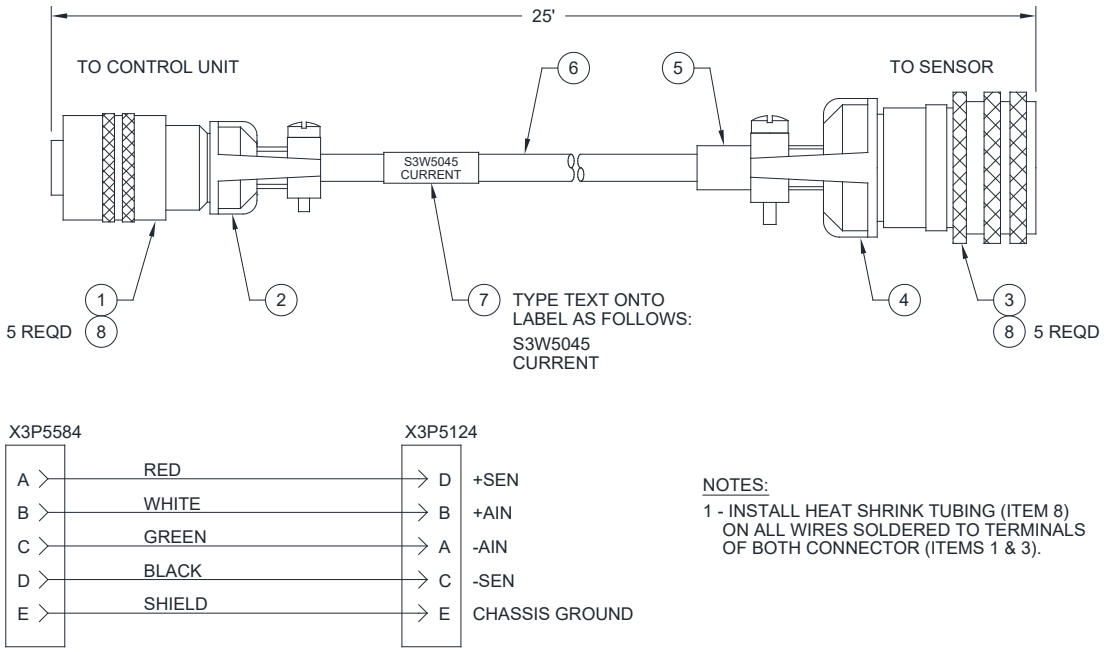
A-3 CLAMP-ON CURRENT SENSOR – P/N: X3Q5010



CONNECTOR PINOUTS		
PIN	DESCRIPTION	
A	-	OUTPUT
B	+	
C	-15V	INPUT
D	+15V	
E	COM	

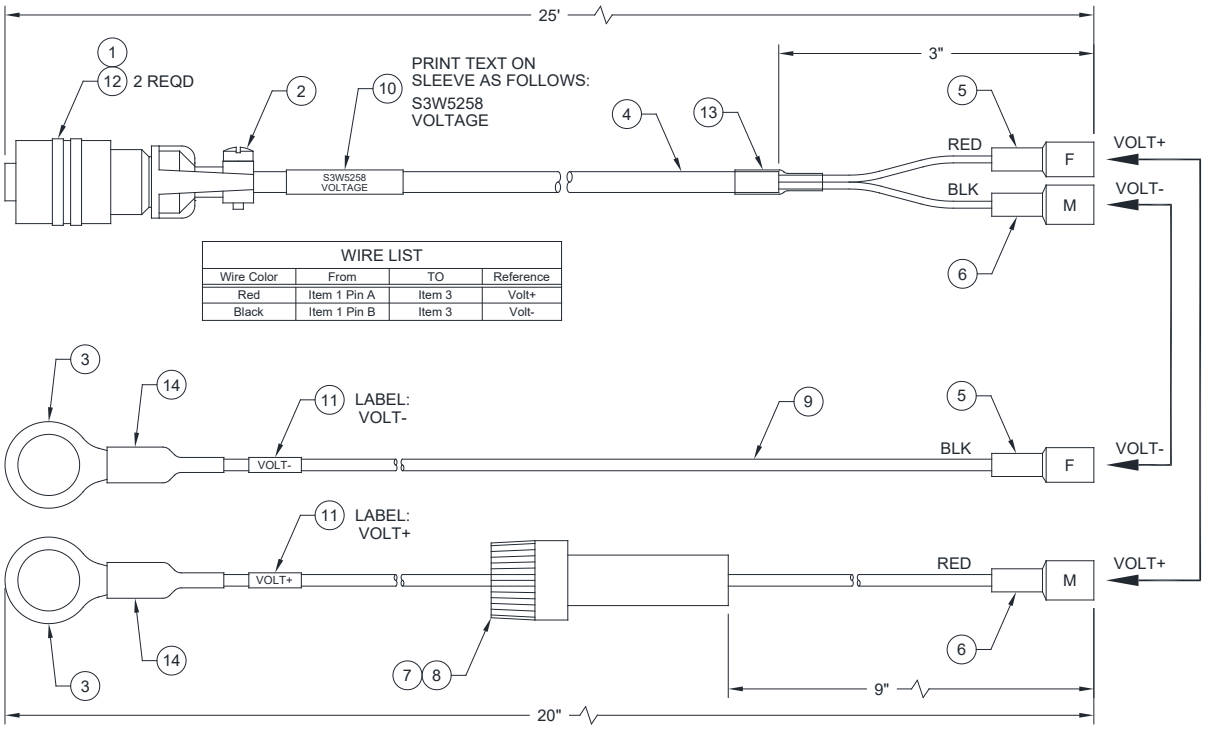
For positive output, positive current cable must enter window through “Red Dot” side of sensor.

A-4 CURRENT SENSOR CABLE – P/N: S3W5045



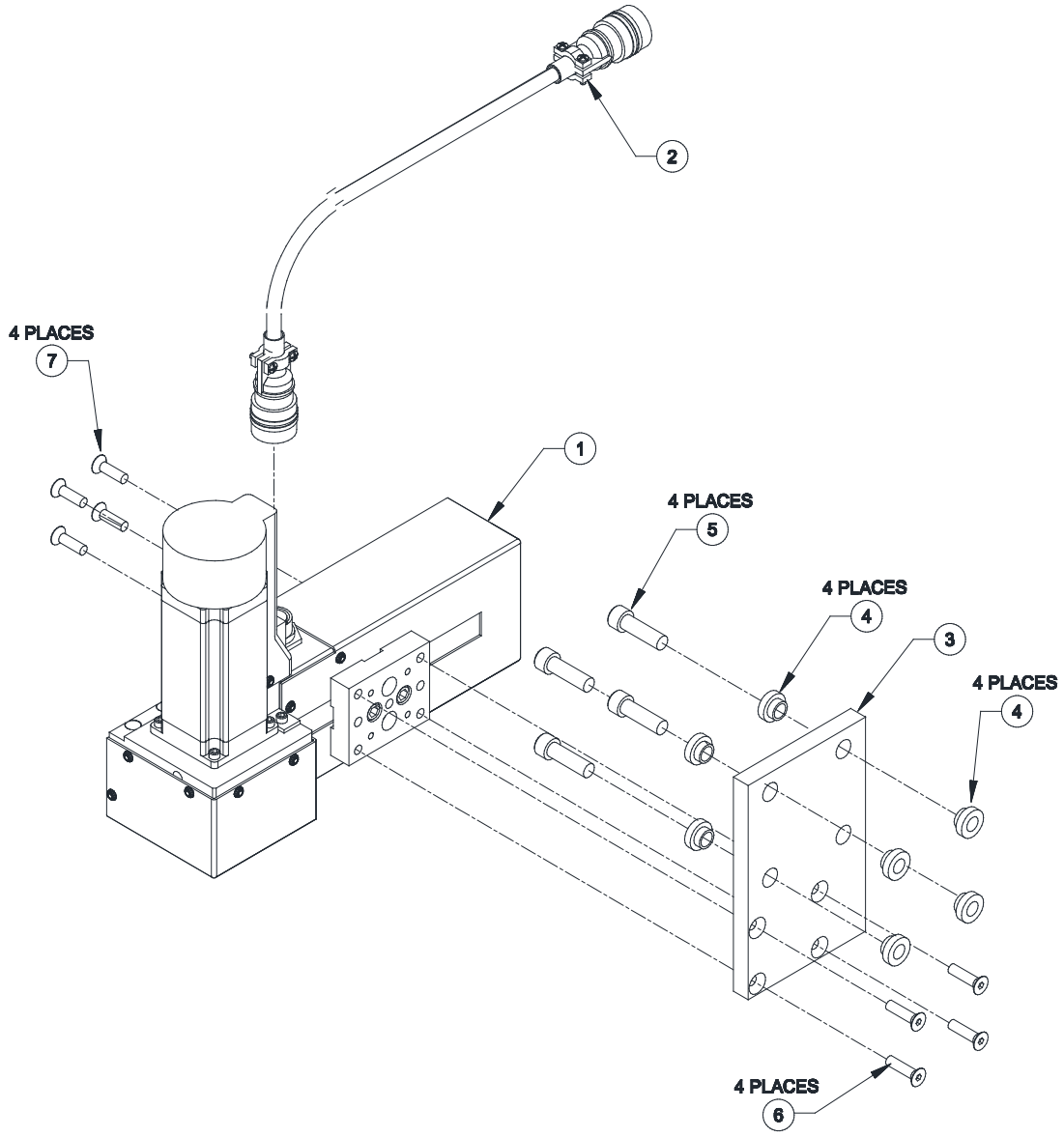
Item	Qty	CWT P/N	Description
1	1	X3P5584	Connector, Plug 5 Circuit
2	1	X3P5588	Clamp, Cable
3	1	X3P5124	Connector, Plug 5 Circuit
4	1	X3P5126	Clamp, Cable
5	1	X3P5519	Boot, Cable Clamp
6	25’	X3W5037	Cable, 4 Conductor Shielded
7	1		Sleeve, Heat Shrink Wire Marker
8	10		Tubing, Heat Shrink 1/8” Diameter x 1/2” Long

A-5 VOLTAGE SENSE CABLE – P/N: S3W5223

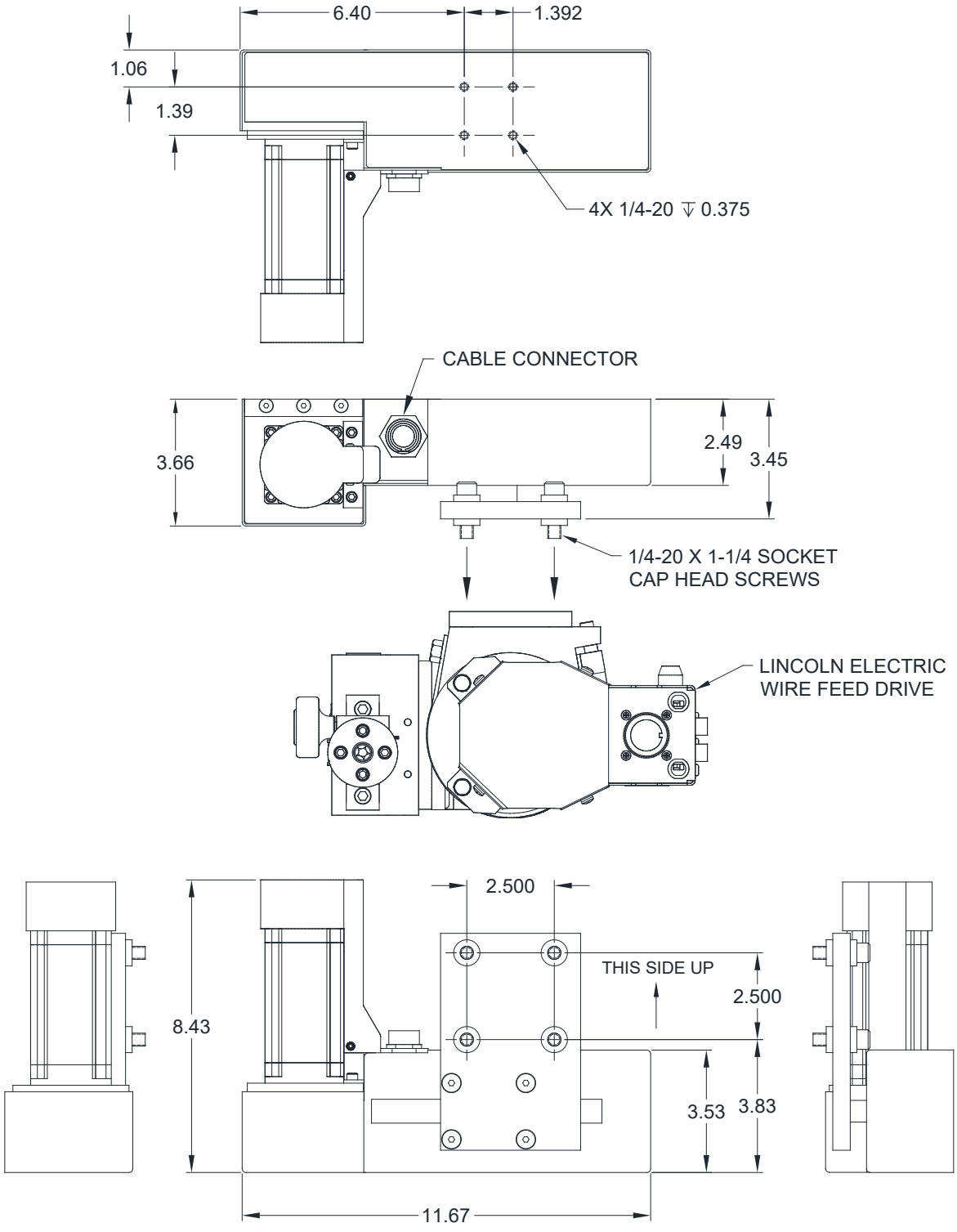


Item	Qty	CWT P/N	Description
1	1	X3P5583	Connector, Plug Cable 3 Circuit
2	1	X3P5587	Clamp, Cable
3	2	X3P5718	Terminal, Ring 1/2"
4	25’	X3W5025	Cable, 3 Conductor 22awg Shielded
5	2	X3P5419	Terminal, 1/4” Male Coupler
6	2	X3P5717	Terminal, 1/4” Female Coupler
7	3’	X3C5045	Holder, Inline Fuse 3AG
8	1	X3C5014	Fuse, 1 Amp 3AG
9	19”		Wire, 16 awg Black
10	1		Sleeve, Wire Heat Shrink
11	2		Sleeve, Wire Heat Shrink
12	2		Tubing, Heat Shrink Ø1/8" x 3/8" Long
13	1		Tubing, Heat Shrink Ø1/4" x 3/4" Long
14	2		Tubing, Heat Shrink Ø1/4" x 1" Long

A-6 HSA-2003 3” HORIZONTAL SLIDE SYSTEM – P/N: S0A5137

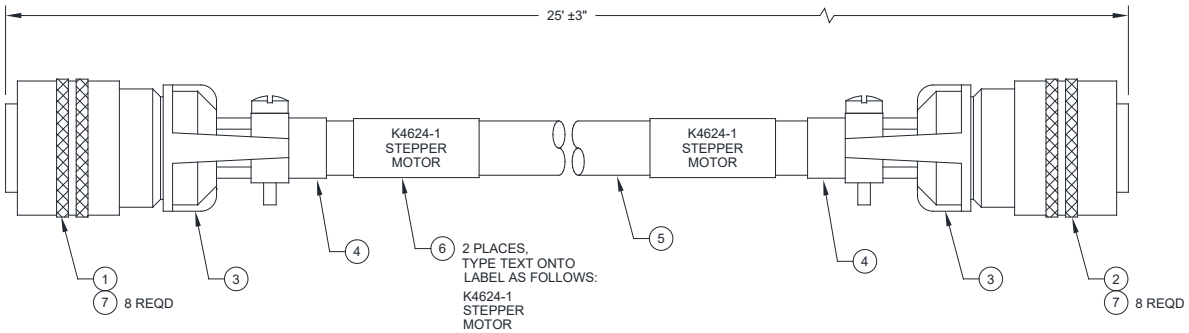


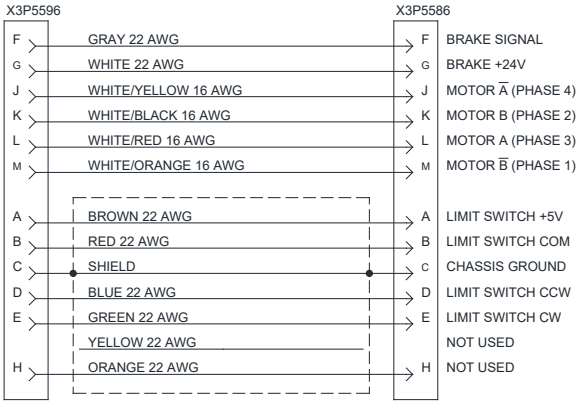
Item	Qty	CWT P/N	Description
1	1	S2A5055	Slide Assembly, HSA-2003 3” Horizontal
2	1	S3W5034	Cable, Stepper Motor 25’
3	1	S2M5237	Plate, Lincoln Wire Drive Mounting
4	8	S2M5217	Washer, Shoulder
5	4		Screw, #3/8-16 x 1-1/4” Socket Cap Head
6	4		Screw, #1/4-20 x 1” Socket Cap Head
7	4		Screw, #1/4-20 x 7/8” Socket Cap Head



HSA-2003 Mounting Dimension

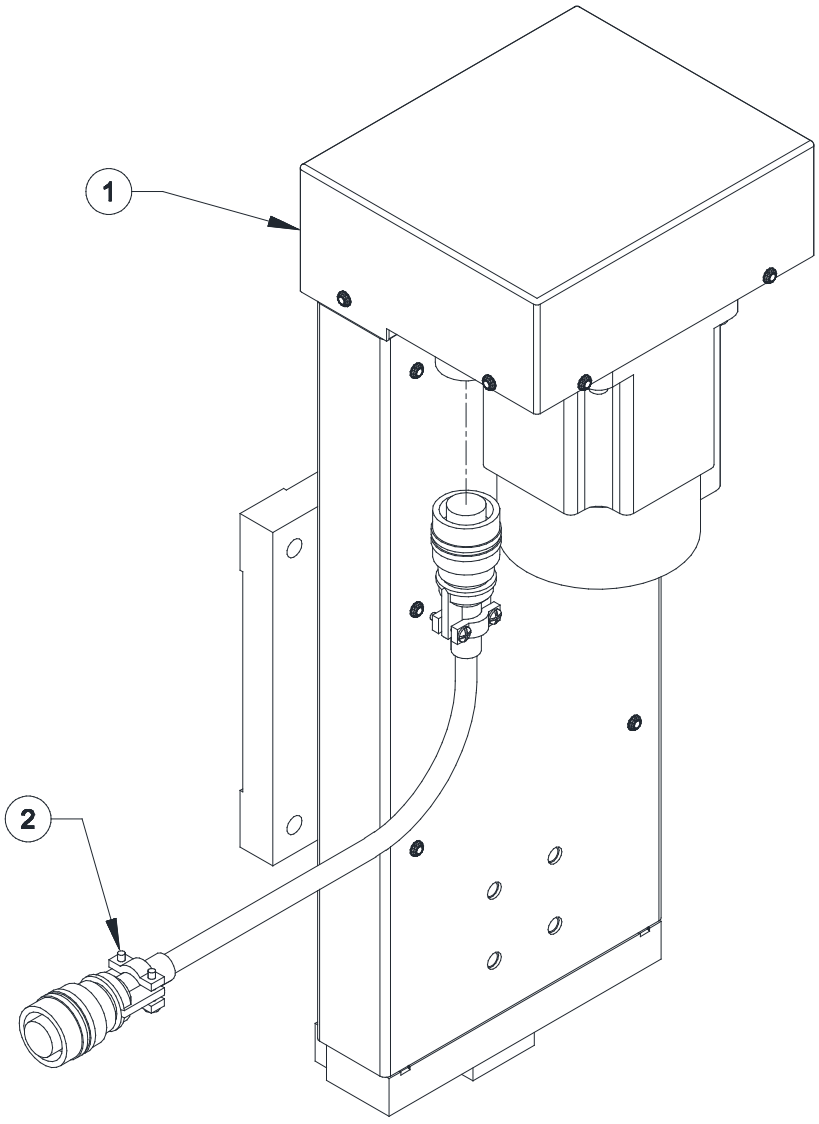
A-7 STEPPER MOTOR CABLE – P/N: S3W5034



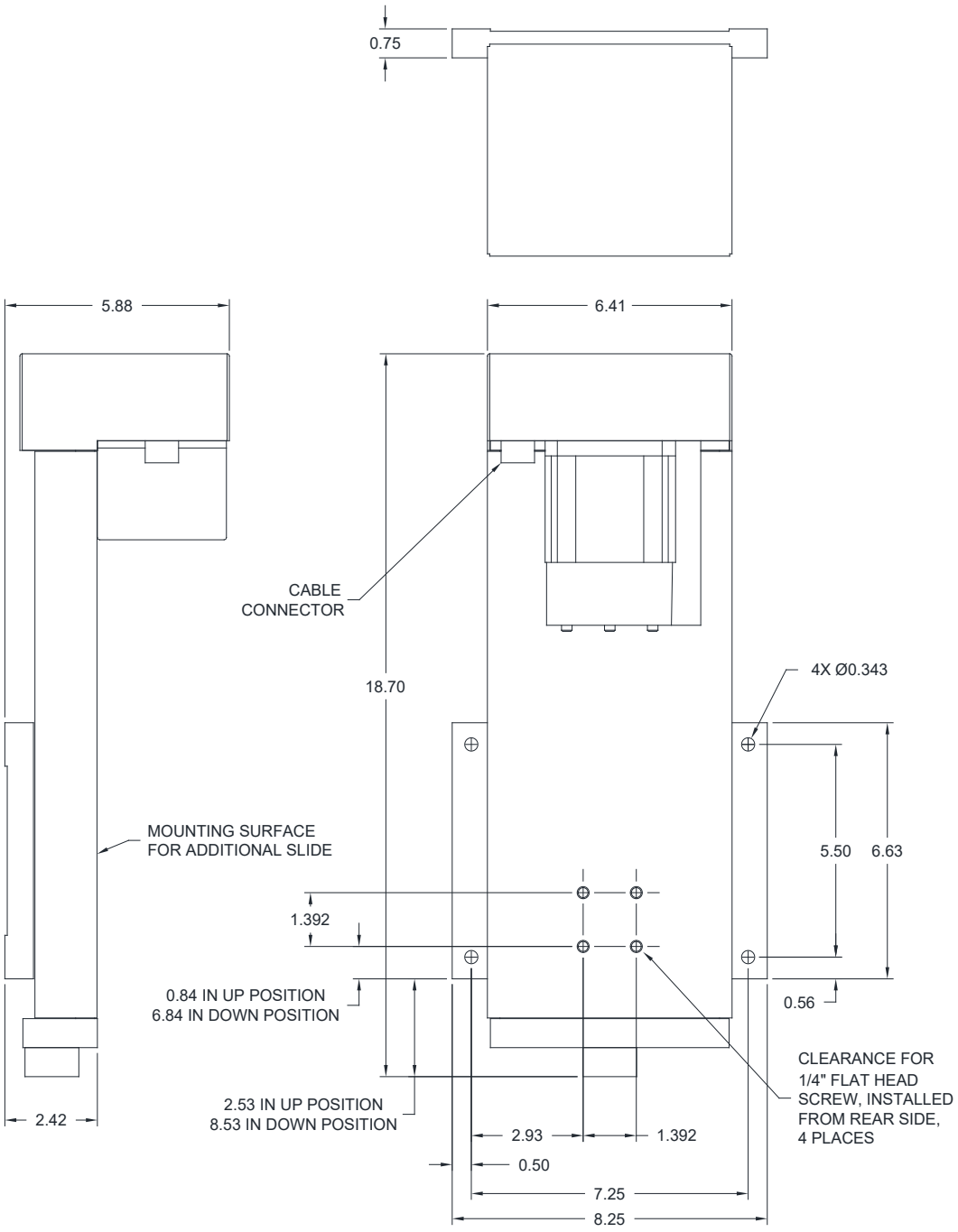


Item	Qty	CWT P/N	Description
1	1	X3P5596	Connector, Plug 12 Circuit Female
2	1	X3P5586	Connector, Plug 12 Circuit Male
3	2	X3P5589	Clamp, Cable
4	2	X3P5505	Boot, Cable Clamp
5	25’	X3W5080	Cable, CWT Custom
6	2		Sleeve, Wire Heat Shrink
7	16		Tubing, Heat Shrink Ø1/8" x 1/2" Long

A-8 VSA-2006BH VERTICAL SLIDE SYSTEM – P/N: S0A5138

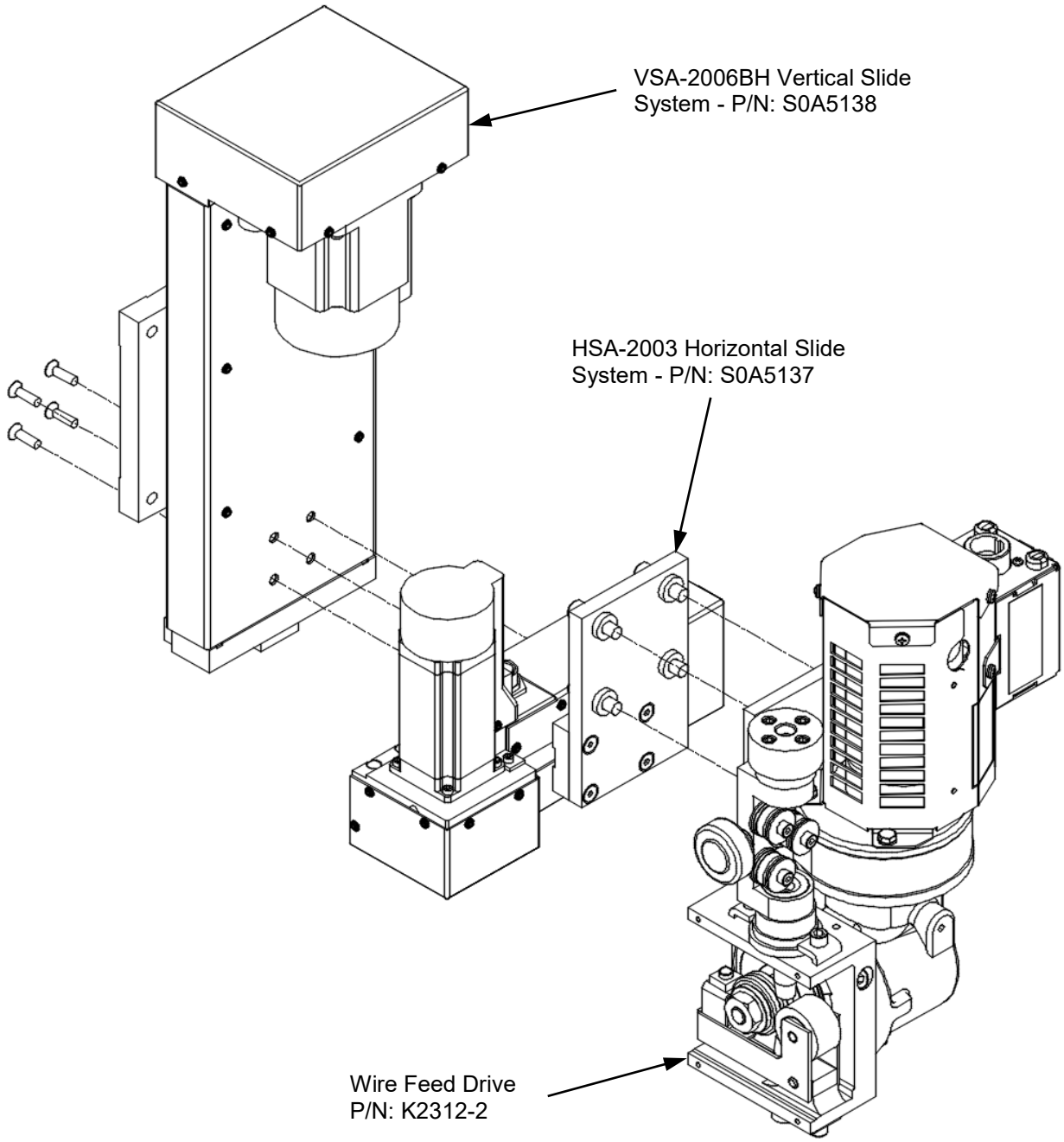


Item	Qty	CWT P/N	Description
1	1	S2M5044	Slide Assembly, VSA-2006BH 6” Vertical
2	1	S3W5034	Cable, Stepper Motor 25’



VSA-2006BH Mounting Dimension

A-9 SLIDES AND WIRE FEED DRIVE INSTALLATION DIAGRAM



			
WARNING	● Do not touch electrically live parts or electrode with skin or wet clothing. ● Insulate yourself from work and ground.	● Keep flammable materials away.	● Wear eye, ear and body protection.
Spanish **AVISO DE PRECAUCION**	● No toque las partes o los electrodos bajo carga con la piel o ropa mojada. ● Aislese del trabajo y de la tierra.	● Mantenga el material combustible fuera del área de trabajo.	● Protéjase los ojos, los oídos y el cuerpo.
French **ATTENTION**	● Ne laissez ni la peau ni des vêtements mouillés entrer en contact avec des pièces sous tension. ● Isolez-vous du travail et de la terre.	● Gardez à l'écart de tout matériel inflammable.	● Protégez vos yeux, vos oreilles et votre corps.
German **WARNUNG**	● Berühren Sie keine stromführenden Teile oder Elektroden mit Ihrem Körper oder feuchter Kleidung! ● Isolieren Sie sich von den Elektroden und dem Erdboden!	● Entfernen Sie brennbarres Material!	● Tragen Sie Augen-, Ohren- und Körperschutz!
Portuguese **ATENÇÃO**	● Não toque partes elétricas e electrodos com a pele ou roupa molhada. ● Isole-se da peça e terra.	● Mantenha inflamáveis bem guardados.	● Use proteção para a vista, ouvido e corpo.
Japanese **注意事項**	● 通電中の電気部品、又は溶材にヒフやぬれた布で触れないこと。 ● 施工物やアースから身体が絶縁されている様にして下さい。	● 燃えやすいものの側での溶接作業は絶対にしてはなりません。	● 目、耳及び身体に保護具をして下さい。
Chinese **警 告**	● 皮肤或濕衣物切勿接觸帶電部件及銲條。 ● 使你自己與地面和工件絕緣。	● 把一切易燃物品移離工作場所。	● 佩戴眼、耳及身體勞動保護用具。
Korean **위 험**	● 전도체나 용접봉을 젖은 헝겁 또는 피부로 절대 접촉치 마십시요. ● 모재와 접지를 접촉치 마십시요.	● 인화성 물질을 접근 시키지 마시요.	● 눈, 귀와 몸에 보호장구를 착용하십시요.
Arabic **تحذير**	● لا تلمس الاجزاء التي يسري فيها التيار الكهربائي أو الالكترود بجلد الجسم أو بالملابس المبللة بالماء. ● ضع عازلا على جسمك خلال العمل.	● ضع المواد القابلة للاشتعال في مكان بعيد.	● ضع أدوات وملابس واقية على عينيك وأذنيك وجسمك.

READ AND UNDERSTAND THE MANUFACTURER'S INSTRUCTION FOR THIS EQUIPMENT AND THE CONSUMABLES TO BE USED AND FOLLOW YOUR EMPLOYER'S SAFETY PRACTICES.

SE RECOMIENDA LEER Y ENTENDER LAS INSTRUCCIONES DEL FABRICANTE PARA EL USO DE ESTE EQUIPO Y LOS CONSUMIBLES QUE VA A UTILIZAR, SIGA LAS MEDIDAS DE SEGURIDAD DE SU SUPERVISOR.

LISEZ ET COMPRENEZ LES INSTRUCTIONS DU FABRICANT EN CE QUI REGARDE CET EQUIPMENT ET LES PRODUITS A ETRE EMPLOYES ET SUIVEZ LES PROCEDURES DE SECURITE DE VOTRE EMPLOYEUR.

LESEN SIE UND BEFOLGEN SIE DIE BETRIEBSANLEITUNG DER ANLAGE UND DEN ELEKTRODENEINSATZ DES HERSTELLERS. DIE UNFALLVERHÜTUNGSVORSCHRIFTEN DES ARBEITGEBERS SIND EBENFALLS ZU BEACHTEN.

			
● Keep your head out of fumes. ● Use ventilation or exhaust to remove fumes from breathing zone.	● Turn power off before servicing.	● Do not operate with panel open or guards off.	**WARNING**
● Los humos fuera de la zona de respiración. ● Mantenga la cabeza fuera de los humos. Utilice ventilación o aspiración para gases.	● Desconectar el cable de alimentación de poder de la máquina antes de iniciar cualquier servicio.	● No operar con panel abierto o guardas quitadas.	Spanish **AVISO DE PRECAUCION**
● Gardez la tête à l'écart des fumées. ● Utilisez un ventilateur ou un aspirateur pour ôter les fumées des zones de travail.	● Débranchez le courant avant l'entretien.	● N'opérez pas avec les panneaux ouverts ou avec les dispositifs de protection enlevés.	French **ATTENTION**
● Vermeiden Sie das Einatmen von Schweibrauch! ● Sorgen Sie für gute Be- und Entlüftung des Arbeitsplatzes!	● Strom vor Wartungsarbeiten abschalten! (Netzstrom völlig öffnen; Maschine anhalten!)	● Anlage nie ohne Schutzgehäuse oder Innenschutzverkleidung in Betrieb setzen!	German **WARNUNG**
● Mantenha seu rosto da fumaça. ● Use ventilação e exhaustão para remover fumo da zona respiratória.	● Não opere com as tampas removidas. ● Desligue a corrente antes de fazer serviço. ● Não toque as partes elétricas nuas.	● Mantenha-se afastado das partes moventes. ● Não opere com os paineis abertos ou guardas removidas.	Portuguese **ATENÇÃO**
● ヒュームから頭を離すようにして下さい。 ● 換気や排煙に十分留意して下さい。	● メンテナンス・サービスに取りかかる際には、まず電源スイッチを必ず切って下さい。	● パネルやカバーを取り外したままで機械操作をしないで下さい。	Japanese **注意事項**
●頭部遠離煙霧。 ●在呼吸區使用通風或排風器除煙。	●維修前切斷電源。	●儀表板打開或沒有安全罩時不準作業。	Chinese **警 告**
● 얼굴로부터 용접가스를 멀리하십시요. ● 호흡지역으로부터 용접가스를 제거하기 위해 가스제거기나 통풍기를 사용하십시요.	● 보수전에 전원을 차단하십시요.	● 판넬이 열린 상태로 작동치 마십시요.	Korean **위 험**
● ابعد رأسك بعيداً عن الدخان. ● استعمل التهوية أو جهاز ضغط الدخان للخارج لكي تبعد الدخان عن المنطقة التي تتنفس فيها.	● اقطع التيار الكهربائي قبل القيام بأية صيانة.	● لا تشغل هذا الجهاز اذا كانت الاغطية الحديدية الواقية ليست عليه.	Arabic **تحذير**

LEIA E COMPREENDA AS INSTRUÇÕES DO FABRICANTE PARA ESTE EQUIPAMENTO E AS PARTES DE USO, E SIGA AS PRÁTICAS DE SEGURANÇA DO EMPREGADOR.

使う機械や溶材のメーカーの指示書をよく読み、まず理解して下さい。そして貴社の安全規定に従って下さい。

請詳細閱讀並理解製造廠提供的説明以及應該使用的銀焊材料，並請遵守貴方的有関勞動保護規定。

이 제품에 동봉된 작업지침서를 숙지하시고 귀사의 작업자 안전수칙을 준수하시기 바랍니다.

اقرأ بتمعن وافهم تعليمات المصنع المنتج لهذه المعدات والمواد قبل استعمالها واتبع تعليمات الوقاية لصاحب العمل.

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