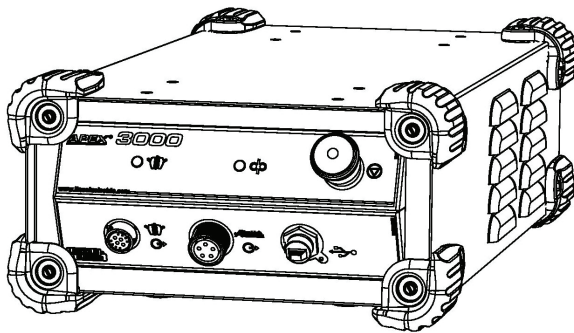


# Operator's Manual

# **APEX<sup>®</sup> 3000 CONTROL**

For use with machines having Code Numbers:  
**70310, 70313, 70316**



Register your machine:  
[www.lincolnelectric.com/register](http://www.lincolnelectric.com/register)  
Authorized Service and Distributor Locator:  
[www.lincolnelectric.com/locator](http://www.lincolnelectric.com/locator)

Save for future reference

Date Purchased

Code: (ex: 10859)

Serial: (ex: U1060512345)

Need Help? In the USA and Canada, call  
1.800.770.0063 to talk to a Service Representative.

Hours of Operation:  
7:00 AM to 5:00 PM (PT) Mon. thru Fri.

After hours?  
Use "Ask the Experts" at [lincolnelectric.com](http://lincolnelectric.com)  
A Lincoln Service Representative will contact you  
no later than the following business day.

For Service outside the USA and Canada, please call  
1.619.628.1022 or e-mail us at:  
[orbitalsupport@lincolnelectric.com](mailto:orbitalsupport@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.

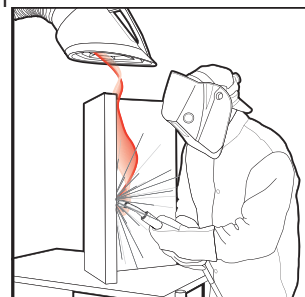
**READ** and obey the Material Safety Data Sheet (MSDS) and the warning label that appears on all containers of welding materials.

**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

#### Diesel Engines

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

#### Gasoline Engines

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.



**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.



Do  
or

- 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 Z87.1 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.



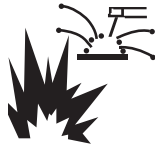
## FUMES AND GASES CAN BE DANGEROUS.



- 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 with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) 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. In confined spaces or in some circumstances, outdoors, a respirator may 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 material safety data sheet (MSDS) and your employer's safety practices. MSDS 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-1, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.



## 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.



Welding Safety  
Interactive Web Guide  
for mobile devices

Get the free mobile app at  
<http://gettag.mobi>

# ELECTROMAGNETIC COMPATIBILITY (EMC)

## CONFORMANCE

Products displaying the CE mark are in conformity with European Community Council Directive of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility (89/336/EEC). 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. Be aware that interference may result and extra precautions may be required when a welding power source is used in a domestic establishment.

## 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 construction of 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 according to national codes. 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

### Mains Supply

Welding equipment should be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply. 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 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, not connected to earth because of its size and position, e.g., ships 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 work piece 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 work piece, 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 Portions of the preceding text are contained in EN 60974-10: "Electromagnetic Compatibility (EMC) product standard for arc welding equipment."

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# Technical Specifications APEX® 3000

APEX® 3000 Control Unit Product Number K52103-1	
Input Power	40 VDC + 120 VAC
Rated Output	24V 9A
Input Current	5A AC / 9A DC
Dimensions L x W x H (in.)	7.35 X 13.85 X 24.4
Dimensions L x W x H (mm)	186.7 X 351.8 X 619.8
Net Weight lbs. (kg)	37.5 lbs. (17 kg)
<b>Temperature Ranges</b>	
Operating Temperature Range 32°F to 122°F (0°C - 60°C)	Storage Temperature Range -22°F to 140°F (-30°C - 60°C)

## Safety Precautions

Read entire manual before installation or operation.

### **WARNING**

Electric shock can kill



- Only qualified personnel should perform this installation.
- Turn the input power OFF at the disconnect switch or fuse box before working on this equipment turn off the input power to any other equipment connected to the welding system at the disconnect switch or fuse box before working on the equipment.

connected to the welding system at the disconnect switch or fuse box before working on the equipment.

- Do not touch electrically hot parts.
- Always connect the power supply grounding lug to a proper safety (Earth) ground.

## Proper Handling

Do not attempt to pick up, move or manipulate the control unit by the cables.

Always operate the control unit on stable, flat and level surfaces with the bottom or side rails facing the ground. Unplug the control unit when not in use. Do

not place on wet ground or in puddles.

## Operation

Read entire manual before operation.

Only operate while on firm level surface or attached to a system cart.

Keep hands away from weld head while in operation.

### **CAUTION**

Never unplug or plug in control cables to the tractor while the system is powered on.

Verify that the system is properly grounded before beginning to weld.

Refer to the individual system manuals for additional instructions.



# APEX® 3000 System

## Basic Information

The APEX® 3000 Control Unit (K52103-1) is part of the APEX® 3 Series family of controls. The control unit enables the following welding process from the power supply and optional advanced process modules which include: GTAW, GMAW, Pulsed MIG, FCAW, and STT®. All aspects of the welding process are synchronized through the APEX® 3000.

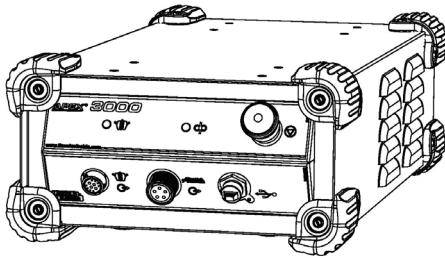


FIGURE 1 - APEX® 3000 Control Unit

The control unit works with ArcLink technology. This technology allows all of the system components to work together and communicate with the weld head and other motion control components using the CanOpen Protocol. Together these technologies allow the system to be controlled digitally with less wires. The status of the system can be monitored on the front panel, see **FIGURE 1 - APEX® 3000 Control Unit** and **FIGURE 2 - APEX® 3000 Front Panel**. Additionally, the front of the control has a Reset button, pendant and weld head connectors, and a USB port.

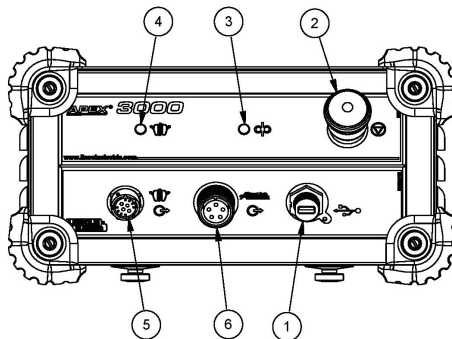


FIGURE 2 - APEX® 3000 Front Panel

### Front Panel

For all front panel connections, see **FIGURE 2 - APEX® 3000 Front Panel**.

1. **USB** - Welding programs and data can be saved and loaded via the USB port.
2. **Power Off** - Allows operator to remove power from

the weld head and halt welding operation. The weld head will remain off until switch is rotated clockwise. This switch does not remove power from the pendant or the welding power source.

3. **Wire Feed Status** - The wire feed status will show green if the wire feed control board is operational.
4. **Motion System Status** - The Motion System Status light (CANOpen Status) will be green if all motion systems are operational.
5. **Weld Head CONNECTOR** - Connection from the APEX® 3000 to the weld head.
6. **ArcLink CONNECTOR** - One ArcLink Cable connection for the pendant or other ArcLink devices.

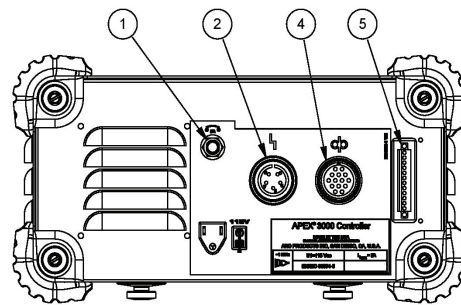


FIGURE 3 - APEX® 3000 Back Panel

### Back Panel Connections

For all back panel connections, see **FIGURE 3 - APEX® 3000 Back Panel**.

1. **Breaker, 5A** - Will trip in overcurrent situations; push to reset.
2. **ArcLink In** - The ArcLink connection from the Power Wave or other ArcLink enabled device.
3. **System Label** - Contains part number, serial number and code number of the machine.
4. **14 Pin CONNECTOR** - Provides motor power, tach feedback, solenoid drive and electrode sense (wire # 67) between the APEX® 3000 control unit and the wire feeder.
5. **External I/O CONNECTOR** - Terminal Strip is for making simple input signal connections for the wire feeder for use external of the APEX® Pendants; for example to have gas purge and wire forward jog switches near the wire feed head, See **FIGURE 5 - External I/O CONNECTOR on page B-2**. The terminal strip is divided into three groups: Shutdown, Trigger and Feed groups.

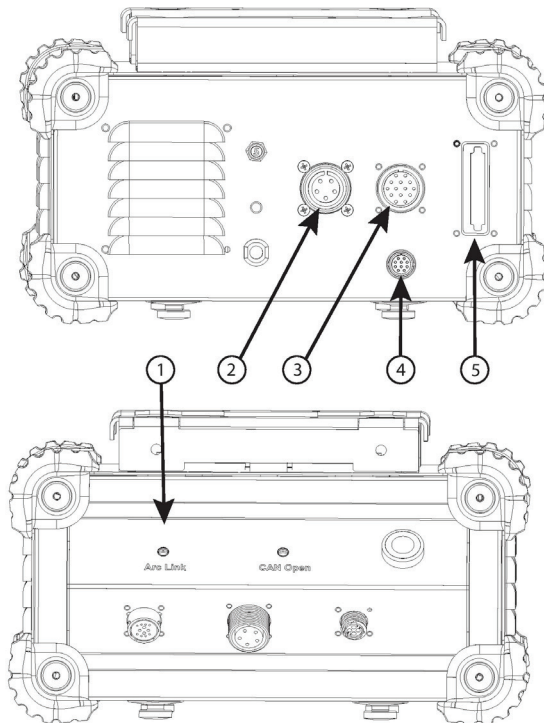
## Wire Feeder Control Board

The APEX® 3000 incorporates a wire feeder control board to communicate with the wire feed drive head.

## Wire Feeder Functions

Refer to **FIGURE 4 - Wire Feeder Functions** for the different parts of the AutoDrive®.

1. **Status LED** - The status light is a two color LED. Normal operation is steady green. Flashing green or red/green indicates a system error. See the troubleshooting section. Note: At power up of the Power Wave system, the status light will flash green for up to 60 seconds. This is normal and indicates that the system is performing a self test and mapping each component in the local ArcLink system. The status lights will also flash green as a result of a system reset or configuration change during operation. When the status lights become steady green, the system is ready for operation.



**FIGURE 4 - Wire Feeder Functions**

2. **ArcLink Input CONNECTOR (5 Pin)** - Receives power and communication from the power source.
3. **Wire Feeder CONNECTOR (14 Pin)** - The wire feed head receives power and motor speed voltages through this connector and provides encoder feedback to the wire feeder control board.
4. **ArcLink Output CONNECTOR (5 Pin)** - Provides

power and communication to a robotic controller.

5. **External I/O CONNECTOR** - Terminal Strip is for making simple input signal connections for the wire feeder for use external of the APEX® Pendants; for example to have gas purge and wire forward jog switches near the wire feed head, See **FIGURE 5 - External I/O CONNECTOR** on page B-2. The terminal strip is divided into three groups: Shutdown, Trigger and Feed groups.

### Additional Info

See **4R220 Wire Feeder Manual** for specifics on the wire feeder.

All inputs for the terminal strip below use “normally open” logic except the shut-down group. The shutdown inputs use “normally closed” logic, and are always enabled. Unused shut-downs must be tied to the +15V supply for the shut-down group, e.g., Terminal 10 and 11, must be jumpered to Terminal 9 to operator normally. The APEX® 3000 controllers are shipped from the factory with jumpers installed on both shutdown inputs, Terminal 9, 10, and 11 are jumpered.

Shutdown 2 Input	Shutdown 1 Input	+15VDC - Group #3	Gas Purge	Feed Reverse	Feed Forward	+15VDC - Group #2	2/4 Step	Dual Procedure	Trigger	+15VDC - Group #1	
12	11	10	9	8	7	6	5	4	3	2	1

**FIGURE 5 - External I/O CONNECTOR**

## Maintenance

The APEX® 3000 Control System is designed for trouble free operation and normally requires minimal preventive care and cleaning. This section provides instructions for maintaining user serviceable items. The suggested repair procedure for all such items is to remove and replace defective assemblies or parts. When users and / or service personnel are not familiar with electrical and electronic equipment, the product should be returned to the factory or serviced by factory authorized representatives.

### Maintenance Schedule

The maintenance schedule is suggested as a guideline for proper system maintenance. More stringent maintenance requirements may be required depending on the work being performed and the requirements of the customer for whom the work is performed. All maintenance schedules are based on a 40 hour work week. Any excess play in parts or equipment should be noted and reported to an authorized repair facility. Any anomalous activity, such as motor hesitation, clicking or other noises, or anything out of the ordinary should be noted and reported to an authorized repair facility.

#### Every Shift

- Check lines, cables, and hoses for loose connections and worn areas.

Observe all Safety Guidelines detailed throughout this manual

## Using the Status LED to Troubleshoot System Problems

The APEX® 30M and Power Wave® is equipped with a Status Light. 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.

Included in this section is information about the Power Wave® power source and APEX® 30M Status LEDs and a basic troubleshooting chart for both the machine and the weld performance. The APEX® 30M and Power Wave® Status Lights are dual-color LEDs that indicate system errors. Normal operation for each is steady green. Error conditions are indicated in **FIGURE 6 - Status LED Light Conditions**.

**FIGURE 6 - Status LED Light Conditions**

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® is mapped (identifying) each component in the system. This is normal for the first 1 to 60 seconds after the power is turned on, or if the system configuration is changed during operation.
Fast Blinking Green	Under normal conditions indicates Auto-mapping has failed. Also used by the Weld Manager Utilities (included on the Service Navigator CDs or at <a href="http://www.powerwavesoftware.com">www.powerwavesoftware.com</a> to identify the selected machine when connecting to a specific IP address).
Alternating Red and Green	<p>Non-recoverable system fault. If the Status lights are flashing any combination of red and green, errors are present. Read and note the error code(s) before turning off the machine.</p> <p>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 are accessible through the Status light.</p> <p>Error codes can also be retrieved with the Weld Manager Utility (included on the Service Navigator CDs or at <a href="http://www.powerwavesoftware.com">www.powerwavesoftware.com</a>). This is the preferred method, since it can access historical information contained in the error log.</p> <p>To clear the active error(s), turn the power source off and back on to reset the system.</p>
Steady Red	Not applicable.
Blinking Red	Not applicable.

**⚠ CAUTION**

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

Observe all Safety Guidelines detailed throughout this manual

## List of Error Codes for Troubleshooting

Error ID	Description	Potential Solution
5-3-1	Weld Head network not recognized by controller. Weld Head has no power.	Check to make sure the Weld Head cable is plugged in and that the APEX® 3000 controller has power via 110VAC aux connector (if applicable). Cycle power to Power Wave®.
5-3-3	Communication with oscillation motor has halted.	Check Weld Head cable for potential bad connections. Cycle power.
5-3-4	Communication with height motor has halted.	Check Weld Head cable for potential bad connections. Cycle power.
5-3-5	Communication with travel motor has halted.	Check Weld Head cable for potential bad connections. Cycle power.
5-3-6	Calibrated fault with oscillation	Check weld head cable and cycle power.
5-3-7	Calbrated fault with height	Check weld head cable and cycle power.
5-3-8	Wire drive timeout	Check weld head cable and cycle power.
5-3-9	“Other”	Cycle power.
5-3-6	Calibrated fault with oscillation	Check weld head cable and cycle power.
5-3-7	Calibration fault with height	Check weld head cable and cycle power.
5-3-8	Wire drive timeout	Check weld head cable and cycle power.
5-3-9	“Other”	Cycle power.
5-4-1	Oscillation motor following error	Check for resistance on the torch arm. Oscillation speeds too high.
5-4-2	Oscillation motor overcurrent	Check power supplies, cycle power. Clear any resistance/debris from track and the weld head arm.
5-4-3	Oscillation motor overheat	Check welding conditions. Turn off power for 5 minutes.
5-4-4	Oscillation communications fault	Check Weld Head cable and make sure no extra power/noise is being discharged into the Weld Head.
5-4-5	Oscillation communications off	Check Weld Head cable and make sure no extra power/noise is being discharged into the Weld Head.
5-4-6	Oscillation was moved passed programmed limit	Recalibrate the system/cycle power. Make sure Weld Head arm moves all the way in and you have full range of movement.
5-4-7	Oscillation motor overvoltage	Check power supplies, cycle power. Clear any resistance/debris from track and the weld head arm.
5-4-8	Oscillation motor position sensor error	Cycle power. Make sure internal motor controller wire harnesses and connectors are secure.
5-4-9	Oscillation fault unknown	Check all of the above items. Cycle Power. Contact a Service Representation at the number on the cover of this manual.
5-5-1	Height motor following error	Check for resistance on the torch arm. Height movement speeds too high.
5-5-2	Height motor overcurrent	Check power supplies, cycle power. Clear any resistance/debris from track and the weld head arm.
5-5-3	Height motor overheat	Check welding conditions. Turn off power for 5 minutes.
5-5-4	Height communications fault	Check Weld Head cable and make sure no extra power/noise is being discharged into the Weld Head.

### CAUTION

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

Observe all Safety Guidelines detailed throughout this manual

5-5-5	Height communications off	Check Weld Head cable and make sure no extra power/ noise is being discharged into the Weld Head.
5-5-6	Height was moved passed programmed limit	Recalibrate the system/cycle power. Make sure Weld Head arm moves all the way in and you have full range of movement. Check Setup
5-5-7	Height motor overvoltage	Check power supplies, cycle power. Clear any resistance/ debris from track and the weld head arm.
5-5-8	Height motor position sensor error	Cycle power. Make sure internal motor controller wire harnesses and connectors are secure.
5-5-9	Height fault unknown	Check all of the above items. Cycle Power. Contact a Service Representation at the number on the cover of this manual.
5-6-1	Travel motor following error	Check for resistance on the torch arm. Travel speeds too high.
5-6-2	Travel motor overcurrent	Check power supplies, cycle power. Clear any resistance/ debris from track and the weld head arm.
5-6-3	Travel motor overheat	Check welding conditions. Turn off power for 5 minutes.
5-6-4	Travel communications fault	Check Weld Head cable and make sure no extra power / noise is being discharged into the Weld Head.
5-6-5	Travel communications off	Check Weld Head cable and make sure no extra power / noise is being discharged into the Weld Head.
5-6-6	Travel was moved passed programmed limit	Recalibrate the system/cycle power. Make sure you can jog travel along your track.
5-6-7	Travel motor overvoltage	Check power supplies, cycle power. Clear any resistance / debris from track and the weld head arm.
5-6-8	Travel motor position sensor error	Cycle power. Make sure internal motor controller wire harnesses and connectors are secure.
5-6-9	Travel fault unknown	Check all of the above items. Cycle Power. Contact a Service Representation at the number on the cover of this manual.
5-7-1	Wire motor following error	Check for resistance when pulling wire through the liner. Wire speeds too high.
5-7-2	Wire motor overcurrent	Check power supplies, cycle power. Check for wire bird-nest. Check for resistance when pulling wire through the liner.
5-7-3	Wire motor overheat	Check welding conditions. Turn off power for 5 minutes. Check for resistance when pulling wire through the liner.
5-7-4	Wire communications fault	Check Weld Head cable and make sure no extra power / noise is being discharged into the Weld Head.
5-7-5	Wire communications off	Check Weld Head cable and make sure no extra power / noise is being discharged into the Weld Head.
5-7-6	Wire motor / encoder issue	Cycle power to the system and allow the system to recalibrate. Make sure you can jog wire in Jog mode.
5-7-7	Wire motor overvoltage	Check power supplies, cycle power. Check for wire bird-nest. Check for resistance when pulling wire through the liner.
5-7-8	Wire motor / encoder issue	Cycle power to the system and allow the system to recalibrate. Make sure you can jog wire in Jog mode.

## ⚠ CAUTION

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

Observe all Safety Guidelines detailed throughout this manual

5-7-9	Wire fault unknown	Check all of the above items. Cycle Power. Contact a Service Representation at the number on the cover of this manual.
6-3-3-1	Unstable or "noisy" WFS feedback signal	Check the cables and connections. Cycle power.
8-1	Motor Overload (Long Term)	Check the electrode feeds easily through feed system. Verify the wire reel bracket is not too tight. Verify quality of electrode.
8-2	Motor Overload (Short Term)	Check that motor can turn freely when idle arm is open. Check gears for dirt and debris. Check all items for error 8.1.
8-3	Shutdown #1 is open	Contact a Service Representation at the number on the cover of this manual.
8-4	Shutdown #2 is open	Contact a Service Representation at the number on the cover of this manual.

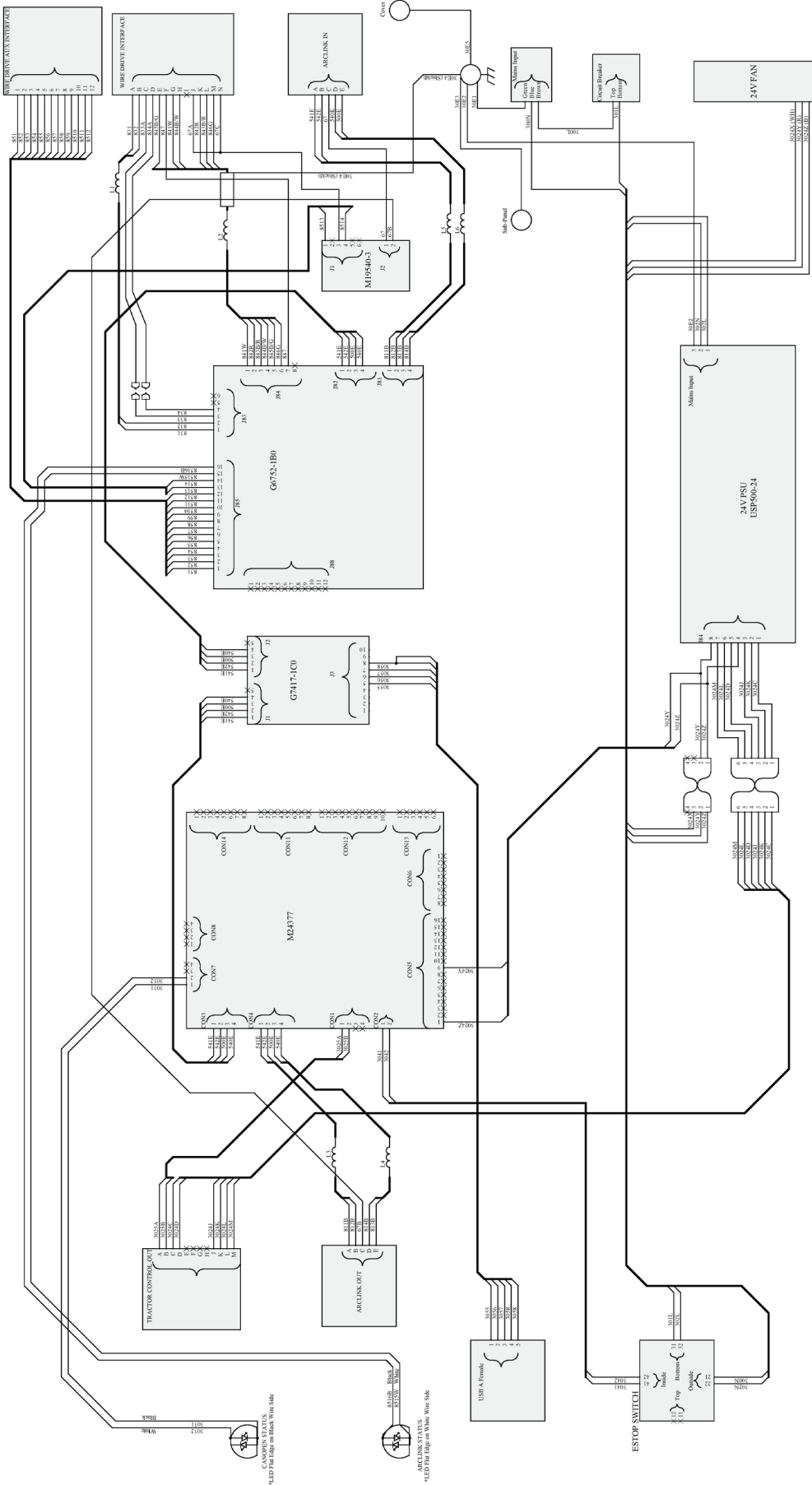
### Cable Management

Always use the shortest cable lengths possible. Do not coil excess cable. It is recommended that the total length of control cable does not exceed 100' (30.5M). The use of non-standard cables in excess of 25' (7.5M) can lead to communication problems (system shutdowns), poor motor acceleration (poor arc starting), and low wire driving force (wire feeding problems).

Best results will be obtained when the 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.

## ⚠ CAUTION

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



**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.



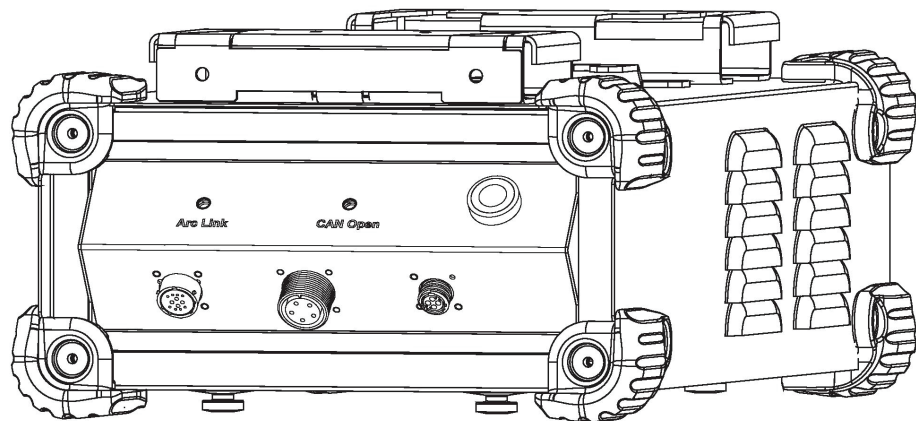
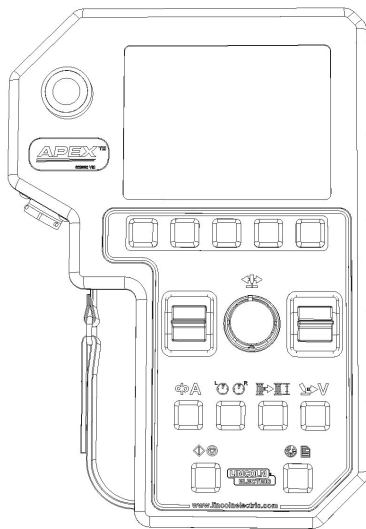
**P-787  
GENERAL ASSEMBLY**

# **APEX® 3000 PARTS MANUAL**

**Code: 70317**

**This parts list is provided as an informative guide only.**

P-787  
ILLUSTRATION OF PARTS



**NOTE:** This Parts Manual is provided as an informative guide only, when ordering parts always refer to the Lincoln Electric Parts List.

# APEX® 3000 CONTROL

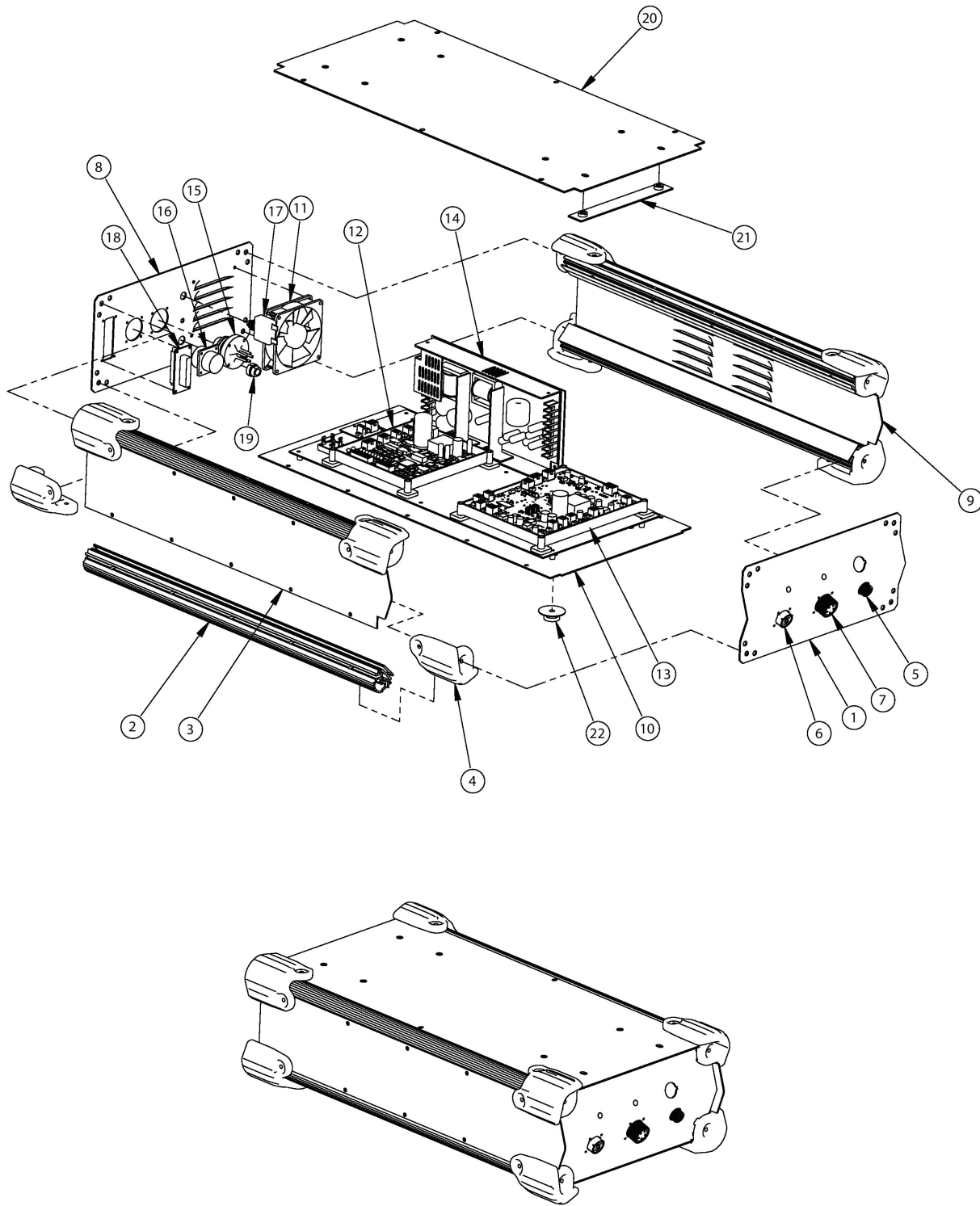
P-787-A.1  
GENERAL ASSEMBLY

For Code: 70310, 70313, 70316

Sub Assembly Item No.	1	2	3						
SUB ASSEMBLY PAGE NAME	APEX® 3000 Control	APEX® System Cables	APEX® 3 series Pendant						
PAGE NO.	P-787-B	P-787-C	P-787-D						
CODE NO.									
70310	1	1							
70316	2								
70313			1						

**NOTE:** This Parts Manual is provided as an informative guide only, when ordering parts always refer to the Lincoln Electric Parts List.

P-787-B  
APEX 3000 Control



**NOTE:** This Parts Manual is provided as an informative guide only, when ordering parts always refer to the Lincoln Electric Parts List.

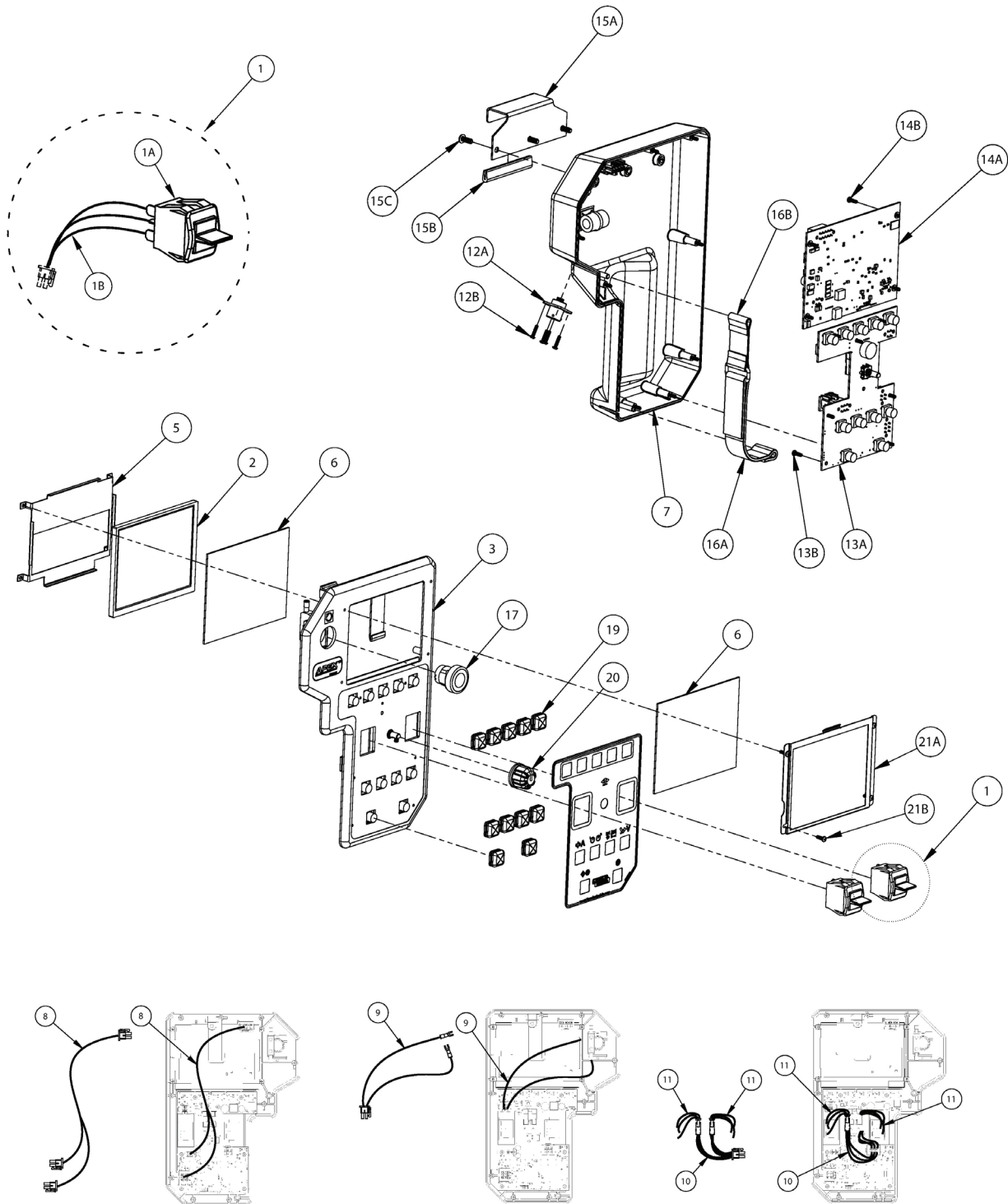
# Indicates a change in this printing.

Use only the parts marked "x" in the column under the heading number called for in the model index page.

ITEM	DESCRIPTION	PART NO.	QTY.	1	2	3	4	5	6	7	8	9
	APEX® 3000 Controller											
	APEX® 3000 Controller	K52102-1										
1	Enclosure Front Plate	M23074										
2	Aluminum Extrusion (4 per unit)	N/A										
3	Enclosure Side Plate Right	M23087										
4	Corner Cap	L13138										
5	USB Connection											
6	Tractor Output Harness Assy	S30459										
7	Pendant Output Harness Assy											
8	Enclosure Back Plate	M23075										
9	Enclosure Left Plate	M23073										
10	Enclosure Bottom Plate	M23071										
11	Fan Assy	S30460										
12	Wire Feed Board Assy											
13	CanOpen PCB Assy	S30301										
14	Power Supply	S30730										
15	ArcLink Input Harness	M20123-3										
16	Wire Drive Harness											
17	5A Circuit Breaker											
18	Wire Feed/Auxiliary Interface Harness											
19	Lens Cap											
20	Enclosure Top Plate	M23072										
21	Retaining Strap											
22	Quick Lock Foot											
	APEX® 3000 Front Overlay Upper	M24532-2										
	APEX® 3000 Front Overlay Lower	M24532-3										
	APEX® 3000 Back Overlay	M24532-1										
	Sub Panel	M23076										
	ArcLink Extension/USB Interface	S30452										

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GENERAL ASSEMBLY



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Use only the parts marked "x" in the column under the heading number called for in the model index page.

ITEM	DESCRIPTION	PART NO.	QTY.	1	2	3	4	5	6	7	8	9
	Pendant Assembly	K52113-1										
1	Rocker Switch & Harness Assembly	S30720	2									
1A	Rocker Switch	S30493	2									
1B	Harness Assembly		2									
2	Color LCD	S29390	1									
3	Pendant Top	M23062-2	1									
4	Pendant Overlay	S30292	1									
5	Screen Holder	M24594	1									
6	Screen Protector	S30712	2									
7	Pendant Bottom (Includes item 12)	M23063	1									
8	UI to IO Link Harness	S30398	1									
9	Pendant Estop Harness	S30399	1									
10	Dual Rocker Switch PCB Harness	S30717	1									
11	Pendant Rocker Switch Harness	S30720	2									
12	Pendant Input Harness Assy	S30458	1									
12A	Pendant Input Harness											
12B	Screw											
13	I/O PCB Assy	S30302	1									
13A	I/O PCB											
13B	Screw											
14	User Interface PCB Assy	S30300	1									
14A	User Interface PCB											
14B	Screw											
15	Pendant Hook Assy	S29560-22	1									
15A	Pendant Hook											
15B	Rubber Bumper											
15C	Screw											
16	Pendant Strap Assy	S29560-21	1									
16A	Pendant Strap A		1									
16B	Pendant Strap B		1									
17	Pushbutton Operator	S29987	1									
18	Pendant Overlay Small		1									
19	Button Cover Small (Lincoln Item)	S23055-1	1									
20	Knob (Lincoln Item)	M22778-1	1									
21	Spatter Shield Pocket Assy	M23325	1									
21A	Spatter Sheild Pocket		1									
21B	Screws		4									

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Use only the parts marked "x" in the column under the heading number called for in the model index page.

ITEM	DESCRIPTION	PART NO.	QTY.	1	2	3	4	5	6	7	8	9
1	HELIX® Control Cable 25'		1	x								
2	HELIX® Control Cable 50'		1	x								
3	APEX® 3000 Pendant Cable 25'		1	x								
4			1	x								
5			1	x								
6			1	x								
7			1	x								
8			1	x								

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**P-787  
GENERAL ASSEMBLY**

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## **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.

Lincoln Electric is a responsive manufacturer, but the selection and use of specific products sold by Lincoln Electric is solely within the control of, and remains the sole responsibility of the customer. Many variables beyond the control of Lincoln Electric affect the results obtained in applying these types of fabrication methods and service requirements.

Subject to Change – This information is accurate to the best of our knowledge at the time of printing. Please refer to [www.lincolnelectric.com](http://www.lincolnelectric.com) for any updated information.



**THE LINCOLN ELECTRIC COMPANY**

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