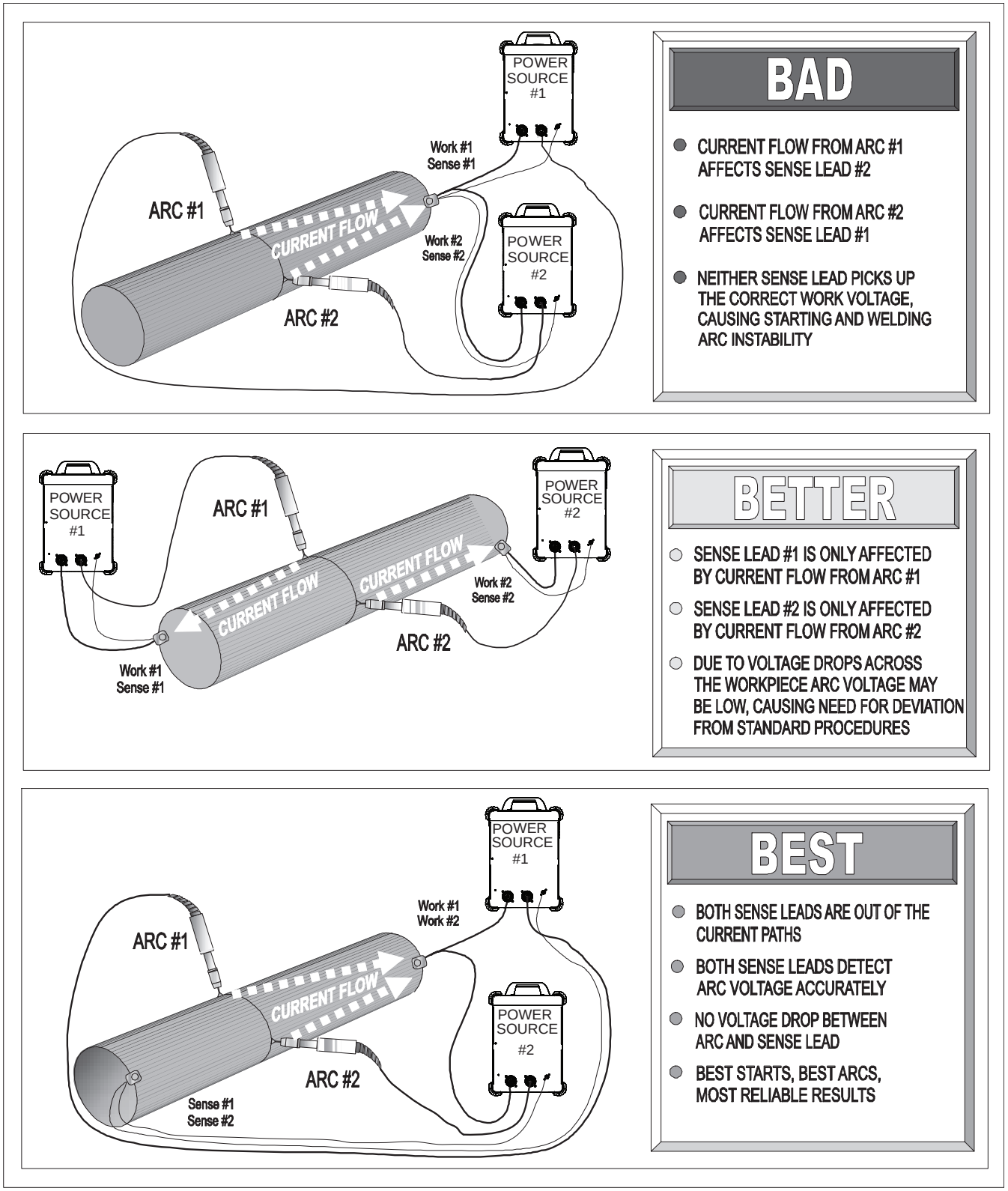
- **For circumferential applications**, connect all work leads on one side of the weld joint, and all of the work voltage sense leads on the opposite side, such that they are out of the current path.

(See Figure A.7)

FIGURE A.7



CONTROL CABLE CONNECTIONS

General Guidelines

Genuine Lincoln control cables should be used at all times (except where noted otherwise). Lincoln cables are specifically designed for the communication and power needs of the Power Wave® / Power Feed™ systems. Most are designed to be connected end to end for ease of extension. Generally, it is recommended that the total length not exceed 100ft. (30.5m). The use of non-standard cables, especially in lengths greater than 25 feet, can lead to communication problems (system shutdowns), poor motor acceleration (poor arc starting), and low wire driving force (wire feeding problems). Always use the shortest length of control cable possible, and DO NOT coil excess cable.

Regarding cable placement, best results will be obtained when control cables are routed separate from the weld cables. This minimizes the possibility of interference between the high currents flowing through the weld cables, and the low level signals in the control cables. These recommendations apply to all communication cables including ArcLink® and Ethernet connections.

Product specific Installation Instructions

Connection Between Power Source and ArcLink® Compatible Wirefeeders (K1543, K2683 – ArcLink Control Cable)

The 5-pin ArcLink control cable connects the power source to the wire feeder. The control cable consists of two power leads, one twisted pair for digital communication, and one lead for voltage sensing. The 5-pin ArcLink connection on the Power Wave® R450 is located on the rear panel (See Case Back Controls in the Operation Section). The control cable is keyed and polarized to prevent improper connection. Best results will be obtained when control cables are routed separate from the weld cables, especially in long distance applications. The recommended combined length of the ArcLink control cable network should not exceed 200ft. (61.0m).

Connection Between Power Source and Ethernet Networks

The POWER WAVE® R450 is equipped with an IP67 rated ODVA compliant RJ-45 Ethernet connector, which is located on the rear panel. All external Ethernet equipment (cables, switches, etc.), as defined by the connection diagrams, must be supplied by the customer. It is critical that all Ethernet cables external to either a conduit or an enclosure are solid conductor, shielded cat 5e cable, with a drain. The drain should be grounded at the source of transmission. For best results, route Ethernet cables away from weld cables, wire drive control cables, or any other current carrying device that can create a fluctuating magnetic field. For additional guidelines refer to ISO/IEC 11801. Failure to follow these recommendations can result in an Ethernet connection failure during welding.

OPERATION

SAFETY PRECAUTIONS

Read this entire section of operating instructions before operating the machine.

⚠ WARNING

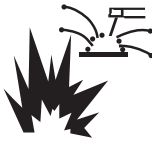
ELECTRIC SHOCK can kill.

- **Do not touch electrically live part or electrode with skin or wet clothing.**
- **Insulate yourself from work and ground.**
- **Always wear dry insulating gloves.**
- **Do not operate with covers, panels or guards removed or open.**

FUMES AND GASES can be dangerous.

- **Keep your head out of fumes.**
- **Use ventilation or exhaust to remove fumes from breathing zone.**

WELDING SPARKS can cause fire or explosion.



- **Keep flammable material away.**
- **Do not weld on containers that have held combustibles.**

ARC RAYS can burn.

- **Wear eye, ear, and body protection.**

Observe additional guidelines detailed in the beginning of this manual.

POWER-UP SEQUENCE

When the POWER WAVE® R450 is powered up, it can take as long as 30 seconds for the machine to be ready to weld. During this time period the user interface will not be active.

DUTY CYCLE

The duty cycle is based on a ten-minute period. A 40% duty cycle represents 4 minutes of welding and 6 minutes of idling in a ten-minute period. Refer to the technical specification section for the POWER WAVE® R450's duty cycle ratings.

GRAPHIC SYMBOLS THAT APPEAR ON THIS MACHINE OR IN THIS MANUAL

WARNING OR CAUTION

DANGEROUS VOLTAGE

POSITIVE OUTPUT

NEGATIVE OUTPUT

HIGH TEMPERATURE

STATUS

PROTECTIVE GROUND

COOLER

OUTPUT

OPERATORS MANUAL

WORK

CIRCUIT BREAKER

EXPLOSION

PRODUCT DESCRIPTION

The POWER WAVE® R450 is a portable multi-process power source with high-end functionality capable of Stick, DC TIG, MIG, Pulsed MIG and Flux-Cored welding. It is ideal for a wide variety of materials including aluminum, stainless, and nickel — where arc performance is critical.

The POWER WAVE® R450 is designed to be a very flexible welding system. Like existing Power Wave's®, the software based architecture allows for future upgradeability. One significant change from the current range of Power Wave® units is that the Ethernet communication feature is standard on the POWER WAVE® R450 which allows for effortless software upgrades through Powerwavesoftware.com. The Ethernet communication also gives the POWER WAVE® R450 the ability to run Production Monitoring™ 2. A Devicenet option allows the POWER WAVE® R450 to be used in a wide range of configurations and the POWER WAVE® R450 is designed to be compatible with advanced welding modules like STT.

RECOMMENDED PROCESSES AND EQUIPMENT

The POWER WAVE® R450 is recommended for robotic and semiautomatic welding. The Power Wave® R450 can be set up in a number of configurations, some requiring optional equipment or welding programs.

Recommended Processes

The POWER WAVE® R450 is a high speed, multi-process power source capable of regulating the current, voltage, or power of the welding arc. With an output range of 5 to 550 amperes, it supports a number of standard processes including synergic GMAW, GMAW-P, FCAW, FCAW-SS, SMAW, GTAW and GTAW-P on various materials especially steel, aluminum and stainless.

PROCESS LIMITATIONS

The software based weld tables of the POWER WAVE® R450 limit the process capability within the output range and the safe limits of the machine. In general the processes will be limited to .030-.052 solid steel wire, .030 -.045 stainless wire, .035 -1/16 cored wire, and .035 - 1/16 Aluminum wire.

EQUIPMENT LIMITATIONS

Only ArcLink compatible semiautomatic wire feeders and users interfaces may be used. If other Lincoln wire feeders or non-Lincoln wire feeders are used there will be limited process capability and performance and features will be limited.

The Power Wave R450's are not compatible with the S-Series user Interface Kit.

CASE FRONT CONTROLS

(See Figure B.1)

1. **Status LED** - (See Troubleshooting Section for operational functions).
2. **Thermal LED** - Indicates when machine has thermal fault.
3. **FEEDER Status LED** - A two color LED that indicates system errors. The Power Wave R450 is equipped with two indicators. One is for the inverter power source, while the other indicates the status of the feeder control system. Normal operation is a steady green light. For more information and a detailed listing, see the troubleshooting section of this document or the Service Manual for this machine. (See Troubleshooting Section for operational functions.)

NOTE: The Power Wave R450 status light will flash green, and sometimes red and green, for up to one minute when the machine is first turned on. This is a normal situation as the machine goes through a self test at power up.

4. **Power Switch -** Controls power to the POWER WAVE® R450.
5. **NEGATIVE WELD OUTPUT**
6. **POSITIVE WELD OUTPUT**
7. **Voltage Sense Connector -** Allows for separate remote electrode and work sense leads.

VOLTAGE SENSE PINS		
Pin	**Lead**	**Function**
3	21	Work Voltage Sense
1	67E	Electrode Voltage Sense

FIGURE B.1 for K3451-1, K3451-2, K3456-1

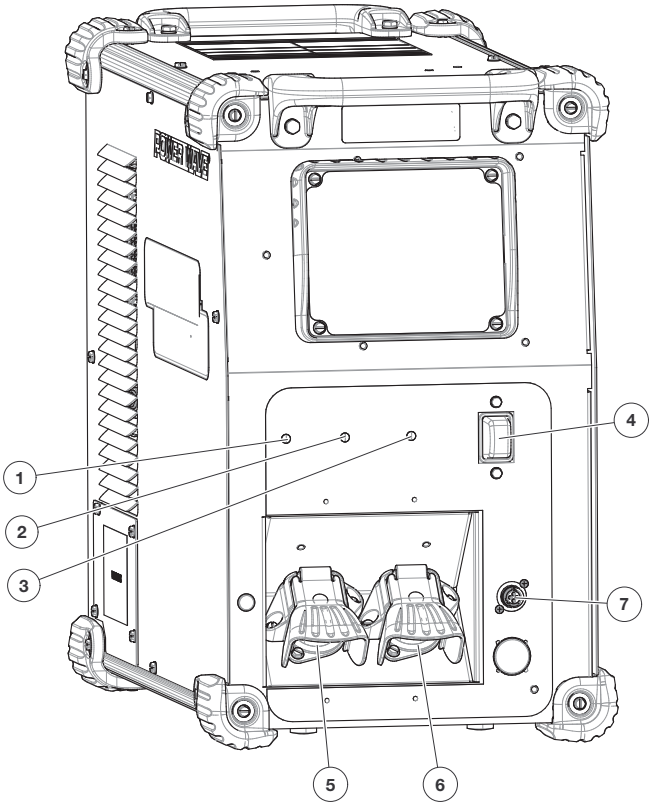
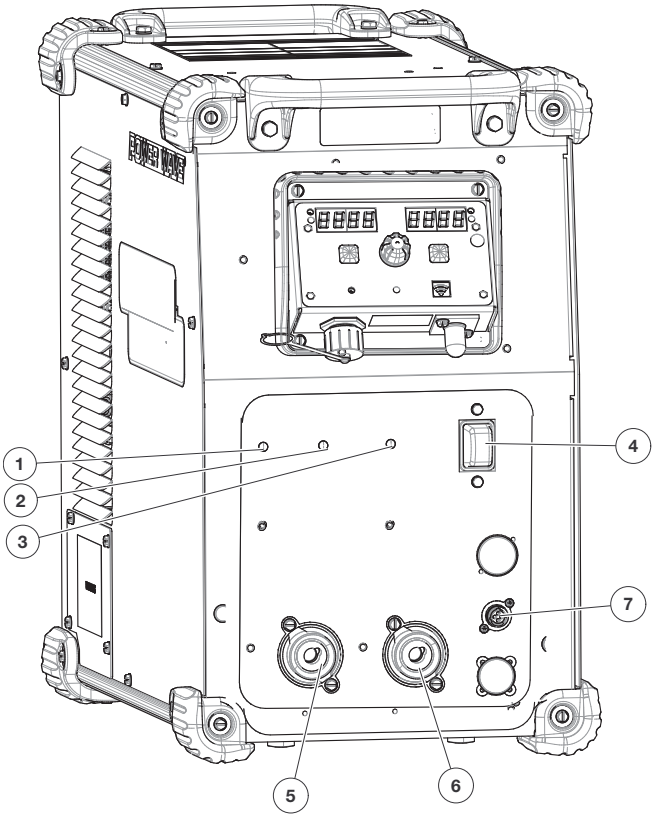


FIGURE B.1- for K3455-1 & K3455-2



CASE BACK CONTROLS

(See Figure B.2)

1. **115 VAC RECEPTACLES (Optional Kit - K2829-1)**
2. **WIRE FEEDER RECEPTACLE (14 Pin) -** Robotic wire feeder connector (for 4R220, Power Feed 10 Robotic, etc).
3. **DIFFERENTIAL I/O CONNECTOR -** For (Optional) K2902-1 STT or K2912-1 Advanced Module.
4. **ArcLink OUTPUT CONNECTOR (5 PIN) -** Provides power and communication to ArcLink periferals (semi-automatic feeder, Cool Arc 55S, etc).
5. **Devicenet Kit (optional - K2827-2) -** For PLC control.
6. **40V CIRCUIT BREAKER**
7. **Ethernet (SHIELDED) -** For ArcLink XT enabled robot, computer or network connection.
8. **External I/O CONNECTOR -** Terminal Strip for making simple input signal connections. (See Figure B.2A)

   The terminal strip is divided into three groups:

   Group #1 - TRIGGER

   Group #2 - FEED FORWARD/REVERSE

   Group #3 - SHUTDOWN INPUTS

   All inputs use "normally open" logic except the shutdown group. The shutdown inputs use "normally closed" logic, and are always enabled. Unused shutdowns must be tied to the +15V supply for the shutdown group. Machines are shipped from the factory with jumpers installed on both shutdown inputs.

FIGURE B.2A

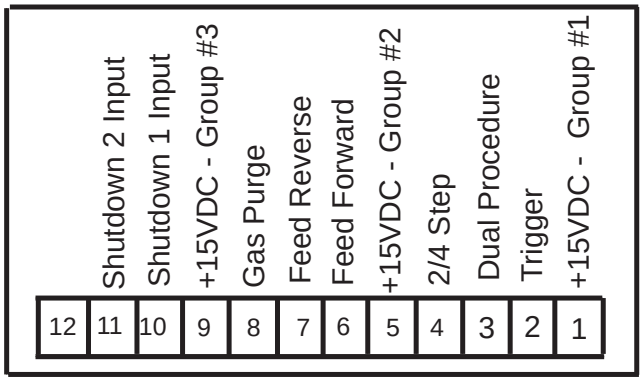
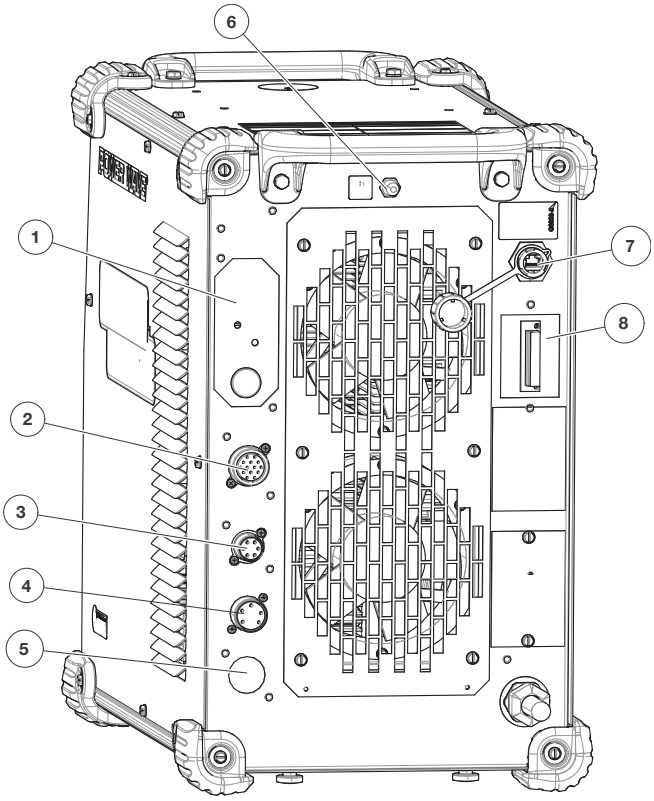


FIGURE B.2



COMMON WELDING PROCEDURES

Making a Weld

The serviceability of a product or structure utilizing the welding programs is and must be the sole responsibility of the builder/user. Many variables beyond the control of The Lincoln Electric Company affect the results obtained in applying these programs. These variables include, but are not limited to, welding procedure, plate chemistry and temperature, weldment design, fabrication methods and service requirements. The available range of a welding program may not be suitable for all applications, and the builder is and must be solely responsible for welding program selection.

Choose the electrode material, electrode size, shielding gas, and process (GMAW, GMAW-P etc.) appropriate for the material to be welded.

Select the weld mode that best matches the desired welding process. The standard weld set shipped with the POWER WAVE® R450 encompasses a wide range of common processes that will meet most needs. If a special weld mode is desired, contact the local Lincoln Electric sales representative.

All adjustments are made through the user interface. Because of the different configuration options your system may not have all of the following adjustments.

See Accessories Section for Kits and Options available to use with the POWER WAVE® R450.

DEFINITION OF WELDING MODES

NON-SYNERGIC WELDING MODES

- A Non-synergic welding mode requires all welding process variables to be set by the operator.

SYNERGIC WELDING MODES

- A Synergic welding mode offers the simplicity of single knob control. The machine will select the correct voltage and amperage based on the Wire Feed Speed (WFS) set by the operator.

BASIC WELDING CONTROLS

Weld Mode

Selecting a weld mode determines the output characteristics of the Power Wave® power source. Weld modes are developed with a specific electrode material, electrode size, and shielding gas. For a more complete description of the weld modes programmed into the POWER WAVE® R450 at the factory, refer to the Weld Set Reference Guide supplied with the machine or available at www.powerwavesoftware.com.

Wire Feed Speed (WFS)

In synergic welding modes (synergic CV, GMAW-P), WFS is the dominant control parameter. The user adjusts WFS according to factors such as wire size, penetration requirements, heat input, etc. The POWER WAVE® R450 then uses the WFS setting to adjust the voltage and current according to settings contained in the POWER WAVE®.

In non-synergic modes, the WFS control behaves like a conventional power source where WFS and voltage are independent adjustments. Therefore, to maintain proper arc characteristics, the operator must adjust the voltage to compensate for any changes made to the WFS.

Amps

In constant current modes, this control adjusts the welding amperage.

Volts

In constant voltage modes, this control adjusts the welding voltage.

Trim

In pulse synergic welding modes, the Trim setting adjusts the arc length. Trim is adjustable from 0.50 to 1.50. 1.00 is the nominal setting and is a good starting point for most conditions.

UltimArc™ Control

UltimArc™ Control allows the operator to vary the arc characteristics. UltimArc™ Control is adjustable from –10.0 to +10.0 with a nominal setting of 0.0.

SMAW (STICK) WELDING

The welding current and Arc Force settings can be set through a Power Feed™ 84 or Power Feed™ 25M wire feeder. Alternatively an optional Stick / Tig UI can be installed into the power source to control these settings locally.

In a SMAW (STICK mode), Arc Force can be adjusted. It can be set to the lower range for a soft and less penetrating arc characteristic (negative numeric values) or to the higher range (positive numeric values) for a crisp and more penetrating arc. Normally, when welding with cellulosic types of electrodes (E6010, E7010, E6011), a higher energy arc is required to maintain arc stability. This is usually indicated when the electrode sticks to the workpiece or when the arc becomes unstable during manipulative technique. For low hydrogen types of electrodes (E7018, E8018, E9018, etc.) a softer arc is usually desirable and the lower end of the Arc Control suits these types of electrodes. In either case the arc control is available to increase or decrease the energy level delivered to the arc.

GTAW (TIG) WELDING

The welding current can be set through a Power Feed™ 84 or Power Feed™ 25M wire feeder. Alternatively an optional Stick / Tig UI can be installed into the power source to control these settings locally.

The TIG mode features continuous control from 5 to 550 amps with the use of an optional foot amptrol. The POWER WAVE® R450 can be run in either a Touch Start TIG mode or Scratch start TIG mode.

CONSTANT VOLTAGE WELDING

Synergic CV

For each wire feed speed, a corresponding voltage is preprogrammed into the machine through special software at the factory.

The nominal preprogrammed voltage is the best average voltage for a given wire feed speed, but may be adjusted to preference. When the wire feed speed changes, the POWER WAVE® R450 automatically adjusts the voltage level correspondingly to maintain similar arc characteristics throughout the WFS range.

Non Synergic CV

In non-synergic modes, the WFS control behaves more like a conventional CV power source where WFS and voltage are independent adjustments. Therefore to maintain the arc characteristics, the operator must adjust the voltage to compensate for any changes made to the WFS.

All CV Modes

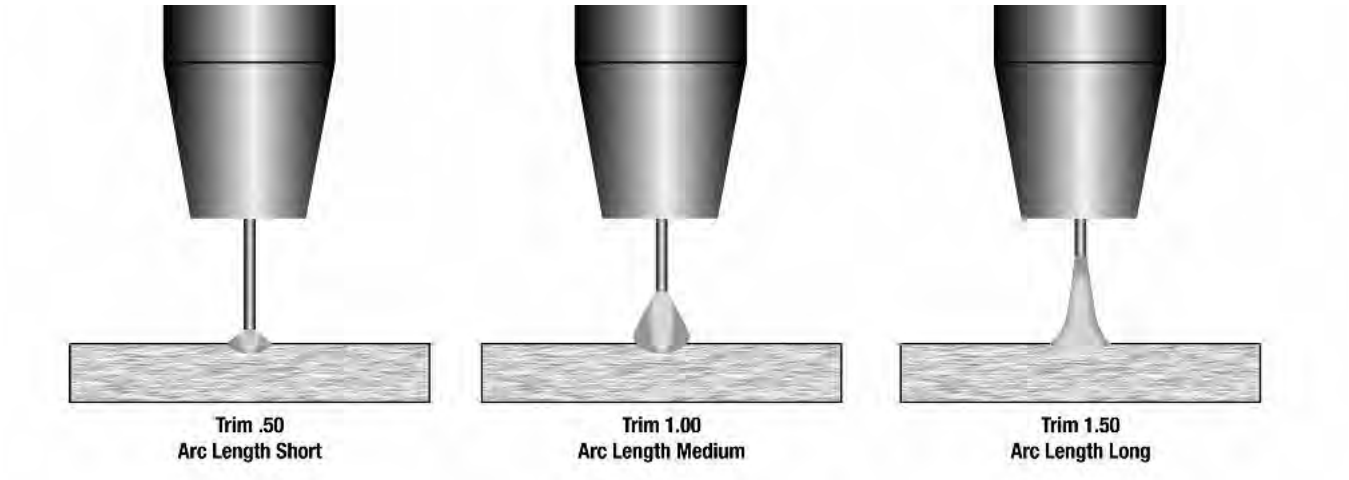
Pinch adjusts the apparent inductance of the wave shape. The "pinch" function is inversely proportional to inductance. Therefore, increasing Pinch Control greater than 0.0 results in a crisper arc (more spatter) while decreasing the Pinch Control to less than 0.0 provides a softer arc (less spatter).

PULSE WELDING

Pulse welding procedures are set by controlling an overall "arc length" variable. When pulse welding, the arc voltage is highly dependent upon the waveform. The peak current, back ground current, rise time, fall time and pulse frequency all affect the voltage. The exact voltage for a given wire feed speed can only be predicted when all the pulsing waveform parameters are known. Voltage or Trim can be adjusted.

Trim adjusts the arc length and ranges from 0.50 to 1.50 with a nominal value of 1.00. Trim values greater than 1.00 increase the arc length, while values less than 1.00 decrease the arc length. (See figure B.3)

FIGURE B.3

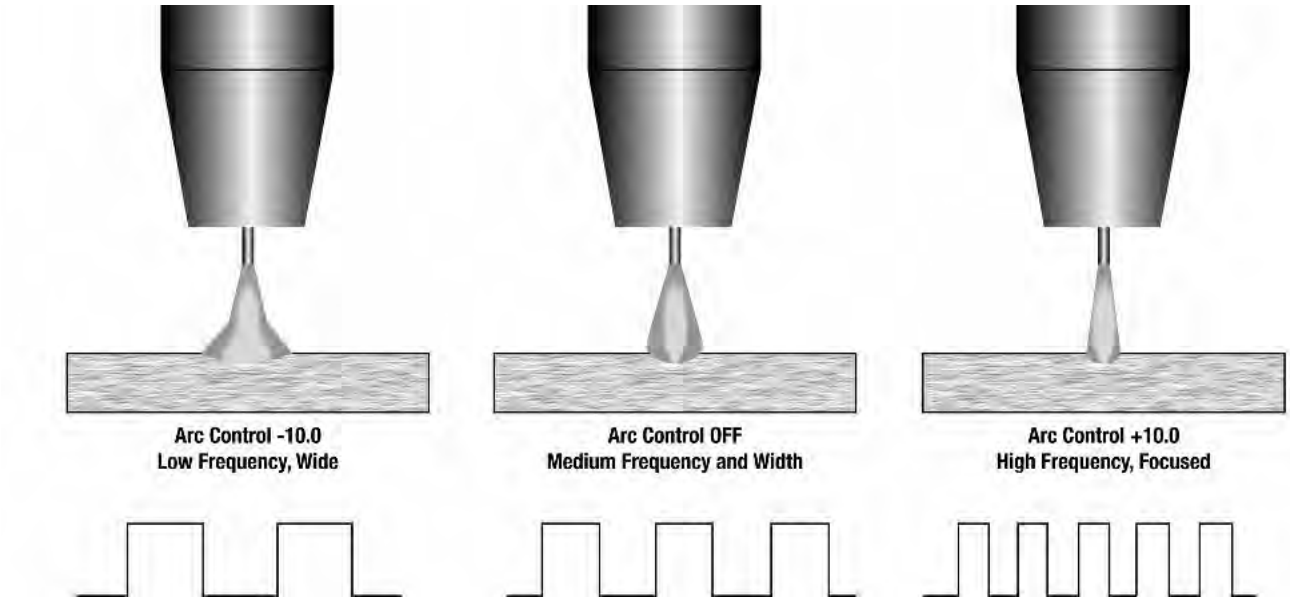


Most pulse welding programs are synergic. As the wire feed speed is adjusted, the POWER WAVE® R450 will automatically recalculate the waveform parameters to maintain similar arc properties.

The POWER WAVE® R450 utilizes “adaptive control” to compensate for changes in the electrical stick-out while welding. (Electrical stick-out is the distance from the contact tip to the work piece.) The POWER WAVE® R450 waveforms are optimized for a 0.75” stick-out. The adaptive behavior supports a range of stick-outs from 0.50 to 1.25”. At very low or high wire feed speeds, the adaptive range may be less due to reaching physical limitations of the welding process.

UltimArc™ Control adjusts the focus or shape of the arc. UltimArc™ Control is adjustable from -10.0 to +10.0 with a nominal setting of 0.0. Increasing the UltimArc™ Control increases the pulse frequency and background current while decreasing the peak current. This results in a tight, stiff arc used for high speed sheet metal welding. Decreasing the UltimArc™ Control decreases the pulse frequency and background current while increasing the peak current. This results in a soft arc good for out of position welding. (See Figure B.4)

FIGURE B.4

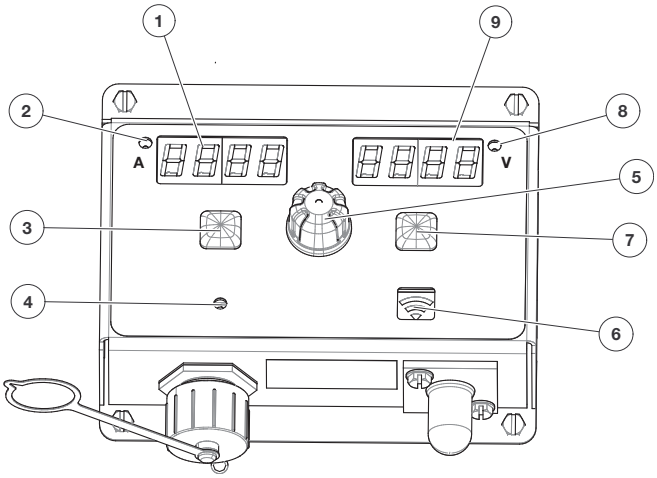


CONNECTIVITY MODULE

If the Power Wave® is equipped with a K4352-1 connectivity module, a digital display is available to show welding feedback values and change communication parameters. See Figure 1.

When the machine is idle and there are no errors, the display will read ---- ----. During welding, the display will read the welding amperage on the left display, and the welding voltage on the right display. After welding, the last amperage and voltage reading will persist for a short time on the display before returning to ---- ----.

FIGURE 1



1. **Left DISPLAY window -** Shows amperage or value of alternative display.
2. **Left INDICATOR light** - Illuminates when amperage is displayed.
3. **Left BUTTON** - Moves back within menus and cancels selections.
4. **Bluetooth STATUS INDICATOR light** - Illuminates only when actively communicating with the Power Wave® using Bluetooth.
5. **Selection KNOB -** Scrolls through menu options and adjusts displayed values.
6. **Wi-Fi STATUS INDICATOR light** - Displays the status of the Wi-Fi connection if Wi-Fi is enabled.
7. **Right BUTTON -** Enters menus and confirms selections.
8. **Right INDICATOR light -** Illuminates when voltage is displayed.
9. **Right DISPLAY window -** Displays voltage or units of alternative display.

NAVIGATING THE USER CONFIGURATION MENU

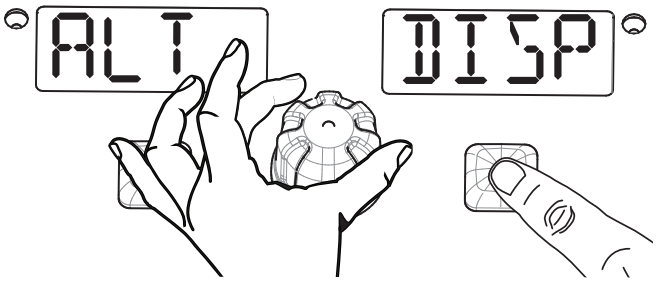
Simultaneously press the Left BUTTON and the Right BUTTON to enter the User Configuration menu. Use the Selection KNOB to scroll through options, the Right BUTTON to make a selection, and the Left Button to return to the previous display. The available options are summarized in the table below. To exit the User Configuration menu, scroll to EXIT and press the Right BUTTON, or press the Left and Right BUTTON simultaneously. The display will return to ---- ---- after a period of inactivity.

	
Configure an additional feedback display to show while welding. See Configuring an Additional Display for details.	
	
Displays the IP address of the Ethernet port on the front of the machine. See Front Ethernet Port Settings for details.	
	
Displays the IP address of the Ethernet port on the rear of the machine. See Rear Ethernet Port Settings for details.	
	
Enables or disables Wi-Fi, or places it into configuration mode. Allows viewing the IP address of the Wi-Fi adapter. See Wi-Fi Settings for details.	
	
Enables or disables Bluetooth. Allows viewing the Bluetooth name of the machine. See Bluetooth Settings for details.	

CONFIGURING AN ADDITIONAL DISPLAY

By default, the display will show welding amperage and voltage during welding. It is possible to choose an additional value to be displayed. When an additional value is enabled, the display will show amperage and voltage for five seconds, then the chosen value for five seconds.

To choose an additional value, use the Selection KNOB to select ALT DISP from the User Configuration menu and press the Right BUTTON. Then use the Selection KNOB to select the desired alternative value to display.



Press the Right BUTTON to enter the ALT DISP menu, then use the Selection KNOB to find the value to display. Press the Right BUTTON again to select the value, or the left BUTTON to cancel the selection.

The following values can be choosen:

ENERGY - True Energy™

MOTR CURR - Wire drive motor current

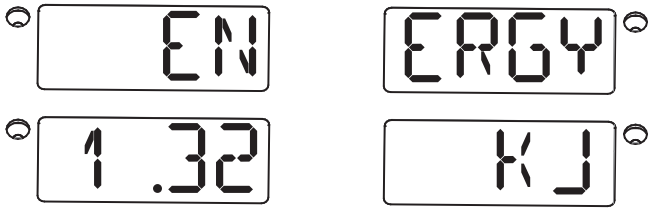
WELD SCOR - WeldScore™

WFS IPM - Wire feed speed in inches per minute

WFS MPM - Wire feed speed in meters per minute

NONE - disable additional display

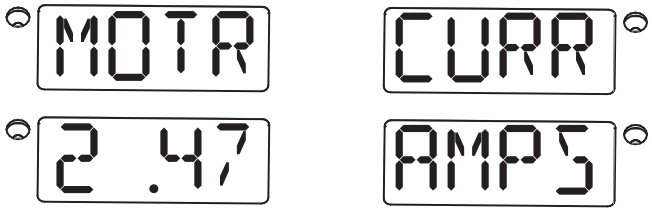
Displaying True Energy™



To display True Energy™, select EN ERGY from the ALT DISP menu.

Every five seconds while welding, the display will show True Energy™ on the Left DISPLAY with the units on the Right DISPLAY. The units will change from joules (J), kilojoules (kJ), and megajoules (MJ), as appropriate.

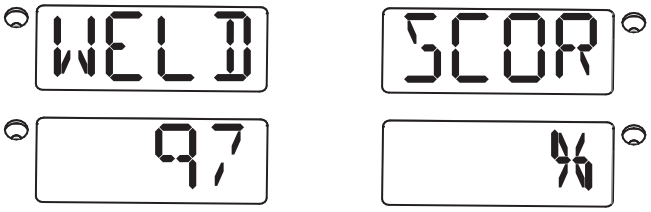
Displaying Motor Current



To display wire feeder motor current, select MOTR CURR from the ALT DISP menu.

Every five seconds while welding, the display will show motor current in amperes on the Left DISPLAY with AMPS on the Right DISPLAY.

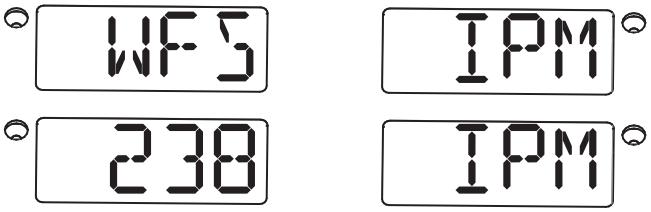
Displaying WeldScore™



To display WeldScore™, select WELD SCOR from the ALT DISP menu.

Every five seconds while welding, the display will show the instantaneous WeldScore™ percentage on the Left DISPLAY and a percent sign on the Right DISPLAY.

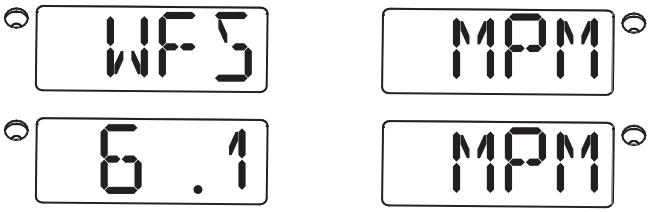
Displaying Wire Feed Speed in Inches per Minute



To display wire feed speed feedback in inches per minute, select WFS IPM from the ALT DISP menu.

Every five seconds while welding, the display will show the wire feed speed on the Left DISPLAY and IPM on the Right DISPLAY.

Displaying Wire Feed Speed in Meters per Minute



To display wire feed speed feedback in meters per minute, select WFS MPM from the ALT DISP menu.

Every five seconds while welding, the display will show the wire feed speed on the Left DISPLAY and MPM on the Right DISPLAY.

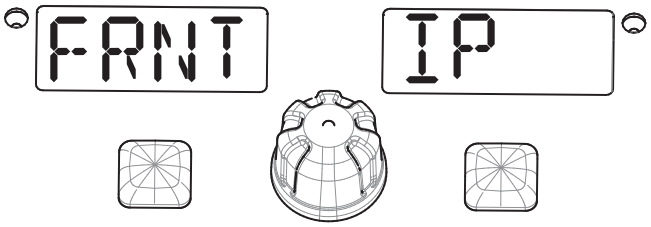
Disabling the Alternative Display

For no alternative display, select NONE from the ALT DISP menu.

While welding, the Left DISPLAY will show welding current in amperes and the Right DISPLAY will show welding voltage in volts.

FRONT ETHERNET PORT SETTINGS

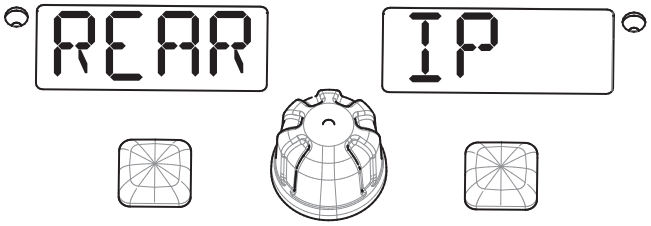
To view the IP address of the Ethernet port on the front of the Power Wave®, use the Selection KNOB to select FRNT IP from the User Configuration menu and press the Right BUTTON.



Press the Right BUTTON to select the FRNT IP item to display the front part's IP address. Press the left BUTTON to return to the menu.

REAR ETHERNET PORT SETTINGS

To view the IP address of the Ethernet port on the rear of the Power Wave®, use the Selection KNOB to select REAR IP from the User Configuration menu and press the Right BUTTON.



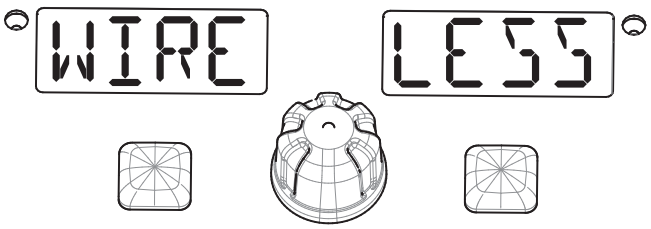
Press the Right BUTTON to select REAR IP item to display the rear part's IP Address. Press the left BUTTON to return to the menu.

WI-FI SETTINGS

To view or change the settings for the Power Wave® Wi-Fi connection, use the Selection KNOB to select WIRE LESS from the User Configuration menu and press the Right BUTTON.

Note: Machines shipped from the factory have the Wi-Fi radio disabled. You must enable the Wi-Fi radio using the options described in this section before attempting to connect to the Power Wave® using Wi-Fi.

Note: For more information on how to connect to your Power Wave®, or to learn how to configure advanced settings, refer to the Help Me Connect Guide and the Power Wave® Manager user manual, available from www.powerwavesoftware.com.



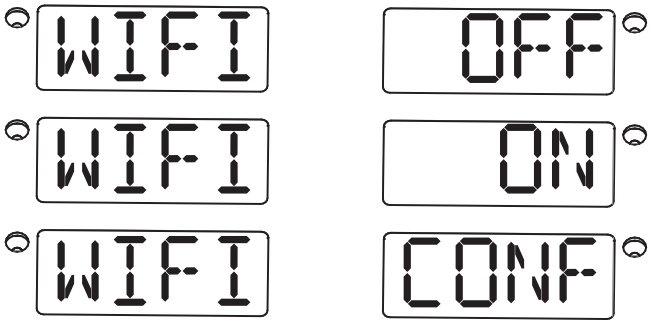
Press the Right BUTTON to enter the WIRELESS menu, then use the Selection KNOB to choose the desired option. Press the Right BUTTON again to make a selection, or the Left BUTTON to canvel the selection.

The following can be choosen:

WIFI ON/OFF/CONF - Enable or disable Wi-Fi, or place the Wi-Fi in configuration mode.

IP ADDR - Display the Power Wave's Wi-Fi IP address,

Enabling or Disabling Wi-Fi

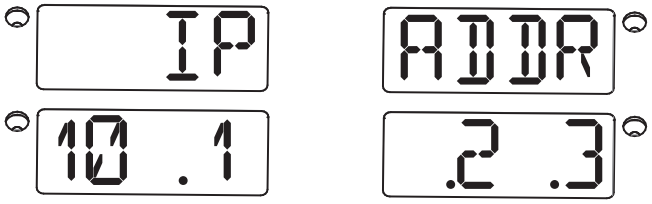


If Wi-Fi is disabled, WIFI OFF will be displayed. If Wi-Fi is enabled, WIFI ON will be displayed. If the Wi-Fi adapter is in configuration mode, WIFI CONF will be displayed. Configuration mode is used to configure the Wi-Fi network settings. Refer to the Help Me Connect Guide on www.powerwavesoftware.com for details.

To change the setting, press the Right BUTTON while WIFI OFF, WIFI ON, or WIFI CONF is displayed. The word ON, OFF, or CONF will blink. Use the Selection KNOB to change the setting. Press the Right BUTTON to confirm the selection, or press the Left BUTTON to cancel the selection.

Note: Machines shipped from the factory have the Wi-Fi radio disabled. You must enable the Wi-Fi radio using this setting before attempting to connect to the Power Wave® using Wi-Fi.

Displaying the Wi-Fi IP Address



To display the IP address of the Wi-Fi adapter, select IP ADDR from the WIRE LESS menu.

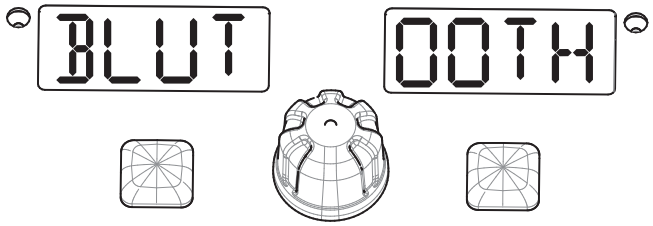
The display will show the current IP address for the Wi-Fi adapter.

BLUETOOTH SETTINGS

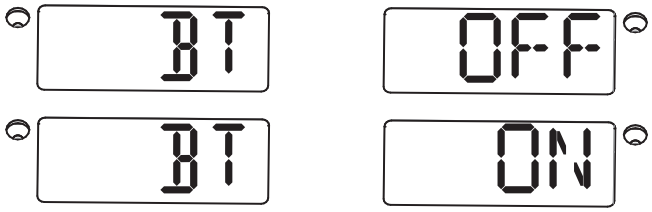
To view or change the settings for the Power Wave® Bluetooth connection, use the Selection KNOB to select BLUT OOTH from the User Configuration menu and press the Right BUTTON.

Note: Machines shipped from the factory have the Bluetooth radio disabled. You must enable the Bluetooth radio using the options described in this section before attempting to connect to the Power Wave® using Bluetooth.

Note: For more information on how to connect to your Power Wave®, or to learn how to configure advanced settings, refer to the Help Me Connect Guide and the Power Wave® Manager user manual, available from www.powerwavesoftware.com.



Enabling or Disabling Bluetooth

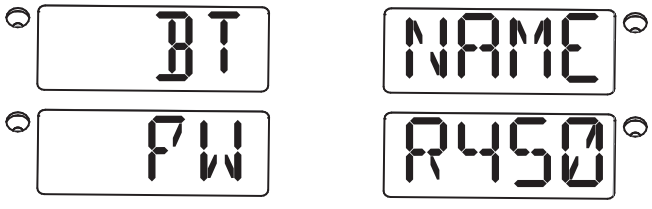


If Bluetooth is disabled, BT ON will be displayed. If Bluetooth is enabled, BT OFF will be displayed.

To change the setting, press the Right BUTTON while BT OFF, or BT ON is displayed. The word ON or OFF will blink. Use the Selection KNOB to change the setting. Press the Right BUTTON to confirm the selection, or press the Left BUTTON to cancel the selection.

Note: Machines shipped from the factory have the Bluetooth radio disabled. You must enable the Bluetooth radio using this setting before attempting to connect to the Power Wave® using Bluetooth.

Displaying the Bluetooth Name



To display the name of the Power Wave® used to identify it as a Bluetooth device, select BT NAME.

The display will show the current Bluetooth name for the Power Wave®. This name can be used when pairing the Power Wave® to a computer or other device with Bluetooth.

WI-FI STATUS INDICATOR LIGHT

The green Wi-Fi STATUS INDICATOR light indicates the connection type and uses the three “bars” to indicate the strength of the Wi-Fi signal. The meanings of the indications are summarized in the table below.

All “Bars” Off	Wi-Fi is disabled; or, Wi-Fi is enabled and the connection is very poor or nonexistent.
Bottom-Most “Bar” On Solid Green, Others Off	Wi-Fi is enabled and connected; the signal strength is poor.
Two Bottom-Most “Bars” On Solid Green, Others Off	Wi-Fi is enabled and connected; the signal strength is good.
All Three “Bars” On Solid Green	Wi-Fi is enabled and connected; the signal strength is excellent.
“Bars” Illuminate in Tandem, from Lowest to Highest	Wi-Fi is in configuration mode. Configuration mode is used to configure the Wi-Fi network settings. Refer to the Help Me Connect Guide on www.powerwavesoftware.com for details.

BLUETOOTH STATUS INDICATOR LIGHT

The blue Bluetooth STATUS INDICATOR light indicates the status of the Bluetooth connection.

Indicator is Off	Bluetooth is disabled; or, Bluetooth is enabled but there is no device actively communicating with the Power Wave® using the Bluetooth connection.
Indicator is On	Bluetooth is enabled and a device is actively communicating with the Power Wave® using the Bluetooth connection.

OPTIONS / ACCESSORIES

All Kits Options and Accessories are found on the Web site:
(www.lincolnelectric.com)

Welding Fume Extractors
Lincoln offers a wide range of fume extraction environmental system solutions, ranging from portable systems easily wheeled around a shop to shop-wide central systems servicing many dedicated welding stations.
Request Lincoln publication E13.40
(See **www.lincolnelectric.com**)

MAINTENANCE

Safety Precautions

⚠ WARNING

ELECTRIC SHOCK can kill.

- **Do not operate with covers removed.**
- **Turn off power source before installing or servicing.**
- **Do not touch electrically hot parts.**
- **Turn the input power to the welding power source off at the fuse box before working in the terminal strip.**
- **Only qualified personnel should install, use or service this equipment.**

See additional warning information throughout this Operator's Manual

ROUTINE MAINTENANCE

Routine maintenance consists of periodically blowing out the machine, using a low-pressure air stream, to remove accumulated dust and dirt from the intake and outlet louvers, and the cooling channels in the machine.

PERIODIC MAINTENANCE

Calibration of the POWER WAVE® R450 is critical to its operation. Generally speaking the calibration will not need adjustment. However, neglected or improperly calibrated machines may not yield satisfactory weld performance. To ensure optimal performance, the calibration of output Voltage and Current should be checked yearly.

CALIBRATION SPECIFICATION

Output Voltage and Current are calibrated at the factory. Generally the machine calibration will not need adjustment. However, if the weld performance changes, or the yearly calibration check reveals a problem, use the calibration section of thePower Wave Manager to make the appropriate adjustments.

The calibration procedure itself requires the use of a grid, and certified actual meters for voltage and current. The accuracy of the calibration will be directly affected by the accuracy of the measuring equipment you use. SVM251 VERIFICATION AND CALIBRATION PROCEDURES includes detailed instructions at www.powerwavesoftware.com.

TROUBLESHOOTING

HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

Service and Repair should only be performed by Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and machine operator and will invalidate your factory warranty. For your safety and to avoid Electrical Shock, please observe all safety notes and precautions detailed throughout this manual.

This Troubleshooting Guide is provided to help you locate and repair possible machine malfunctions. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM).

Look under the column labeled "PROBLEM (SYMPTOMS)". This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting.

Step 2. POSSIBLE CAUSE.

The second column labeled "POSSIBLE CAUSE" lists the obvious external possibilities that may contribute to the machine symptom.

Step 3. RECOMMENDED COURSE OF ACTION

This column provides a course of action for the Possible Cause, generally it states to contact your local Lincoln Authorized Field Service Facility.

If you do not understand or are unable to perform the Recommended Course of Action safely, contact your local Lincoln Authorized Field Service Facility.

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your Lincoln Authorized Service Facility for technical troubleshooting assistance before you proceed.

WWW.LINCOLNELECTRIC.COM/LOCATOR

USING THE STATUS LED TO TROUBLESHOOT SYSTEM PROBLEMS

Not all of the POWER WAVE® R450 errors will be displayed on the user interface (if it is installed). There are two status lights that display error codes. If a problem occurs it is important to note the condition of the status lights. Therefore, prior to cycling power to the system, check the power source status light for error sequences as noted below.

There is one externally mounted status light located on the case front of the machine. This status light corresponds to the main control board and input control board's status.

Included in this section is information about the Status Lights and some basic troubleshooting charts for both machine and weld performance.

The status light for the main control board and input control board are dual-color LED's. Normal operation for each is steady green.

Error conditions are indicated in the following chart Table E.1.

TABLE E.1

Light Condition	Meaning
	Main control board status light and Input control board
Steady Green	System OK. Power source is operational, and is communicating normally with all healthy peripheral equipment connected to its ArcLink network.
Blinking Green	Occurs during power up or a system reset, and indicates the POWER WAVE® R450 is mapping (identifying) each component in the system. Normal for first 1-10 seconds after power is turned on, or if the system configuration is changed during operation.
Fast Blinking Green	Indicates Auto-mapping has failed
Alternating Green and Red	Non-recoverable system fault. If the Status lights are flashing any combination of red and green, errors are present. **Read the error code(s) before the machine is turned off.**
	Error Code interpretation through the Status light is detailed in the Service Manual. Individual code digits are flashed in red with a long pause between digits. If more than one code is present, the codes will be separated by a green light. Only active error conditions will be accessible through the Status Light.
	Error codes can also be retrieved with the **Power Wave Manager Utility** available at **www.powerwavesoftware.com**). This is the preferred method, since it can access historical information contained in the error logs.
	To clear the active error(s), turn power source off, and back on to reset.
Steady Red	Not applicable.
Blinking Red	Not applicable.
Status LED off	Not applicable.

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your Lincoln Authorized Service Facility for technical troubleshooting assistance before you proceed.
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Observe all Safety Guidelines detailed throughout this manual

ERROR CODES FOR THE POWER WAVE® R450

The following is a partial list of possible error codes for the POWER WAVE® R450. For a complete listing consult the Power Wave Manager "Lookup Error".

MAIN CONTROL BOARD ("STATUS" LIGHT)	
Error Code #	**Indication**
36 Thermal error	Indicates over temperature. Usually accompanied by Thermal LED. Check fan operation. Be sure process does not exceed duty cycle limit of the machine
54 Secondary (Output) over current error	The long term average secondary (weld) current limit has been exceeded. **NOTE:** The long term average secondary current limit is 325A (1 Phase) or 575A (3 Phase).
56 Chopper communication error	Indicates communication link between main control board and chopper has errors. If cycling the input power on the machine does not clear the error, contact the Service Department.
58 Primary Fault error	Review error code from input board status light or status beeper. Most likely caused by an over power condition which caused an under voltage on the primary bus. If cycling the input power on the machine does not clear the error, contact the Service Department.
71 Secondary (Output) over power error	The long term secondary (Weld) power limit has been exceeded. NOTE: The long term average secondary current limit is 25kw (3 Phase), 14kw (1 Phase).
Other	Error codes that contain three or four digits are defined as fatal errors. These codes generally indicate internal errors on the Power Source Control Board. If cycling the input power on the machine does not clear the error, contact the Service Department.

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your Lincoln Authorized Service Facility for technical troubleshooting assistance before you proceed.

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INPUT CONTROL BOARD

Error Code #	Indication	Type
331 Instantaneous Input Current Limit	Instantaneous input current limit has been exceeded. Typically indicates short term power overload. If problem persists contact Service Department.	Persistent
334 Startup Current Check Failure	Input current limit was exceeded during machine power-up. If problem persists contact Service Department.	Persistent
335 Startup Voltage Check Failure	Input voltage was too high or too low during machine power-up. Verify that the input voltage is between 200V and 650V.	Temporary
336 Thermal Fault	Thermostat on primary module tripped. Typically caused by a fan malfunction or blocked air vent.	Temporary
337 Precharge Timeout	The DC bus voltage was not charged to a certain level at end of precharge. If problem persists contact Service Department.	Persistent
338 Input Power Limit	The input power drawn by the machine exceeded a safe level. If problem persists, contact the Service Department.	Persistent
341 Input Voltage Dropout	The input voltage momentarily dropped out. Check connections and verify quality of input power.	Temporary
346 Transformer Primary Overcurrent	Transformer current too high. Typically indicates short-term power overload. If problem persists, contact the Serivce Department.	Persistent
347 Average Input Current Limit	Average input current limit has been exceeded. Typically indicates short term power overload. If problem persists contact Service Department.	Persistent
349 Bus Undervoltage	The DC bus voltage dropped below the allowable limit. If problem persists, contact the Service Department.	Temporary

Persistent errors require power to be cycled for the error to clear.
Temporary faults will go away on their own if the error condition is removed.

WIRE DRIVE MODULE

Error Code #	Indication
81 Motor Overload	Long term average motor current limit has been exceeded. Typically indicates mechanical overload of system. If problem continues consider higher torque gear ratio (lower speed range).
82 Motor Overcurrent	Absolute maximum motor current level has been exceeded. This is a short term average to protect drive circuitry.
83 Shutdown #1 Is Open	1.This refers to the 'green' I/O connector on the bottom of the controller. If not being externally accessed, verify the integrity of the connector and jumper. If accessed through a remote circuit, verify the integrity of that circuit.
84 Shutdown #2 Is Open	1.This refers to the 'green' I/O connector on the bottom of the controller. If not being externally accessed, verify the integrity of the connector and jumper. If accessed through a remote circuit, verify the integrity of that circuit.

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your Lincoln Authorized Service Facility for technical troubleshooting assistance before you proceed.
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Observe all Safety Guidelines detailed throughout this manual

PROBLEMS (SYMPTOMS)	POSSIBLE CAUSE	RECOMMENDED COURSE OF ACTION
Basic Machine Problems		
Input fuses keep blowing	1. Improperly sized input fuses.	1. Make sure fuses are properly sized. See installation section of this manual for recommended sizes.
	2. Improper Weld Procedure requiring output levels in excess of machine rating.	2. Reduce output current, duty cycle, or both.
	3. Major physical or electrical damage is evident when the covers are removed.	3. Contact your local authorized Lincoln Electric Field Service facility for technical assistance.
Machine will not power up (no lights)	1. No Input Power	1. Make sure input supply disconnect has been turned ON. Check input fuses. Make certain that the Power Switch (SW1) on the power source is in the "ON" position.
	2. Input voltage is too low or too high.	2. Make certain that input voltage is correct, according to the Rating Plate located on the rear of the machine.
Machine won't weld, can't get any output. This problem will normally be accompanied by an error code. See "Status Light" section of this document for additional information.	1. Input voltage is too low or too high.	1. Make certain that input voltage is correct, according to the Rating Plate located on the rear of the machine.
	2. Thermal Error.	2. See "Thermal LED is ON" section.
	3. Secondary current limit has been exceeded. (see error 54)	3. Possible short in output circuit. If condition persists, contact an authorized Lincoln Electric Field Service facility.
	3a. Input control board fault (see input control board error status).	

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your Lincoln Authorized Service Facility for technical troubleshooting assistance before you proceed.
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Observe all Safety Guidelines detailed throughout this manual

PROBLEMS (SYMPTOMS)	POSSIBLE CAUSE	RECOMMENDED COURSE OF ACTION
Basic Machine Problems (Continued)		
Thermal LED is ON	1. Improper fan operation.	1. Check for proper fan operation. Fan should run in a low speed setting when the machine is idle and increase in speed as the machine temperature increases. Check for material blocking intake or exhaust louvers, or for excessive dirt clogging cooling channels in machine.
	2. Open thermostat circuit.	2. Check for broken wires, open connections or faulty thermostats in the thermostat circuit.
"Real Time Clock" no longer functioning	1. Control PC Board Battery.	1. Replace the battery (Type: BS2032)
Weld and Arc Quality Problems		
General degradation of weld performance	1. Wire feed problem.	1. Check for feeding problems.
	2. Cabling problems.	2. Check for bad connections, excessive loops in cable, etc. **NOTE:** The presence of heat in the external welding circuit indicates poor connections or undersized cables.
	3. Loss of, or improper Shielding Gas.	3. Verify gas flow and type are correct.
	4. Verify weld mode is correct for process.	4.Select the correct weld mode for the application.
	5. Machine calibration.	5. The power source may require calibration. (current, voltage, WFS).

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your Lincoln Authorized Service Facility for technical troubleshooting assistance before you proceed.
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Observe all Safety Guidelines detailed throughout this manual

PROBLEMS (SYMPTOMS)	POSSIBLE CAUSE	RECOMMENDED COURSE OF ACTION
Weld and Arc Quality Problems (Continued)		
Wire burns back to tip at the end of the weld.	1. Burnback Time	1. Reduce burnback time and/or work point.
Machine output shuts down during a weld.	1. Secondary current limit has been exceeded, and the machine shuts down to protect itself.	1. Adjust procedure or reduce load to lower current draw from the machine.
	2. System Fault	2. A non-recoverable fault will interrupt welding. This condition will also result in a status light blinking. See the Status Light section for more information.
Machine won't produce full output.	1. Input voltage may be too low, limiting output capability of the power source.	1. Make certain that the input voltage is proper, according to the Rating Plate located on the rear of the machine.
	2. The input may be single phase.	2. Verify all 3 phases are present.
	3. Machine calibration.	3. Calibrate secondary current and voltage.
Excessively long and erratic arc.	1. Wire feed problem.	1. Check for feeding problems. Make sure proper gear ratio has been selected.
	2. Loss of, or improper Shielding Gas	2. Verify gas flow and type are correct
	3. Machine calibration.	3. Calibrate secondary current and voltage.

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your Lincoln Authorized Service Facility for technical troubleshooting assistance before you proceed.
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Observe all Safety Guidelines detailed throughout this manual

PROBLEMS (SYMPTOMS)	POSSIBLE CAUSE	RECOMMENDED COURSE OF ACTION
Ethernet		
Cannot Connect	1. Physical connection.	1. Verify that the correct patch cable or cross over cable is being used (refer to local IT department for assistance). 1a. Verify the cables are fully inserted into the bulk head connector. 1b. The LED under the PC board ethernet connector will be lit when the machine is connected to another network device.
	2. IP address information.	2. Use the appropriate PC utility to verify the correct IP address information has been entered. 2a. Verify no duplicate IP addresses exist on the network.
	3. Ethernet Speed	3. Verify that the network device connected to the Power Wave is either a 10-baseT device or a 10/100-baseT device. 10-baseT is recommended
Connection Drops while welding	1. Cable Location	1. Verify Network cable is not located next to current carrying conductors. This would include input power cables and welding output cables.

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact your Lincoln Authorized Service Facility for technical troubleshooting assistance before you proceed.
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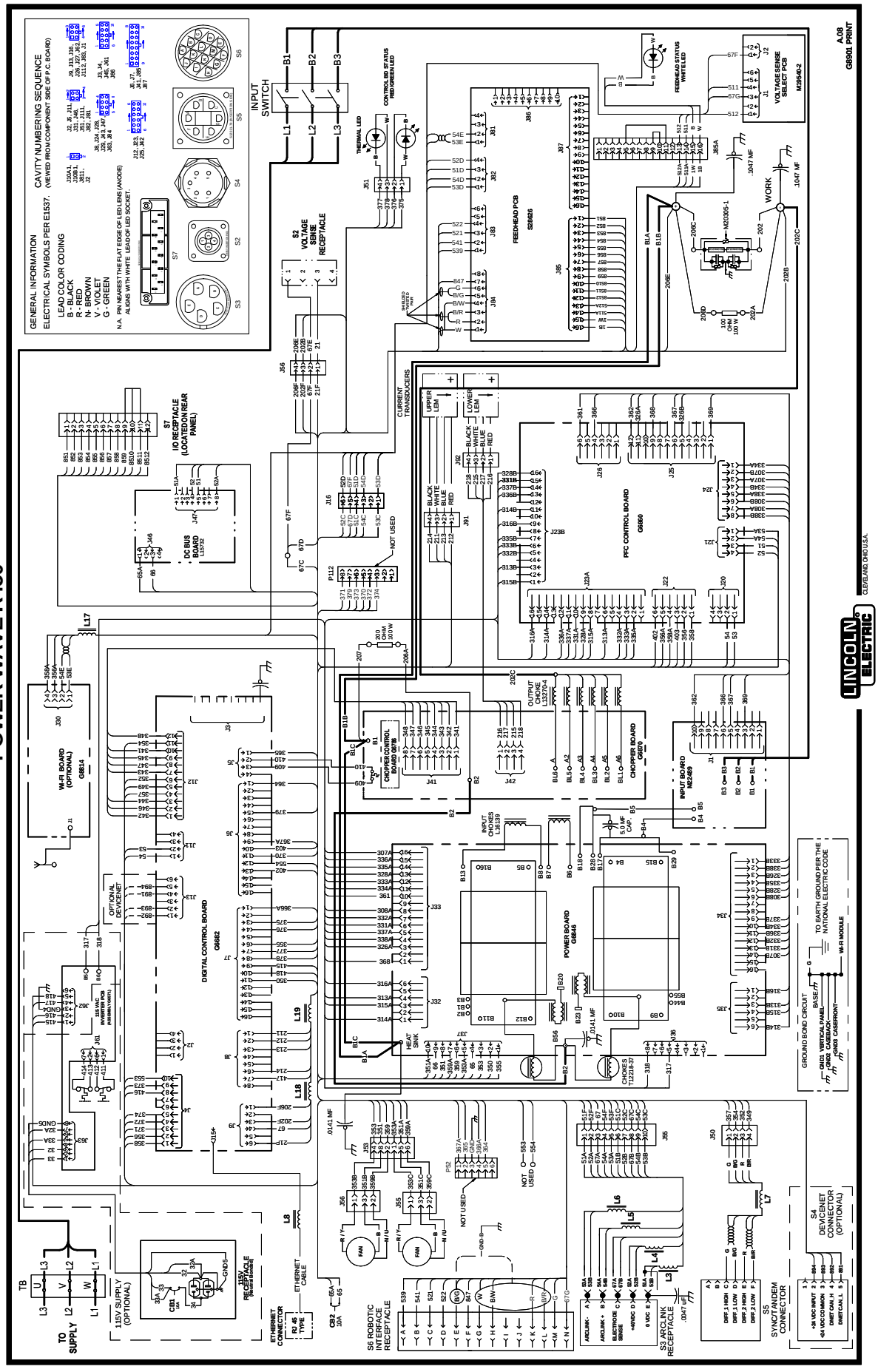
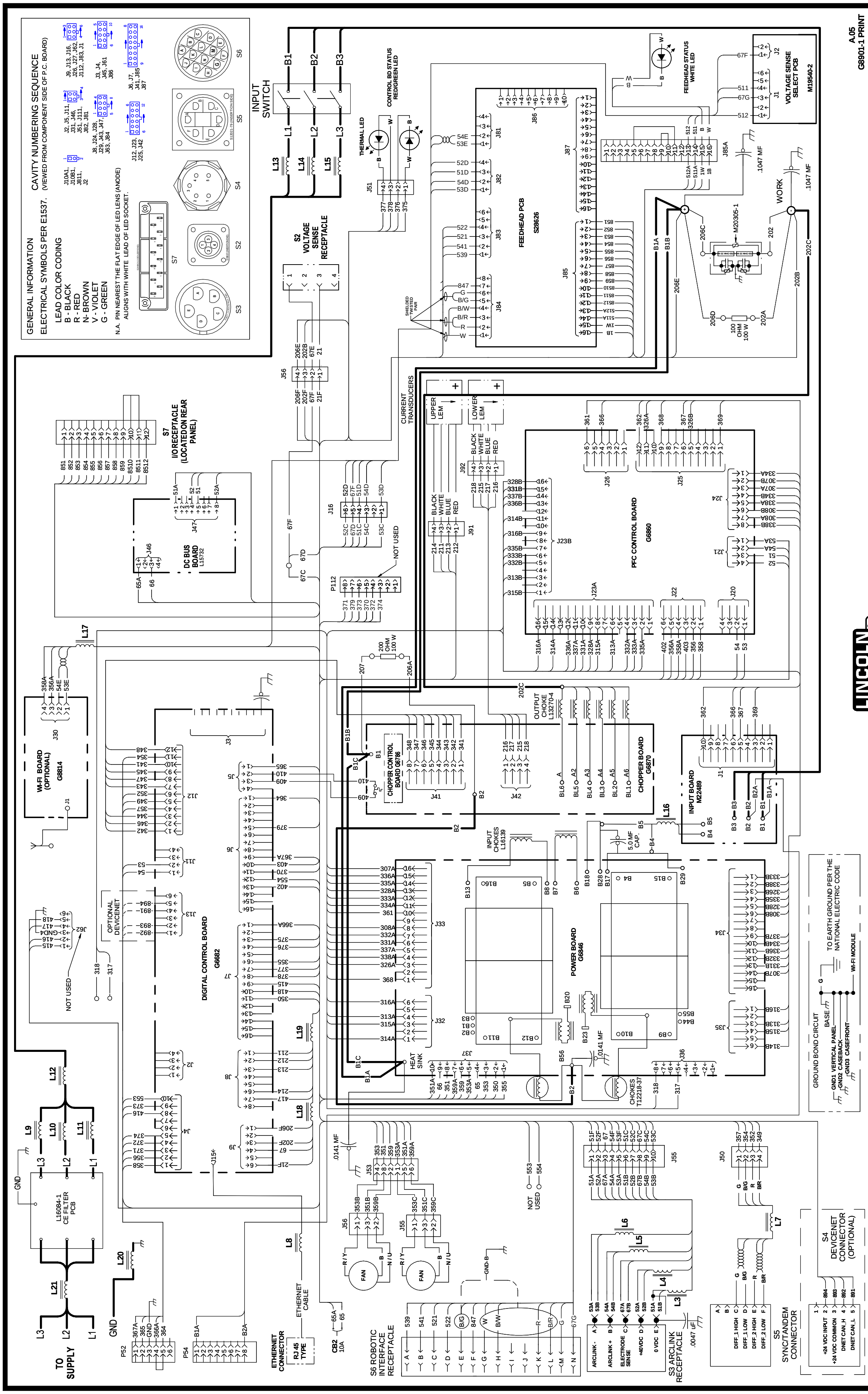
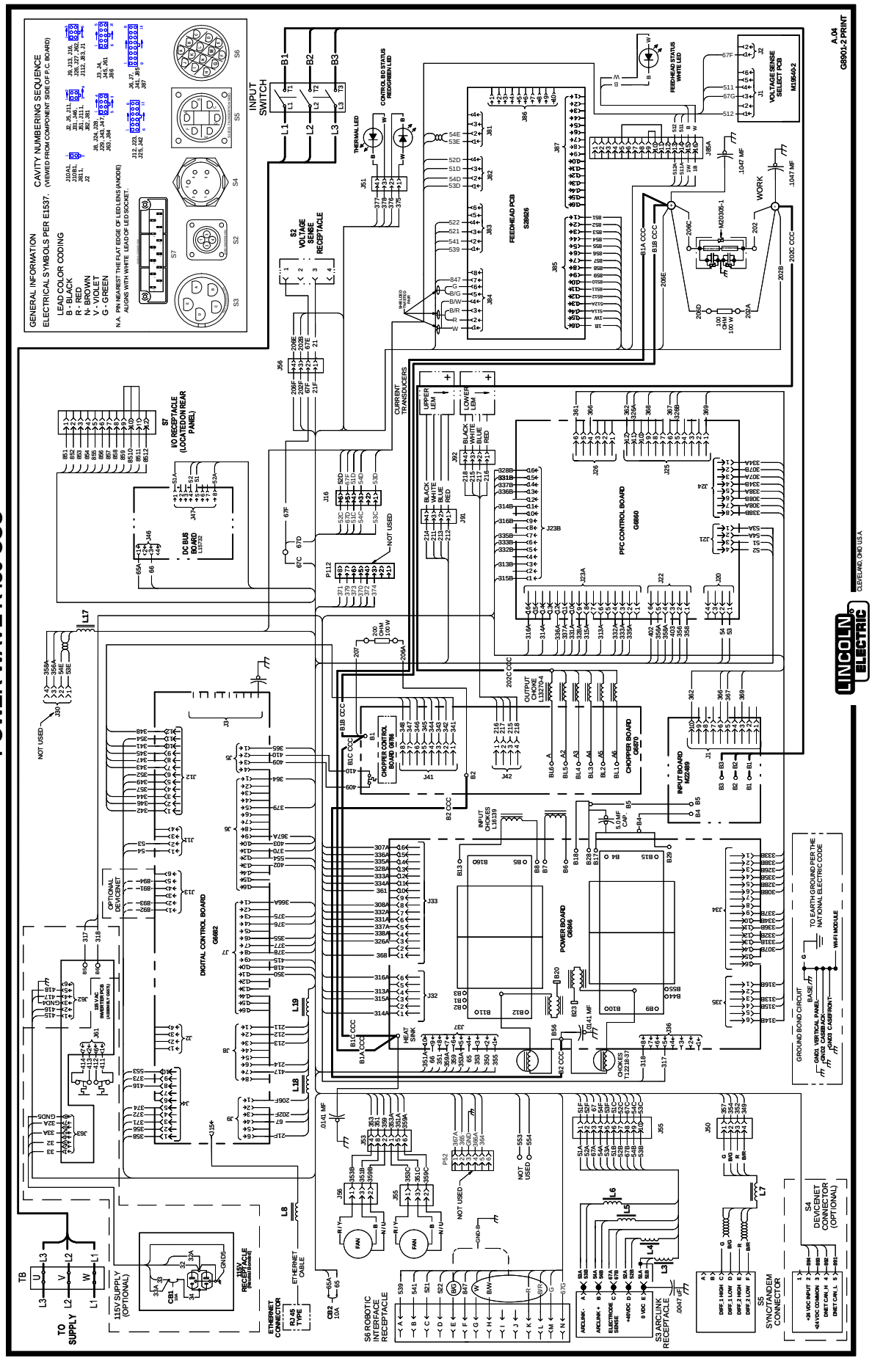
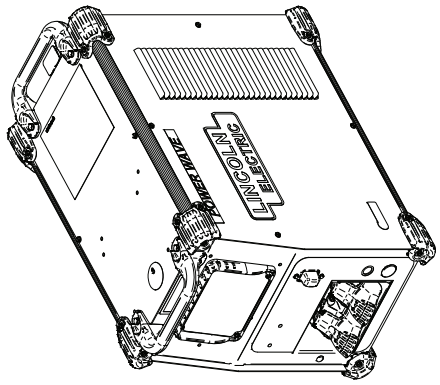


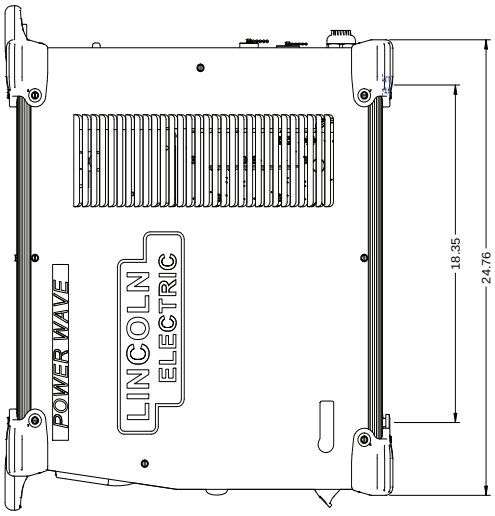
NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual. The specific diagram for a particular code is pasted inside the machine on one of the enclosure panels. If the diagram is illegible, write to the Service Department for a replacement. Give the equipment code number.


POWER WAVE R450 CE
GENERAL INFORMATION
ELECTRICAL SYMBOLS PER E1537.
LEAD COLOR CODING
B - BLACK
R - RED
N - BROWN
V - VIOLET
G - GREEN
CAVITY NUMBERING SEQUENCE
(VIEWED FROM COMPONENT SIDE OF P.C. BOARD)
INPUT SWITCH
S2 VOLTAGE SENSE RECEPTACLE
FEEDHEAD PCB
S28626
CURRENT TRANSDUCERS
UPPER LEM
LOWER LEM
PFC CONTROL BOARD
G6860
S7 I/O RECEPTACLE (LOCATED ON REAR PANEL)
DC BUS BOARD
WI-FI BOARD (OPTIONAL)
G6814
DIGITAL CONTROL BOARD
G6682
OPTIONAL DEVICENET
CHOPPER CONTROL BOARD
CHOPPER BOARD
G6870
OUTPUT CHOKE
POWER BOARD
G6846
INPUT BOARD
M22489
INPUT CHOKES
VOLTAGE SENSE SELECT PCB
M19540-2
FEEDHEAD STATUS WHITE LED
CONTROL BD STATUS RED/GREEN LED
THERMAL LED
WORK
GROUND BOND CIRCUIT
TO EARTH GROUND PER THE NATIONAL ELECTRIC CODE
WI-FI MODULE
TO SUPPLY
CE FILTER PCB
ETHERNET CONNECTOR
ETHERNET CABLE
S6 ROBOTIC INTERFACE RECEPTACLE
S3 ARCLINK RECEPTACLE
S5 SYNC/TANDEM CONNECTOR
S4 DEVICENET CONNECTOR (OPTIONAL)
FAN
NOT USED
CLEVELAND, OHIO U.S.A.
LINCOLN ELECTRIC
A.05
G8901-1 PRINT


POWER WAVE R450 CCC
A.04
G8901-2 PRINT
LINCOLN ELECTRIC
CLEVELAND, OHIO U.S.A.
GENERAL INFORMATION
ELECTRICAL SYMBOLS PER E1537.
CAVITY NUMBERING SEQUENCE
(VIEWED FROM COMPONENT SIDE OF P.C. BOARD)
LEAD COLOR CODING
B - BLACK
R - RED
N- BROWN
V - VIOLET
G - GREEN
N.A. PIN NEAREST THE FLAT EDGE OF LED LENS (ANODE) ALIGNS WITH WHITE LEAD OF LED SOCKET.
INPUT SWITCH
CONTROL BD STATUS RED/GREEN LED
THERMAL LED
FEEDHEAD STATUS WHITE LED
VOLTAGE SENSE SELECT PCB M18540-2
S2 VOLTAGE SENSE RECEPTACLE
FEEDHEAD PCB S26826
CURRENT TRANSDUCERS
UPPER LEM
LOWER LEM
I/O RECEPTACLE (LOCATION ON REAR PANEL)
DC BUS BOARD L9525
PFC CONTROL BOARD G8800
CHOPPER CONTROL BOARD G8798
CHOPPER BOARD G8870
INPUT BOARD M22889
DIGITAL CONTROL BOARD G8882
POWER BOARD G8846
INPUT CHOKES L16139
OUTPUT CHOKE L16104
HEAT SINK
CHOKES T12218/37
5.0MF CAP.
.0141 MF
.0047 MF
.1047 MF
200 OHM 100 W
M20305-1
WORK
GROUND BOND CIRCUIT
TO EARTH GROUND PER THE NATIONAL ELECTRIC CODE
WI-FI MODULE
GMZ1 VERTICAL PANEL
GMZ2 CASE BACK
GMZ3 CASE FRONT
TB
TO SUPPLY
115V SUPPLY (OPTIONAL)
CB1 10A
CB2 10A
115V RECEPTACLE
ETHERNET CONNECTOR
RJ45 TYPE
ETHERNET CABLE
S6 ROBOTIC INTERFACE RECEPTACLE
S3 ARC LINK RECEPTACLE
S5 SYNCHTANDEM CONNECTOR
S4 DEVICENET CONNECTOR (OPTIONAL)
FAN
OPTIONAL DEVICENET
NOT USED
L1
L2
L3
L4
L5
L6
L7
L8
L9
L17
L18
L19

L16215 A01


LINCOLN
ELECTRIC
POWER WAVE


POWER WAVE
LINCOLN
ELECTRIC
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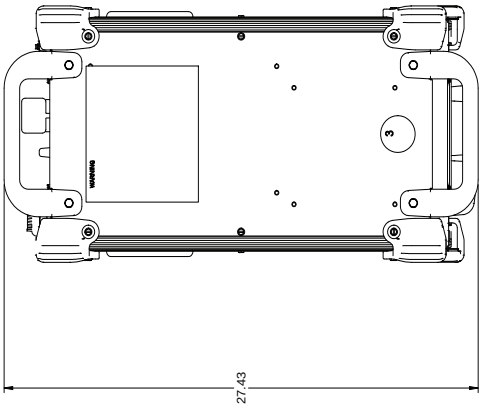
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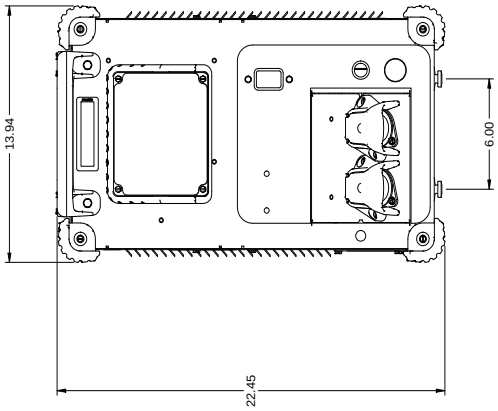
13.94
6.00
22.45

			
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**	● 皮肤或湿衣物切勿接触带电部件及焊条。 ● 使你自己与地面和工件绝缘。	● 把一切易燃物品移离工作場所。	● 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說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.

CUSTOMER ASSISTANCE POLICY

The business of The Lincoln Electric Company is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for advice or information about their use of our products. We respond to our customers based on the best information in our possession at that time. Lincoln Electric is not in a position to warrant or guarantee such advice, and assumes no liability, with respect to such information or advice. We expressly disclaim any warranty of any kind, including any warranty of fitness for any customer's particular purpose, with respect to such information or advice. As a matter of practical consideration, we also cannot assume any responsibility for updating or correcting any such information or advice once it has been given, nor does the provision of information or advice create, expand or alter any warranty with respect to the sale of our products.

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