SERVICE MANUAL
LN-9622-00.5
(REPLACES: LN-9622-00.4)
April - 2013

Ransburg

EVOLVER MICROPAK™ CONTROLLER

MODEL: A10406

IMPORTANT: Before using this equipment, carefully read SAFETY PRECAUTIONS, starting on page 1, and all instructions in this manual. Keep this Service Manual for future reference.

Service Manual Price: $50.00 (U.S.)

NOTE: This manual has been changed from LN-9622-00.4 to revision LN-9622-00.5.Reasons for this change are noted under “Manual Change Summary” page 33 of this manual.

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SAFETY

SAFETY PRECAUTIONS

Before operating, maintaining or servicing any Ransburg electrostatic coating system, read and understand all of the technical and safety literature for your Ransburg products. This manual contains information that is important for you to know and understand. This information relates to USER SAFETY and PREVENTING EQUIPMENT PROBLEMS. To help you recognize this information, we use the following symbols. Please pay particular attention to these sections.

A WARNING! states information to alert you to a situation that might cause serious injury if instructions are not followed.

A CAUTION! states information that tells how to prevent damage to equipment or how to avoid a situation that might cause minor injury.

A NOTE is information relevant to the procedure in progress.

While this manual lists standard specifications and service procedures, some minor deviations may be found between this literature and your equipment. Differences in local codes and plant requirements, material delivery requirements, etc., make such variations inevitable. Compare this manual with your system installation drawings and appropriate Ransburg equipment manuals to reconcile such differences.

Careful study and continued use of this manual will provide a better understanding of the equipment and process, resulting in more efficient operation, longer trouble-free service and faster, easier troubleshooting. If you do not have the manuals and safety literature for your Ransburg system, contact your local Ransburg representative or Ransburg.

⚠ WARNING

➤ The user **MUST** read and be familiar with the Safety Section in this manual and the Ransburg safety literature therein identified.

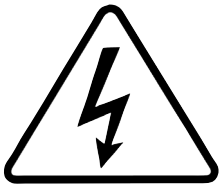
➤ This manual **MUST** be read and thoroughly understood by **ALL** personnel who operate, clean or maintain this equipment! Special care should be taken to ensure that the **WARNINGS** and safety requirements for operating and servicing the equipment are followed. The user should be aware of and adhere to ALL local building and fire codes and ordinances as well as **NFPA-33 SAFETY STANDARD, LATEST EDITION**, prior to installing, operating, and/or servicing this equipment.

⚠ WARNING

➤ The hazards shown on the following pages may occur during the normal use of this equipment. Please read the hazard chart beginning on page 2.

AREA Tells where hazards may occur.	**HAZARD** Tells what the hazard is.	**SAFEGUARDS** Tells how to avoid the hazard.
Spray Area 	**Fire Hazard** Improper or inadequate operation and maintenance procedures will cause a fire hazard. Protection against inadvertent arcing that is capable of causing fire or explosion is lost if any safety interlocks are disabled during operation. Frequent Power Supply or Controller shutdown indicates a problem in the system requiring correction.	Fire extinguishing equipment must be present in the spray area and tested periodically. Spray areas must be kept clean to prevent the accumulation of combustible residues. Smoking must never be allowed in the spray area. The high voltage supplied to the atomizer must be turned off prior to cleaning, flushing or maintenance. When using solvents for cleaning: • Those used for equipment flushing should have flash points equal to or higher than those of the coating material. • Those used for general cleaning must have flash points above 100°F (37.8°C). Spray booth ventilation must be kept at the rates required by NFPA-33, OSHA, country, and local codes. In addition, ventilation must be maintained during cleaning operations using flammable or combustible solvents. Electrostatic arcing must be prevented. Safe sparking distance must be maintained between the parts being coated and the applicator. A distance of 1 inch for every 10KV of output voltage is required at all times. Test only in areas free of combustible material. Testing may require high voltage to be on, but only as instructed. Non-factory replacement parts or unauthorized equipment modifications may cause fire or injury. If used, the key switch bypass is intended for use only during setup operations. Production should never be done with safety interlocks disabled. Never use equipment intended for use in waterborne installations to spray solvent based materials. The paint process and equipment should be set up and operated in accordance with NFPA-33, NEC, OSHA, local, country, and European Health and Safety Norms.

AREA Tells where hazards may occur.	**HAZARD** Tells what the hazard is.	**SAFEGUARDS** Tells how to avoid the hazard.
Spray Area 	**Explosion Hazard** Improper or inadequate operation and maintenance procedures will cause a fire hazard. Protection against inadvertent arcing that is capable of causing fire or explosion is lost if any safety interlocks are disabled during operation. Frequent Power Supply or Controller shutdown indicates a problem in the system requiring correction.	Electrostatic arcing must be prevented. Safe sparking distance must be maintained between the parts being coated and the applicator. A distance of 1 inch for every 10KV of output voltage is required at all times. Unless specifically approved for use in hazardous locations, all electrical equipment must be located **outside** Class I or II, Division 1 or 2 hazardous areas, in accordance with NFPA-33. Test only in areas free of flammable or combustible materials. The current overload sensitivity (if equipped) MUST be set as described in the corresponding section of the equipment manual. Protection against inadvertent arcing that is capable of causing fire or explosion is lost if the current overload sensitivity is not properly set. Frequent power supply shutdown indicates a problem in the system which requires correction. Always turn the control panel power off prior to flushing, cleaning, or working on spray system equipment. Before turning high voltage on, make sure no objects are within the safe sparking distance. Ensure that the control panel is interlocked with the ventilation system and conveyor in accordance with NFPA-33, EN 50176. Have fire extinguishing equipment readily available and tested periodically.
General Use and Maintenance 	Improper operation or maintenance may create a hazard. Personnel must be properly trained in the use of this equipment.	Personnel must be given training in accordance with the requirements of NFPA-33, EN 60079-0. Instructions and safety precautions must be read and understood prior to using this equipment. Comply with appropriate local, state, and national codes governing ventilation, fire protection, operation maintenance, and housekeeping. Reference OSHA, NFPA-33, EN Norms and your insurance company requirements.

AREA Tells where hazards may occur.	**HAZARD** Tells what the hazard is.	**SAFEGUARDS** Tells how to avoid the hazard.
Spray Area / High Voltage Equipment 	**Electrical Discharge** There is a high voltage device that can induce an electrical charge on ungrounded objects which is capable of igniting coating materials. Inadequate grounding will cause a spark hazard. A spark can ignite many coating materials and cause a fire or explosion.	Parts being sprayed and operators in the spray area must be properly grounded. Parts being sprayed must be supported on conveyors or hangers that are properly grounded. The resistance between the part and earth ground must not exceed 1 meg ohm. (Refer to NFPA-33.) Operators must be grounded. Rubber soled insulating shoes should not be worn. Grounding straps on wrists or legs may be used to assure adequate ground contact. Operators must not be wearing or carrying any ungrounded metal objects. When using an electrostatic handgun, operators must assure contact with the handle of the applicator via conductive gloves or gloves with the palm section cut out. NOTE: REFER TO NFPA-33 OR SPECIFIC COUNTRY SAFETY CODES REGARDING PROPER OPERATOR GROUNDING. All electrically conductive objects in the spray area, with the exception of those objects required by the process to be at high voltage, must be grounded. Grounded conductive flooring must be provided in the spray area. Always turn off the power supply prior to flushing, cleaning, or working on spray system equipment. Unless specifically approved for use in hazardous locations, all electrical equipment must be located **outside** Class I or II, Division 1 or 2 hazardous areas, in accordance with NFPA-33.

AREA Tells where hazards may occur.	**HAZARD** Tells what the hazard is.	**SAFEGUARDS** Tells how to avoid the hazard.
Electrical Equipment 	**Electrical Discharge** High voltage equipment is utilized in the process. Arcing in the vicinity of flammable or combustible materials may occur. Personnel are exposed to high voltage during operation and maintenance. Protection against inadvertent arcing that may cause a fire or explosion is lost if safety circuits are disabled during operation. Frequent power supply shutdown indicates a problem in the system which requires correction. An electrical arc can ignite coating materials and cause a fire or explosion.	Unless specifically approved for use in hazardous locations, the power supply, control cabinet, and all other electrical equipment must be located outside Class I or II, Division 1 and 2 hazardous areas in accordance with NFPA-33 and EN 50176. Turn the power supply OFF before working on the equipment. Test only in areas free of flammable or combustible material. Testing may require high voltage to be on, but only as instructed. Production should never be done with the safety circuits disabled. Before turning the high voltage on, make sure no objects are within the sparking distance.
Toxic Substances 	Certain material may be harmful if inhaled, or if there is contact with the skin.	Follow the requirements of the Material Safety Data Sheet supplied by coating material manufacturer. Adequate exhaust must be provided to keep the air free of accumulations of toxic materials. Use a mask or respirator whenever there is a chance of inhaling sprayed materials. The mask must be compatible with the material being sprayed and its concentration. Equipment must be as prescribed by an industrial hygienist or safety expert, and be NIOSH approved.
Spray Area 	**Explosion Hazard – Incompatible Materials** Halogenated hydrocarbon solvents for example: methylene chloride and 1,1,1,-Trichloroethane are not chemically compatible with the aluminum that might be used in many system components. The chemical reaction caused by these solvents reacting with aluminum can become violent and lead to an equipment explosion.	Aluminum is widely used in other spray application equipment - such as material pumps, regulators, triggering valves, etc. Halogenated hydrocarbon solvents must never be used with aluminum equipment during spraying, flushing, or cleaning. Read the label or data sheet for the material you intend to spray. If in doubt as to whether or not a coating or cleaning material is compatible, contact your coating supplier. Any other type of solvent may be used with aluminum equipment.

EUROPEAN ATEX DIRECTIVE 94/9/EC, ANNEX II, 1.0.6

The following instructions apply to equipment covered by certificate number Sira 05ATEX5127X:

1. The equipment may be used with flammable gases and vapors with apparatus groups II and with temperature class T6.

2. The equipment is only certified for use in ambient temperatures in the range +12.8°C to +55°C and should not be used outside this range.

3. Installation shall be carried out by suitably trained personnel in accordance with the applicable code of practice e.g. EN 60079-14:

4. Inspection and maintenance of this equipment shall be carried out by suitably trained personnel in accordance with the applicable code of practice e.g. EN 60079-17.

5. Repair of this equipment shall be carried out by suitable trained personnel in accordance with the applicable code of practice e.g. EN 60079-19.

6. Putting into service, use, assembling, and adjustment of the equipment shall be fitted by suitably trained personnel in accordance with the manufacturer's documentation.

Refer to the "Table of Contents" of this service manual:

a. Installation
b. Operation
c. Maintenance
d. Parts Identification

7. Components to be incorporated into or used as replacement parts of the equipment shall be fitted by suitably trained personnel in accordance with the manufacturer's documentation.

8. The certification of this equipment relies upon the following materials used in its construction:

If the equipment is likely to come into contact with aggressive substances, then it is the responsibility of the user to take suitable precautions that prevent it from being adversely affected, thus ensuring that the type of protection provided by the equipment is not compromised.

Aggressive substances: e.g. acidic liquids or gases that may attack metals, or solvents that may affect polymeric materials.

Suitable precautions: e.g. regular checks as part of routine inspections or establishing from the material's data sheets that it is resistant to specific chemicals.

Refer to "Specifications" in the "Introduction" section:

a. All fluid passages contain stainless steel or nylon fittings.
b. High voltage cascade is encapsulated with a solvent resistant epoxy.

9. A recapitulation of the certification marking is detailed in the "ATEX" section, on the next page, drawing numbers: A10752, A10754, A10775, and A10915.

10. The characteristics of the equipment shall be detailed e.g. electrical, pressure, and voltage parameters.

The manufacturer should note that, on being put into service, the equipment must be accompanied by a translation of the instructions in the language or languages of the country in which the equipment is to be used and by the instructions in the original language.

MICROPAK A10406 ATEX PRODUCT MARKING DEFINITIONS

Ex Certificate Number: Sira 05 ATEX 5 127 X

Sira = Notified Body performing EC-type examination
05 = Year of certification
ATEX = Reference to ATEX Directive
5 = Protection Concept Code (code 5 is titled Encapsulation)
127 = Document serial number
X = Special conditions for safe use apply

Special conditions for safe use: The Evolver 79190, Series Automatic Atomizers shall only be used with associated MicroPak A10406 or LECU5004-31 Power Supplies.

Product Marking

 **II 2 G**

Ex = Specific marking of explosive protection
II = Equipment Group hazardous area characteristics
2 = Equipment Category
G = Type of explosive atmosphere (gases, vapors, or mists)

EEx 0.24mJ = The MicroPak A10406 Power Supply is suitable for use in automatic spraying installations complying with EN 50176 as they are a Type A class with a discharge energy limit of 0.24mJ.

NOTES

INTRODUCTION

GENERAL DESCRIPTION

The Evolver MicroPak™ Controller, is used to provide voltage to the cascade inside the Evolver Spray Gun Assembly.

The Evolver MicroPak Controller together with the Evolver Spray Gun Assembly and it's Low Voltage Cable is an "FM" Listed System. It is unique in that it contains a built-in DC Power Supply and is capable of operating either 1 or 2 Evolver MicroPak control units.

The MicroPak uses a combination of proven high voltage generation technology including microprocessor-based control with diagnostic and communication functions. The processor circuitry provides the maximum in applicator transfer efficiency, while maintaining the maximum safety when used in conjunction with FM listed applicators.

SAFETY FEATURES

When used with FM listed applicators, the MicroPak provides the ultimate in operational safety. The microprocessor circuits allow the use of output load curve control, which limits the high voltage output to safe levels, even with the controls set at maximum levels, and does so without a hard shut down. The Over-current setpoint, which can be monitored on the µa Display by pressing the SET push-button and holding for one second, does provide a hard shut down if the output current exceeds the setpoint. The KV setpoint is also displayed on the KV display when the SET pushbutton is pressed for one second.

DISPLAYS

The front panel displays for output voltage and current indicate the true outputs from the cascade or the tip voltage for indirect charge, and waterborne applications. They are derived from feedback signals in the low voltage cable between the controller and the cascade.

SPECIFICATIONS
(At Sea-Level Conditions)

Environmental / Physical

Temp. Operating:	(0° to 55° C)
Storage:	(-40° C to 85° C)
Humidity:	(95% Non-Condensing)
Cabinet Size:	13.0" Wide 19.0" Deep 7.0" Height
Weight:	19 lbs.

Electrical

DC Power Required: * (per MicroPak)	24 VDC at 2.5A (fully loaded output), HP404, Cascade
AC Electrical Requirements:	90-264 VAC @ 1.5 amps @ 47/63 Hertz

*** DC power supplied from 24VDC built-in, regulated power supy which has overcurrent (40%) and overvoltage (20%) protection.**

Electrical (Cont.)

Controls:
1) Discrete signals available via discrete I/O Module

Analog In:	KV SET (0-10VDC) OVER CURRENT SET (0-10VDC)
Discrete Out:	HV ON (+24V) HV READY (+24V) OVER CURRENT FAULT (+24V)
Discrete In:	HV RESET (+24V) HV ON (+24V)

MicroPak With HP404 FM

Output:	100 kV @ 0 µA (85 µA Max.)
Cascade Size:	1.50” x 1.56” x 7.0”

NOTES

INSTALLATION

MICROPAK INPUT POWER

For non-conduit installations, plug the detachable AC line cord into the receptacle on the rear of the Evolver MicroPak Controller. Plug the other end of the line cord into a properly grounded 120 Volt AC outlet.

NOTE

In general, conduit must be used for approved AC installation, however, if national and local codes permit, the AC power may be supplied via the factory supplied line cord.

For installations where it is required to run the AC input wiring in conduit, perform the following:

1. Ensure the AC line cord is unplugged and remove the top cover from the controller (see Figure 9).

2. Remove the AC Inlet Receptacle wiring from 1TB-L1, 1TB-N, and 1TB-Ground (see Figure 1 for AC input wiring locations).

⚠ WARNING

Always double check that the control unit is unplugged from its AC outlet before working with any internal wiring.

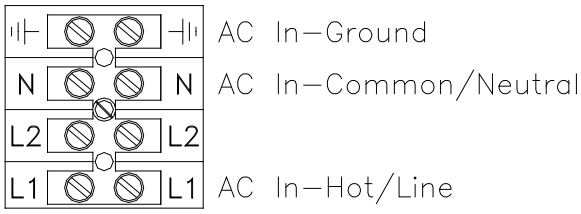


Figure 1: Terminal Block 1 (1TB

3. Remove the mounting hardware from the AC Inlet Receptacle and remove it from the rear of the control unit.

4. Install the Conduit Adapter Plate (supplied) in the hole where the AC Inlet Receptacle was removed (see Figure 2).

5. Install the AC line cord through the Conduit Adapter Plate using conduit and wire to 1TB as follows:

Hot/Line	to	1TB-L1
Neutral/common	to	1TB-N
Ground	to	1TB-Ground

6. Reinstall top cover on controller.

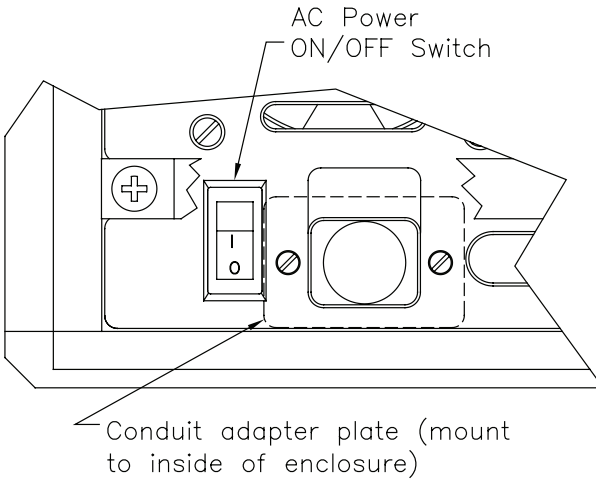


Figure 2: Installation of Conduit Adapter Plate

SAFETY GROUND

Install the ground wire assembly supplied with the Evolver MicroPak Controller from the ground stud on the rear of the controller to a true earth ground. For maximum noise immunity, cut the ground wire assembly to the shortest length required and reinstall the end lug before making connections.

⚠ CAUTION

➤ The ground wire assembly MUST be connected from the Evolver MicroPak Controller ground stud to a true earth ground.

LOW VOLTAGE CABLE

Standard Low Voltage Cable (A11353-XX)

Plug the connector of the low voltage cable assembly into the appropriate receptacle on the rear of the controller (see Figure 3). P1 is the output for the leftmost MicroPak control unit, when viewed from the front, and P2 is the output for the rightmost MicroPak control unit, if installed. When making the connection, line the red dot on the connector with the red mark on the receptacle and push in until it clicks. To remove, simply pull back on the knurled portion of the connector. Attach the low voltage cable(s) to the stress relief bar using TR-SSEM-200 cable ties (supplied) as shown in Figure 3.

Junction Box Cables (A11355-XX and A11356-XX)

The Evolver spray gun can be ordered with special low voltage cables (A11355-XX and A11356-XX) for splicing to a junction box. This is sometimes done in the field, to reduce the amount of cable that has to be replaced if a failure of the cable occurs.

The control unit and gun ends of these cables attach as described in the standard low voltage cable section above. Follow the instructions below to wire the junction box ends of these cables:

Junction Box in Hazardous Location

If the junction box is in the hazardous location, an explosion-proof junction box must be used. In this case, connect the numbered wires of cable A11356-XX to the same numbered wire of cable A11355-XX using a terminal strip inside the explosion-proof junction box. Ensure the junction box is grounded to earth ground. Connect wire 18 (braid) of cable A11355-XX to the junction box (ground). Seal the cable in the explosion-proof junction box using appropriate explosion-proof fittings and sealing compound. The exposed area of the cable braids must be located on the junction box side of the sealing compound.

Junction Box in Non-Hazardous Location

If the junction box is in a non-hazardous location, then it is not necessary to use an explosion-proof junction box. In this case, use the supplied cable gland (A11357-02) and gland nut (A11358-02) to secure the cables at their entry and exit to the junction box. Install the cable gland in the junction box and position the cable so that the spring of the gland makes contact to the exposed braid of the cable when the gland nut is tightened. Ensure the junction box is grounded to earth ground. Connect the numbered wires of cable A11356-XX to the same numbered wire of cable A11355-XX using a terminal strip inside the junction box. The braid of cable A11355-XX will be grounded through its contact to the cable gland spring and the grounded junction box. Wire 18, therefore is unnecessary and may be trimmed off. Connection in this manner will ensure maximum noise immunity.

INTERLOCKS AND I/O

Interlock and I/O connections are made to connector P3 on the rear of the controller. P3 consists of three, 8-position terminal blocks A, B, and C (see Figure 3). To wire to these terminal blocks, perform the following (see Figure 4):

1. Loosen the 2 screws of P3's connector housing and remove P3 from the controller.

2. Loosen the 4 screws holding the terminal block assembly to the inside of the connector housing and remove the terminal block assembly from the housing.

3. Feed the I/O / Interlock cable(s) through the cable grommet attached to the connector housing and pull out the other side. It may be necessary to remove the cable grommet to fit the cable(s) through. If so, slide the grommet connections onto the cable(s) in the order shown in Figure 4 before pulling the cable through the connector housing.

NOTE

➤ For maximum noise immunity, all wiring should be run in cables having a foil shield with an overall braided shield. The foil shield provides 100% shielding, while the braid provides a means of making proper 360° shield terminations at the cable ends.

4. Strip the jacket off the cable(s) 3" from the end and remove the braid 1.5" from the end (see Figure 5).

5. Strip the individual cable wires, install appropriate wire ferrules, and connect to the terminal blocks according to Table 1.

NOTE

If multiple I/O / Interlock cables are used, connect the exposed 1.5" cable braids together using copper tape.

6. Rotate the connector housing to achieve desired routing of the cable bundle (right or left), then reinstall the terminal block assembly into the connector housing.

7. Tighten the connector grommet ensuring the grommet spring makes 360° contact with the exposed cable braid/copper tape for maximum noise immunity.

For maximum noise immunity, the shields of the I/O and interlock cables should also be connected to earth ground at the end opposite to the MicroPak controller connections.

If it is necessary or desired to run the interlock and I/O cable(s) through conduit, an adapter can be readily purchased that converts the PG21 male threads of the P3 connector housing to 3/4" NPT male threads. This adapter is available through McMaster-Carr as their Part Number 7842K7.

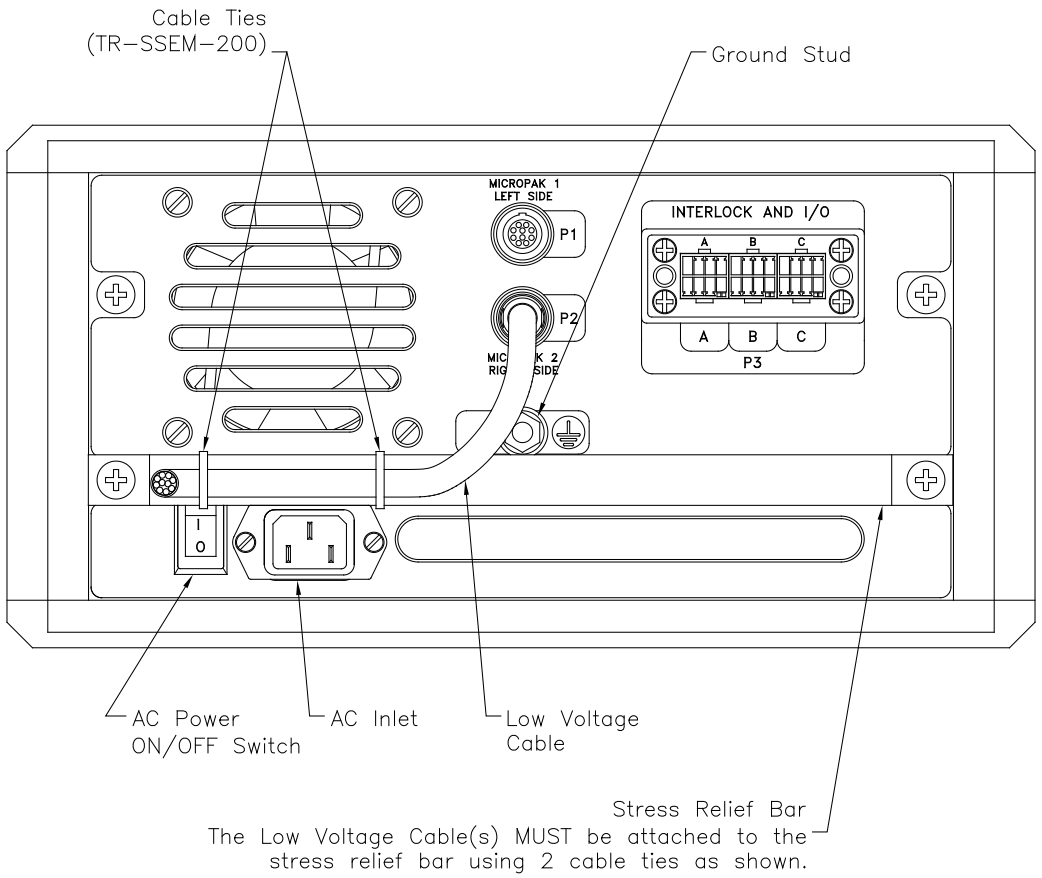


Figure 3: Rear View of Controller

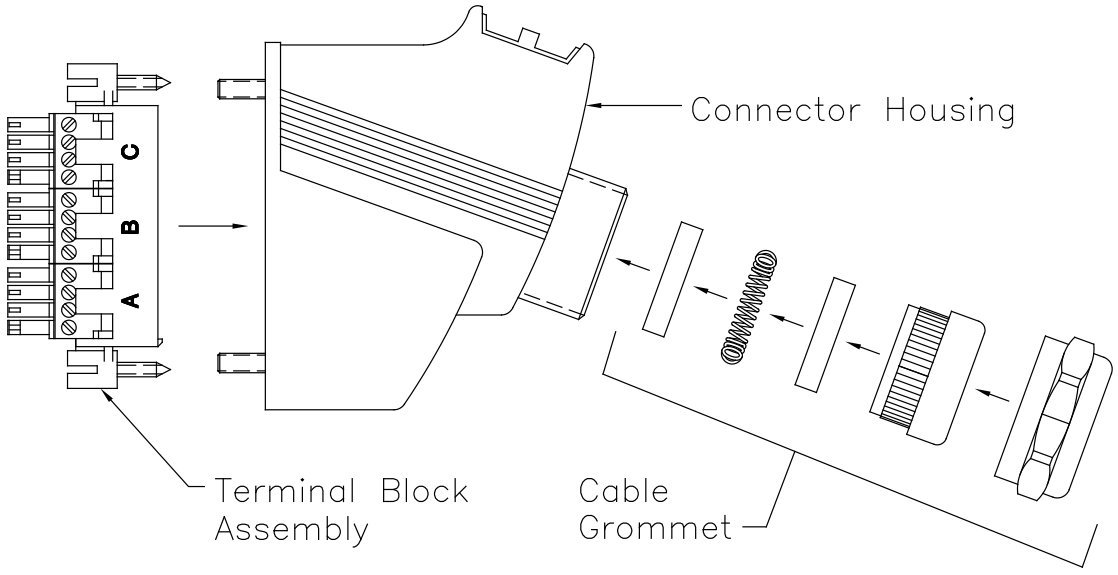


Figure 4: Connector P3 Wiring

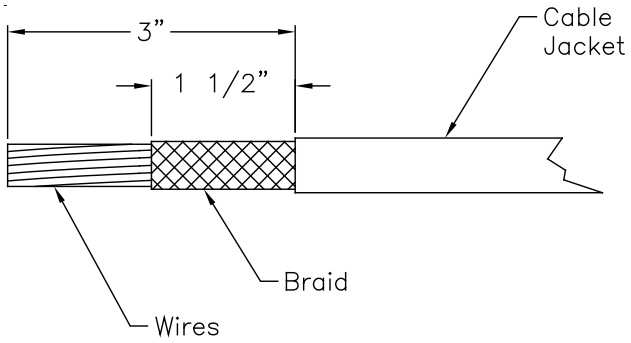


Figure 5: Stripping of I/O Cable(s)

DESCRIPTION OF TABLE 1 INTERLOCK AND I/O TERMINALS

Input Terminals

kV Setpoint (0-10VDC)

0 to 10 VDC remote analog signal input that controls applicator output from 0 to 100 kVDC when high voltage is enabled. This input is active when the MicroPak local/remote switch is in the remote position. Otherwise control is from the kV adjust knob on the front of the MicroPak. In either mode, the kV setpoint can be viewed by pushing and holding the View/Change Setpoint switch (see Figure 8) on the front of the MicroPak.

Over-Current Setpoint (0-10VDC)

0 to 10VDC remote analog signal input that sets the over-current point between 0 and 85 µA when high voltage is enabled. If the current goes above this setpoint an over-current fault will occur. This input is active when the MicroPak local/remote switch is in the remote position and dipswitch SW3-1 on the MicroPak process board (see Figure 6A) is set to the ON position. The range of the over-current setpoint in this mode is 0 to 3.30VDC equals 0 to 85 microamps. The microamps are limited to 85 for all voltages above 3.30VDC.

If the local/remote switch is in the remote position and dipswitch SW3-1 is OFF, then potentiometer R21 on the top of the MicroPak process board (see Figure 6A) will control the over-current setpoint.

This mode is convenient if it is desired to supply an analog input signal for the kV setpoint but not for the over-current setpoint.

Finally, if the local/remote switch is in the local position, the over-current setpoint is controlled by the µA adjust knob on the front of the MicroPak. In any of the modes, the over-current setpoint can be viewed by pushing and holding the View/Change Setpoint switch (see Figure 8) on the front of the MicroPak.

High Voltage Reset (24VDC)

24VDC remote input signal that allows remote reset of fault conditions. When a fault occurs, a momentary supply of 24VDC to this terminal will reset the fault. Faults can also be reset by moving the kV ON/OFF toggle switch on the front of the MicroPak to the OFF position and back to the ON position. This input can also be used to remove the MicroPak from ready mode.

High Voltage On (24VDC)

Remote input signal that enables high voltage. When 24VDC is supplied to this terminal, high voltage will be enabled. This input mode is active in either local or remote mode when dipswitch SW3-3 on the MicroPak process board (see Figure 6A) is set to the ON position and the Ready input is active (the ready input is made active by moving the High Voltage Enable Switch (see Figure 8) to the ON position or by connecting the remote Ready input (see Table 1) to ground). If in local mode and dipswitch SW3-3 is set to the OFF position, high voltage can only be triggered by moving the kV ON/OFF toggle switch on the front of the MicroPak to the ON position.

⚠ WARNING

➤ Never set dipswitch SW3-3 to the OFF position with the remote Ready input active (connected to ground) or high voltage will be on all the time (whenever AC power is on). Ensure dipswitch SW3- 3 is ON whenever the Remote Ready input is active.

Ready
Remote input used to put the MicroPak Control Unit in ready mode. This input is made active by a momentary ground connection. Once active, it can only be deactivated by activating the remote High Voltage Reset input or by momentarily moving the High Voltage Enable switch (see Figure 8) to the OFF position. This input must be made active (grounded) before high voltage can be enabled using the remote High Voltage On input. This can be done externally or by hardwiring this input to the P3-A2 ground connection for MicroPak #1 or the P3-A6 ground connection for MicroPak #2. When hardwired to ground, the MicroPak will be in HV ready mode whenever there are no faults present and the High Voltage Reset Input is not active.

⚠ WARNING

➤ When using the remote Ready input ensure dipswitch SW3-3 is in the ON position, or high voltage to the applicator will be enabled whenever the Ready input is made active.

Output Terminals

Each 24 VDC output is supplied through a relay contact capable of handling up to 1 amp of current. However, if one or more outputs are active at the same time, the total output current should not exceed 2 amps.

Overload (24VDC)
Remote output signal that puts out 24VDC when an over-current fault occurs.

HV Ready (24VDC)
Remote output signal that puts out 24VDC when the MicroPak is in high voltage ready mode. High voltage ready mode occurs when there are no fault conditions present, the high voltage has not yet been enabled and either the High Voltage Enable Switch is moved to the ON position or the remote Ready input is activated.

NOTE

➤ When in local mode and dipswitch SW3-3 is set to the OFF position HV Ready and HV On will occur at the same time.

HV On (24VDC)
Remote output signal that puts out 24VDC when high voltage is enabled.

Interlock Terminal
Terminal that allows interlocking of high voltage with safety components. In order to obtain high voltage, the interlock terminal for the respective MicroPak control unit must be connected to ground by a jumper or voltage free contact. If the high voltage is enabled without the interlock terminal being connected to ground, high voltage output will not occur. This terminal is a convenient place to interlock the controller with the exhaust fan and conveyor as required by NFPA-33. If the interlock connection is momentarily lost, the connection must be restored and the high voltage re-enabled before the high voltage output will turn back on.

Other Terminals

Ground
Terminals supplied for ground connections of various inputs and outputs.

Table 1 - Electrical I/O

MicroPak 1	
Inputs:	**P3 Terminal**
kV Setpoint (0-10VDC)	C4
Overcurrent Setpoint (0-10VDC)	C3
High Voltage Reset (24VDC)	C2
High Voltage On (24VDC)	C1
Ready	A1
Outputs:	
Overload (24VDC)	B4
HV Ready (24VDC)	B3
HV On (24VDC)	B2
Interlock:	
Interlock Line A	A3
Other:	
Ground	B1
Ground	A2

MicroPak 2	
Inputs:	**P3 Terminal**
kV Setpoint (0-10VDC)	C8
Overcurrent Setpoint (0-10VDC)	C7
High Voltage Reset (24VDC)	C6
High Voltage On (24VDC)	C5
Ready	A5
Outputs:	
Overload (24VDC)	B8
HV Ready (24VDC)	B7
HV On (24VDC)	B6
Interlock:	
Interlock Line A	A7
Other:	
Ground	B5
Ground	A6

DIP SWITCH SUMMARY
(See Figure 6A & 6B)

MicroPak Process Board Dipswitch SW3-1

In remote mode, determines whether over-current setpoint control is provided by the remote Over-current Setpoint analog input or from R21 of the MicroPak process board. If dipswitch SW3-1 is ON control is from the remote analog input. If dipswitch SW3-1 is OFF control is from potentiometer R21.

MicroPak Process Board Dipswitch SW3-3

Determines whether high voltage is enabled when ready mode is active. If dipswitch SW3-3 is ON, high voltage is NOT enabled in ready mode. Therefore, separate ready and high voltage enable signals are required to enable high voltage. This is the typical setting for remote mode. If dipswitch SW3-3 is OFF, high voltage IS enabled when ready mode becomes active. This is the typical setting for local (manual) mode, so that pushing the High Voltage Enable Switch to the ON position will enable high voltage output without requiring a ready signal.

⚠ WARNING

➤ Dipswitch SW3-3 should never be set to OFF while the remote Ready input is active or high voltage will be on all of the time (whenever AC power is on).

Discrete I/O Board Dipswitch SW2-1

This dipswitch is set according to the cascade in use with the MicroPak Control Unit. It is factory set to the ON position for use with the HP404 FM cascade in the Evolver applicator.

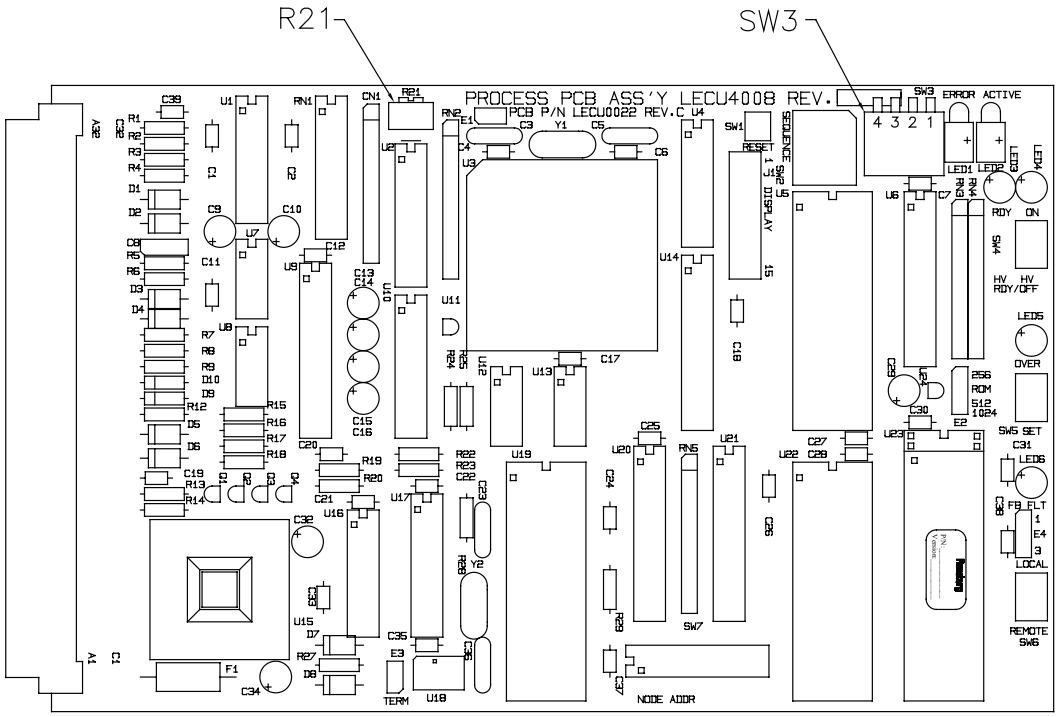


Figure 6A: MicroPak Process Board

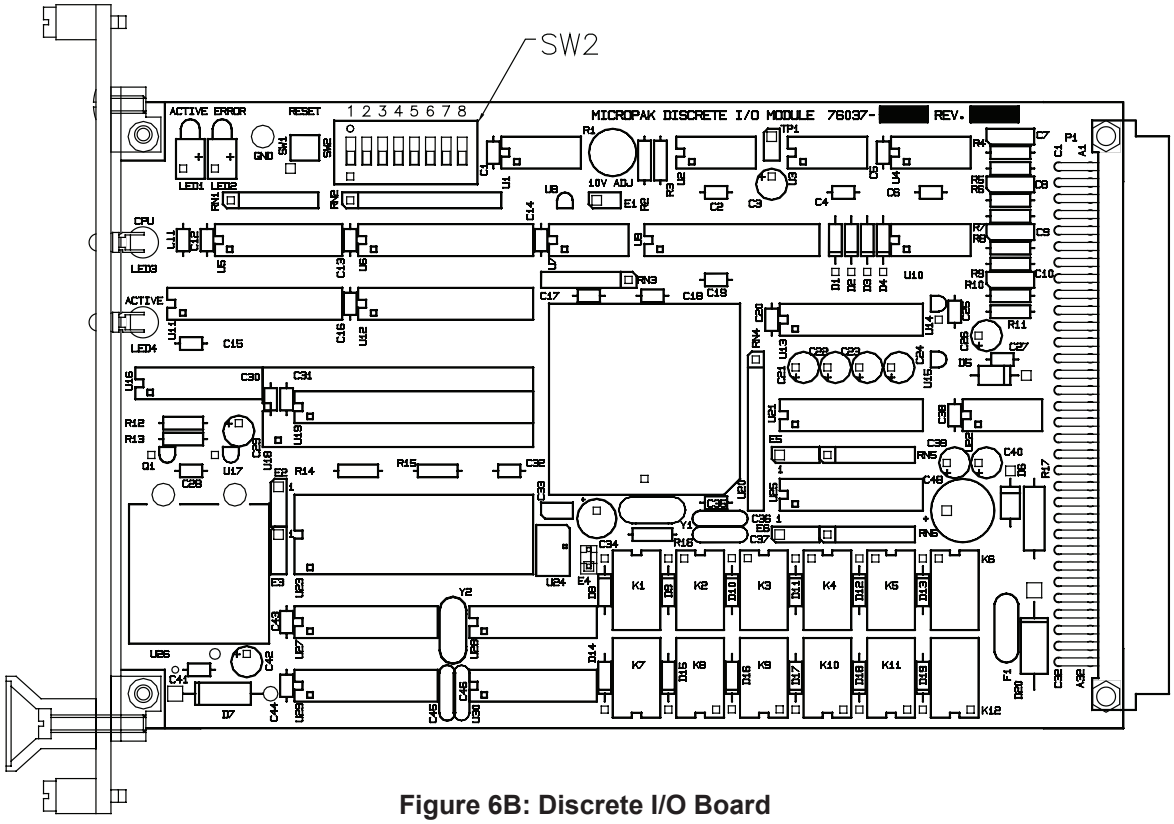


Figure 6B: Discrete I/O Board

MICROPAK GROUNDING THEORY

Electrical noise refers to stray electrical signals in the atmosphere at various signal strengths and frequencies that can affect the operation of electrical equipment. One of the best ways to prevent this is to shield the equipment and cables with a continous ground envelope, such that any incident noise will be conducted to earth ground before it can affect the circuit conductors.

For conductors inside the Evolver MicroPak Controller, the grounded enclosure provides this envelope. For the low voltage cable(s) that run from the controller to the Evolver spray guns, a shielded cable has been used. The shield consists of an overall foiled shield in combination with an overall braided shield. This provides the most effective shielding, as the foil covers the “holes” in the braid, and the braid allows for practical 360° termination at both ends of the cable.

The AC input cord is not shielded, but instead is directed to an AC line filter in the 24VDC power supply as soon as it enters the cabinet. This filter filters out any noise that comes in on the AC line. For maximum noise immunity the AC line should connect to the filter as soon as possible after it enters the cabinet. Additional noise protection can be provided by running the AC input line to the controller in grounded conduit, which is the recommended method and is required by most codes.

For maximum noise protection any user supplied input/output (I/O) wiring should be made using shielded cable or conduit which is connected to earth ground in a continuous 360° fashion at both ends. The best way to do this is to use a conductive connector/fitting at each end of the cable/conduit that makes contact to the shield/conduit in a full 360° circle around the shield/conduit and makes contact to the grounded enclosure in the same fashion. Connecting the drain wire of a shield to a ground point on or in the cabinet (usually referred to as pigtailing) is not an effective method of shielding and can actually make things worse (see Figure 7).

A special cable grommet fitting has been provided for I/O connector P3 of the controller (see Figure 4). When the nut is tightened, the spring in the grommet compresses and makes 360° contact with the braid of the cable. This electrically connects the cable braid to ground via the connector housing and controller back panel.

Using the methods described above, the Evolver MicroPak controller has been successfully tested to the stringent standards of the Electromagnetic Compatibility Directive of the European Union. The results conclude that the Evolver MicroPak Controller is neither a source of electrical noise nor affected by electrical noise when the above methods are utilized.

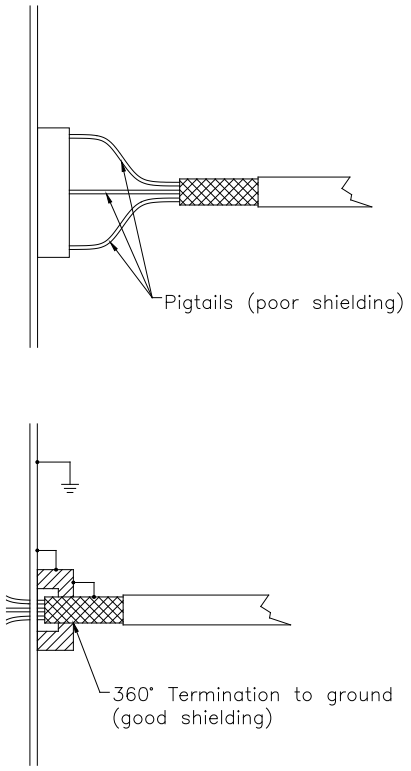


Figure 7: Cable Connection Examples

OPERATION

OPERATING CONTROLS
(See Figures 2 & 8)

AC Power ON/OFF Switch (Figure 2)
Turns AC Power to the Evolver MicroPak Controller on or off.

NOTE

➤ This switch is located on the rear of the controller.

MicroPak ON/OFF Switch
Turns 24VDC power to the MicroPak control unit on or off.

MicroPak Power Indicator
Glows yellow when the MicroPak ON/OFF switch is in the ON position.

µA Adjust Knob
Used to adjust the over-current setpoint in combination with the View/Change Setpoint switch when in local mode.

kV Adjust Knob
Used to adjust the kV setpoint when in local mode.

Kilovolt Meter Display
Displays voltage in thousands of volts (kilovolts) present at the applicator electrode.

High Voltage Ready Indicator
Glows yellow when High Voltage Ready to the MicroPak is enabled.

NOTE

➤ In local mode, with dipswitch SW3-3 OFF, the HV Ready Indicator will not light until the high voltage is enabled.

High Voltage ON Indicator
Glows red when high voltage to the applicator is enabled.

High Voltage Enable/Fault Reset Switch
Enables high voltage to the applicator when momentarily moved to the ON position in local mode with dipswitch SW3-3 off. If dipswitch SW3-3 is ON high voltage enable is from the remote High Voltage ON input instead. Also, resets faults when momentarily moved to the OFF position.

CPU Indicator
Glows green whenever power is supplied to the Discrete I/O Module.

Active Indicator
Glows green whenever the Discrete I/O Module is communicating with the MicroPak Control Unit.

Over-Current Fault Indicator
Glows yellow whenever the current from the applicator exceeds the over-current setpoint.

View/Change Setpoint Switch
Displays present current and voltage setpoints when held in for 1 to 2 seconds. These settings can be adjusted while the switch is held in as follows:

When in local mode the kV setpoint is adjusted using the kV adjust knob. When in remote mode the kV setpoint is adjusted by changing the remote 0 to 10VDC kV setpoint input. When in local mode, the over-current setpoint is adjusted by using the uA Adjust Knob. When in remote mode the over

current setpoint is adjusted by potentiometer R21 if dipswitch SW3-1 is OFF, or by the remote 0 to 10VDC over-current setpoint input if dipswitch SW3-1 is ON.

Feedback Fault Indicator
Glows yellow whenever a feedback fault occurs. The feedback fault monitors the HV and current feedback signals from the cascade for abnormal signal levels. A feedback fault indicates a possible open circuit between the controller and the cascade located in the Evolver applicator. Check the low voltage cable and its' connections for the cause. When high voltage is on, a feedback fault may also indicate a defective cascade. If the Feedback Fault Indicator comes on and flashes, this indicates a board malfunction. In this case, the MicroPak Control Unit should be removed from service and sent back to Ransburg for repair.

Local/Remote Switch
Determines whether the MicroPak Control Unit is in local or remote mode. In local mode the kV and over-current setpoints come from the front panel kV and µA Adjust Knobs, respectively. In remote mode, the kV setpoint comes from the remote analog 0-10VDC kV input and the current setpoint comes from either R21 at the top of the MicroPak process Board (see Figure 6A) or from the remote analog 0-10VDC Over-Current Setpoint input, depending on the setting of dipswitch SW3-1.

Microamp Meter Display
Displays current in millionths of amps (microamps) being drawn from the applicator electrode.

OPERATING PROCEDURES
(See Figures 2 & 8 for Operating Controls)

Typical Local Mode
1. Ensure the AC power, safety ground, low voltage cable, and interlock connections are made as described in the "Installation" section of this manual.

2. Turn the high voltage adjustment knob fully counter-clockwise.

3. Turn the AC Power ON/OFF switch (see Figure 2) to the ON position. When the AC power is on the green CPU Indicator on the front of the Discrete I/O module will illuminate.

4. Turn the MicroPak ON/OFF switch to the ON position. The kV and µA displays will come on along with the yellow MicroPak Power Indicator located above the switch.

5. Momentarily push the High Voltage Enable Switch to the ON position. Assuming dipswitch SW3-3 is off, the red High Voltage On Indicator should turn on.

6. Using the kV Adjust Knob set the kV output to the desired value as displayed on the kV Meter. Ensure the over-current setpoint is set above the maximum expected current, or an overload fault will occur. The over-current setpoint can be adjusted by turning the µA Adjust Knob with the View/Change Setpoint Switch held in.

7. To turn high voltage off, momentarily move the High Voltage Enable Switch to the OFF position.

8. When finished spraying, turn the AC Power ON/OFF Switch (see Figure 2) to the OFF position to prolong the life of the internal fan.

Typical Remote Mode
1. Ensure the AC power, safety ground, low voltage cable, I/O, and interlock connections are made as described in the "Installation" section of this manual.

2. Set the 0-10VDC kV setpoint input to its minimum value (0 volts).

3. Turn the AC Power ON/OFF switch (see Figure 2) to the ON position. When the AC power is on the green CPU Indicator on the front of the Discrete I/O module will illuminate.

4. Turn the MicroPak ON/OFF switch to the ON position. The kV and µA displays will come on along with the yellow MicroPak Power Indicator located above the switch.

5. Supply a momentary ground connection to the Ready input shown in Table 1. The yellow High Voltage Ready Indicator should turn on.

6. Supply a 24VDC signal to the High Voltage On input shown in Table 1. The red High Voltage On Indicator should turn on.

7. Adjust the 0-10VDC kV setpoint input to obtain the desired value on the kV Meter. Ensure the over-current setpoint is set above the maximum expected current, or an overload fault will occur. The over-current setpoint can be adjusted by changing the setpoint of R21 if dipswitch SW3-1 is OFF, or by changing the value of the 0-10VDC over-current setpoint input (see Table 1) if dipswitch SW3-1 is ON.

8. To turn high voltage off, remove the 24VDC signal from the high voltage on input.

9. When finished spraying, turn the AC Power ON/OFF Switch (see Figure 2) to the OFF position to prolong the life of the internal fan.

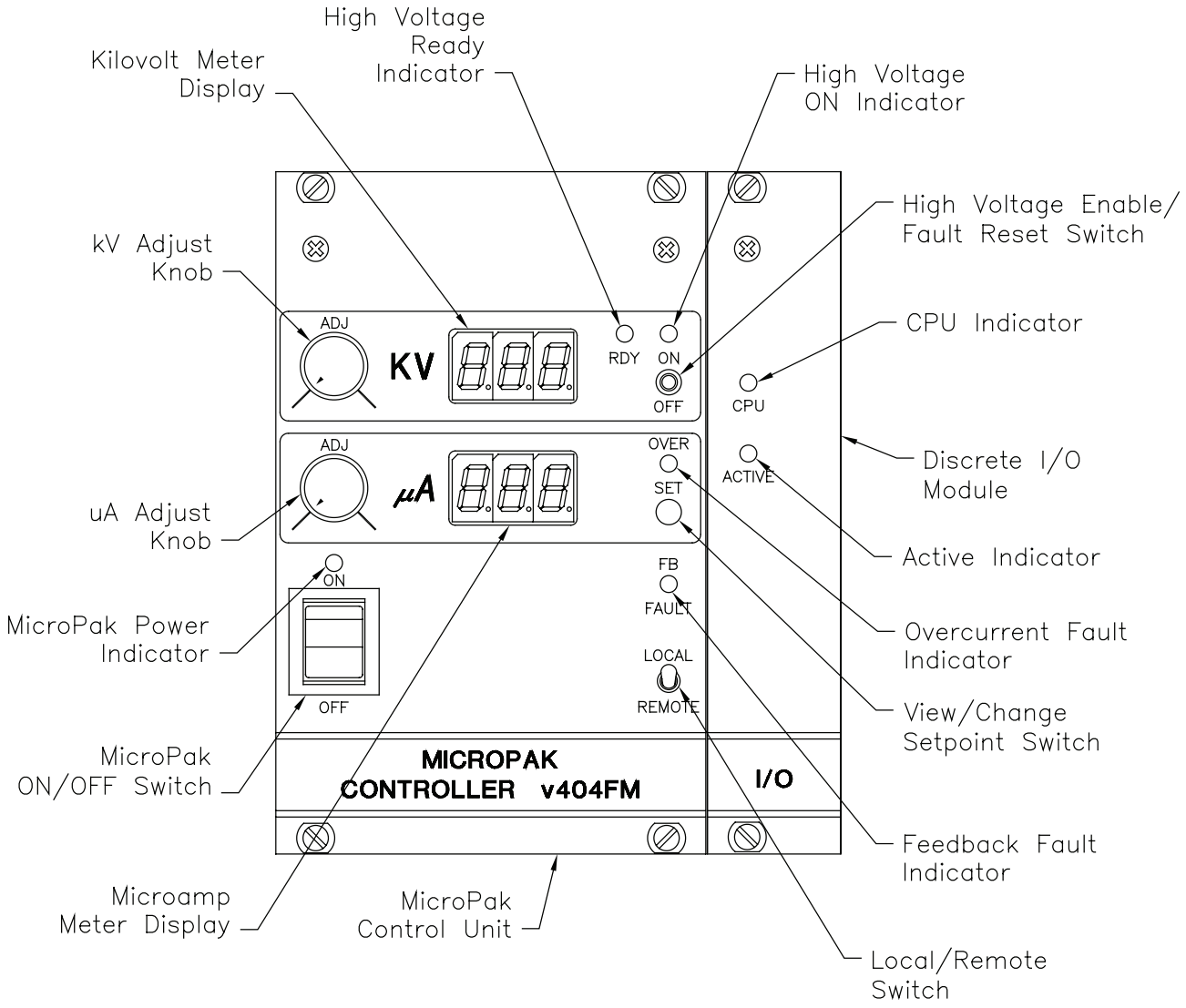


Figure 8: Operating Controls

MAINTENANCE

TROUBLESHOOTING

Following are some areas to investigate when high voltage faults occur:

- Dirty atomizer interior or exterior.
- Conductive solvent residue on atomizer assembly.
- Moisture inside or outside of atomizer body, causing continuity or partial continuity back to ground.
- Moisture inside or outside of air lines back to ground (high humidity).
- Loose connections or defective low voltage cable.
- Loose or defective ground connections.
- Dump lines not clean or dry leading back to ground.
- Target not grounded and causing arcing to ground.

CABLE CONTINUITY TEST

When problems arise, the Cable Continuity Test can be performed to help determine whether the problem is with the Evolver MicroPak controller or the cable and/or cascade assembly.

⚠ WARNING

➤ Because this test involves access to the interior of the Evolver MicroPak controller, where hazardous voltages may be present, it should only be performed by qualified electronics technicians.

To conduct the test, perform the following:

1. Ensure that the controller is disconnected from the AC source.

2. Using a screwdriver, pry open the 6 screw covers on the top panel of the controller, remove the screws, and remove the top panel (see Figure 9).

3. Disconnect connector J3 (see Figure 9) from the rear of the problem MicroPak unit (1 or 2). Leave the other end of the Low Voltage Cable connected to the Evolver Spray Gun.

4. Using an ohmmeter, measure the resistance values between the wires of MicroPak connector J3. The readings should be as shown in Table 2. If any of the readings are significantly outside the values listed in Table 2, the low voltage cable and/or cascade should be checked for the cause of the problem. Otherwise, the cause of the problem is most likely the controller.

5. Reconnect connector J3 and reattach the cover panel to the controller.

TROUBLESHOOTING GUIDE

⚠ WARNING

➤ The "Troubleshooting Guide" below requires measurement of potentials that can cause serious bodily injury if proper measuring procedures are not followed. For this reason, proper troubleshooting should ONLY be conducted by qualified electronics technicians using specific test equipment.

General Problem	Possible Cause	Solution
MicroPak Power Indicator and Meters do not light up when MicroPak ON/OFF Switch is turned ON	AC Power ON/OFF switch on rear of controller not turned ON.	Turn AC Power ON/OFF Switch on.
	Improper input line voltage.	Ensure voltage across terminals L1 and N of terminal block 1TB is between 90 and 264 VAC.
	Fuse of 24VDC power supply is defective.	Check fuse and replace if defective (see Figure 9).
	Defective 24VDC power supply.	Voltage across terminals 1 and 8 of connector CON2 (see Figure 9) of 24VDC power supply should be 24VDC. If not, replace 24VDC power supply.
	Defective MicroPak Control Unit.	If none of the suggestions above resolves the issue, replace the LECU5004-31 MicroPak Control Unit.
No or Low kV Output at Spray Gun when HV ON Indicator (red LED) is Lit	High voltage adjust knob or kV setpoint input not set to proper value.	Set high voltage adjust knob or kV set point input to proper value.
	Local/remote switch in wrong position.	Put local/remote switch in proper position.
	Defective spray gun or low voltage cable.	Perform a Cable Continuity Test. If proper readings are not obtained, check cable or spray gun for cause (see current "Spray Gun" Service Manual).
	Loose or broken wire in power supply.	Check all wiring connections for integrity. Repair wiring as needed.

(Continued On Next Page)

TROUBLESHOOTING GUIDE (Cont.)

General Problem	Possible Cause	Solution
No kV Output at Spray Gun and HV ON Indicator (red LED) is not Lit	Improper interlock connection.	Ensure interlock connection is connected to ground through a jumper or voltage free contact as detailed in the "Installation" section of this manual.
	High voltage ready condition not activated.	Activate the high voltage ready input or set dipswitch 3-3 to the OFF position.
	High Voltage On input not activated.	Supply 24VDC to the High Voltage On input or if in manual mode, move the High Voltage Enable switch to the ON position.
	Defective MicroPak Control Unit.	If none of the suggestions above resolves the issue, replace the LECU5004-31 MicroPak Control Unit.
Power Supply Overloads Excessively	Parts are too close to the spray gun.	Ensure sufficient distance between spray gun and parts.
	Overload setpoint set too sensitive.	Increase the µA setpoint using the µA Adjust Knob, process board potentiometer R21, or the 0-10VDC over-current setpoint input.
	Defective spray gun or cable.	Perform a Cable Continuity Test. If proper readings are not obtained, check cable or spray gun for cause (see current "Spray Gun" service manual).
	Defective MicroPak Control Unit.	If none of the suggestions above resolves the issue, replace the LECU5004-31 MicroPak Control Unit.
High Voltage on all the time.	Ready input is active and dipswitch SW3-3 is off.	Disable ready input or turn dipswitch SW3-3 off.
Component not working, but kV Output OK.	Wiring to/from component loose or broken.	Repair loose or broken wire.
	Defective component.	Replace component.

Table 2. Ohmeter Measurements in Ohms from MicroPak Connector J3 through the Low Voltage Cable to the HP404 Cascade.

Signal	IFB	Vct	Vct	DrB	DrA	SigGnd	kVFB	PLFB	VctRet
From Wire	2 (white)	3 (red)	4 (black)	5 (green)	6 (blue)	9 (grn/yel)	10 (gray)	11 (orange)	16 (bare)
To Wire									
2 (white)	XX	open ckt.	open ckt.	open ckt.	open ckt.	19K - 21K	400K-600K	0 - 3	open ckt.
3 (red)		XX	0 - 3	0 - 3	0 - 3	open ckt.	open ckt.	open ckt.	open ckt.*
4 (black)			XX	0 - 3	0 - 3	open ckt.	open ckt.	open ckt.	open ckt.*
5 (green)				XX	0 - 3	open ckt.	open ckt.	open ckt.	open ckt.*
6 (blue)					XX	open ckt.	open ckt.	open ckt.	open ckt.*
9 (grn/yel)						XX	400K-600K	19K - 21K	open ckt.
10 (gray)							XX	400K-600K	open ckt.
11 (orange)								XX	open ckt.
16 (bare)									XX

* - Meter reading may vary in the megohms range due to capacitance across pins.

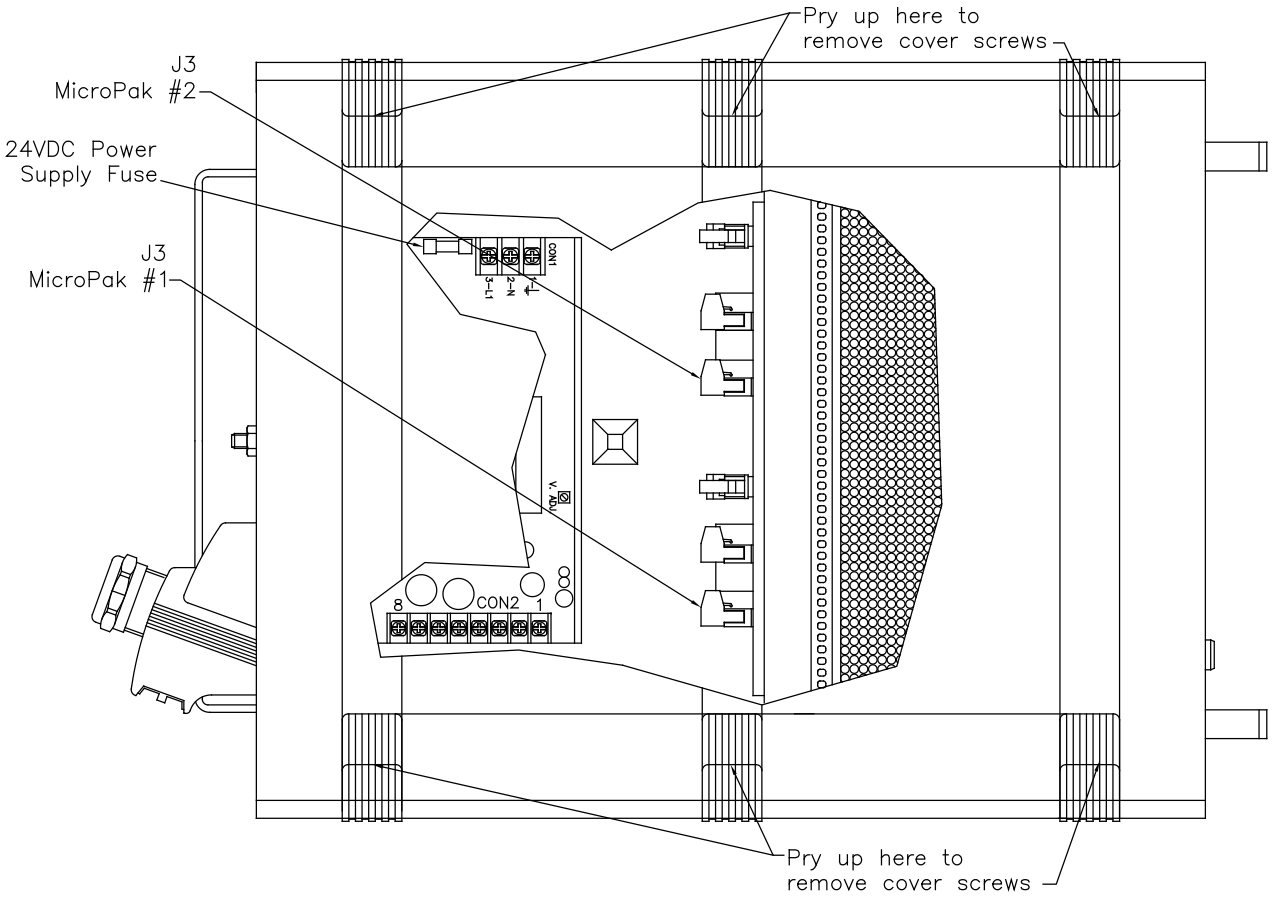


Figure 9: Controller Top View

PARTS IDENTIFICATION

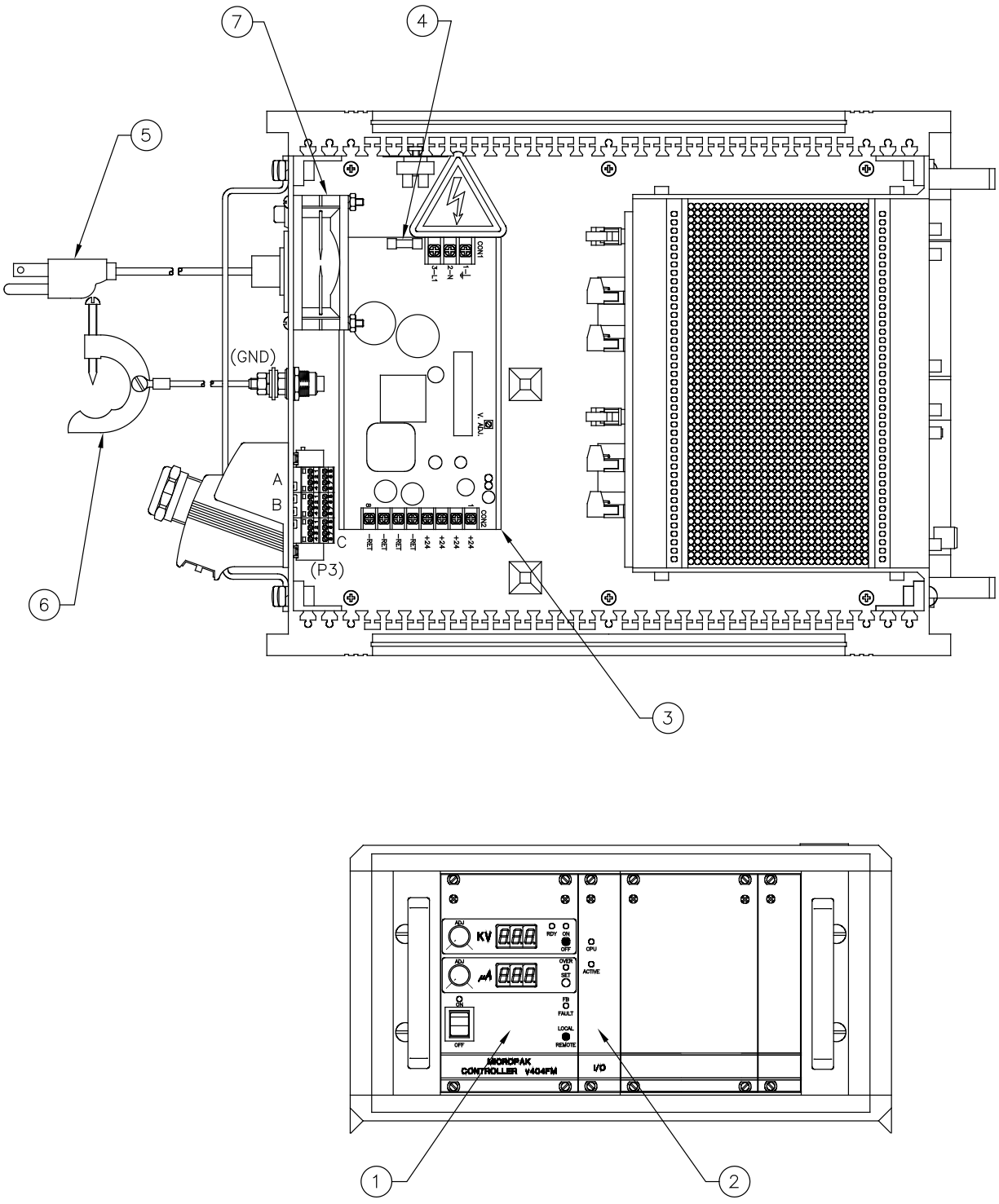


Figure 10: Evolver MicroPak Controller Parts Diagram

EVOLVER MICROPAK CONTROLLER - PARTS LIST (Figure 9)		
Item #	**Part #**	**Description**
1	LECU5004-31	MicroPak Control Unit
2	A11435-00	Discrete I/O Module (0-10VDC)
3	78835-00	24VDC Power Supply
4	72771-19	Fuse, 5A, 250V, 5 X 20mm, Type T (Time Delay)
5	76449-00	AC Line Cord, Detachable
6	70539-00	Ground Wire Assembly
7	A10515-00	Fan, 24VDC
8	A11353-XX	Low Voltage Cable (Not Shown)
9	A11355-XX	Low Voltage Cable, Junction Box to Applicator (Not Shown)
10	A11356-XX	Low Voltage Cable, Controller to Junction Box (Not Shown)

RECOMMENDED SPARE PARTS		
Part #	**Description**	**Qty**
LECU5004-31	MicroPak Control Unit	1
A11435-00	Discrete I/O Module (0-10VDC)	1
72771-19	Fuse, 5A, 250V, 5 X 20mm, Type T (Time Delay)	5
(See Parts List)	Low Voltage Cable	1

WARRANTY POLICIES

LIMITED WARRANTY

Ransburg will replace or repair without charge any part and/or equipment that falls within the specified time (see below) because of faulty workmanship or material, provided that the equipment has been used and maintained in accordance with Ransburg's written safety and operating instructions, and has been used under normal operating conditions. Normal wear items are excluded.

THE USE OF OTHER THAN RANSBURG APPROVED PARTS, VOID ALL WARRANTIES.

SPARE PARTS: One hundred and eighty (180) days from date of purchase, except for rebuilt parts (any part number ending in "R") for which the warranty period is ninety (90) days.

EQUIPMENT: When purchased as a complete unit, (i.e., guns, power supplies, control units, etc.), is one (1) year from date of purchase. **WRAPPING THE APPLICATOR IN PLASTIC, SHRINK-WRAP, ETC., WILL VOID THIS WARRANTY.**

RANSBURG'S ONLY OBLIGATION UNDER THIS WARRANTY IS TO REPLACE PARTS THAT HAVE FAILED BECAUSE OF FAULTY WORKMANSHIP OR MATERIALS. THERE ARE NO IMPLIED WARRANTIES NOR WARRANTIES OF EITHER MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. RANSBURG ASSUMES NO LIABILITY FOR INJURY, DAMAGE TO PROPERTY OR FOR CONSEQUENTIAL DAMAGES FOR LOSS OF GOODWILL OR PRODUCTION OR INCOME, WHICH RESULT FROM USE OR MISUSE OF THE EQUIPMENT BY PURCHASER OR OTHERS.

EXCLUSIONS:

If, in Ransburg's opinion the warranty item in question, or other items damaged by this part was improperly installed, operated or maintained, Ransburg will assume no responsibility for repair or replacement of the item or items. The purchaser, therefore will assume all responsibility for any cost of repair or replacement and service related costs if applicable.

APPENDIX

RANSBURG PAINT AND SOLVENT SPECIFICATIONS

	REA® / EFM™	REM™ / M90	NO. 2 HAND GUN	TURBODISK™	AEROBELL™ II*** AEROBELL™ AEROBELL™ 33 RMA™-101
RECOMMENDED VISCOSITY USING A ZAHN NO. 2	18 TO 30 SEC	18 TO 30 SEC	20 TO 60 SEC	20 TO 60 SEC	20 TO 60 SEC
PAINT ELECTRICAL RESISTANCE**	.1 MΩ TO ∞	.1 MΩ TO ∞	.1 TO 1 MΩ	.1 MΩ TO ∞	.1 MΩ TO ∞
RECOMMENDED DELIVERY (UP TO)	1000 cc/min	1500 cc/min	180 cc/min	1000 cc/min	500 cc/min

GUIDE TO USABLE SOLVENT SELECTION

CHEMICAL NAME	*COMMON NAME*	*CATEGORY*	**CAS NUMBER*	*FLASH POINT†† (TCC)*	**EVAP. RATE†**	*ELEC. RES.***
DICHLOROMETHANE	Methylene Chloride	Chlorinated Solvents	75-09-2		**14.5**	HIGH
MYTHYL ACETATE		Esters	79-20-9	90°F	**5.3**	LOW
VM & P NAPHTHA	Naptha	Aliphatic Hydrocarbons	803-232-4	65°F	**10**	HIGH
ACETONE		Ketones	67-64-1	-18°F	**5.6**	LOW
BENZENE		Aromatic Hydrocarbons	71-43-2	12°F	**5.1**	HIGH
ETHYL ACETATE		Esters	141-78-6	24°F	**3.9**	MEDIUM
2-BUTANONE	MEK	Ketones	78-93-3	16°F	**3.8**	MEDIUM
ISO-PROPYL ACETATE		Esters	108-21-4	35°F	**3.4**	LOW
ISOPROPYL ALCOHOL	IPA	Alcohols	67-63-0	53°F	**2.5**	LOW
2-PENTANONE	MPK	Ketones	107-87-9	104°F	**2.5**	MEDIUM
METHANOL	Methyl Alcohol	Alcohols	67-56-1	50°F	**2.1**	LOW
PROPYL ACETATE	n-Propyl Acetate	Esters	109-60-4	55°F	**2.1**	LOW
TOLUOL	Toluene	Aromatic Hydrocarbons	108-88-3	48°F	**1.9**	HIGH
METHYL ISOBUTYL KETONE	MIBK	Ketones	108-10-1	60°F	**1.6**	MEDIUM
ISOBUTYL ACETATE		Esters	110-19-0	69°F	**1.5**	LOW
ETHANOL	Ethyl Alcohol	Alcohols	64-17-5		**1.4**	LOW
BUTYL ACETATE		**Esters**	**123-86-4**	**78°F**	**1.0**	**LOW**
ETHYLBENZENE		Aromatic Hydrocarbons	100-41-4	64°F	**.89**	HIGH
1-PROPANOL	n-Propyl Alcohol	Alcohols	71-23-8	74°F	**.86**	LOW
2-BUTANOL	sec.-Butyl Alcohol	Alcohols	78-92-2	72°F	**.81**	LOW
XYLOL	Xylene	Aromatic Hydrocarbons	133-02-07	79°F	**.80**	HIGH
AMYL ACETATE		Esters	628-63-7	106°F	**.67**	MEDIUM
2-METHYLPROPANOL	iso-Butyl Alcohol	Alcohols	78-83-1	82°F	**.62**	LOW
METHYL AMYL ACETATE		Esters	108-84-9	96°F	**.50**	LOW
5-METHYL-2-HEXANONE	MIAK	Ketones	110-12-3	96°F	**.50**	MEDIUM
1-BUTANOL	n-Butyl Alcohol	Alcohols	71-36-3	95°F	**.43**	LOW
2-ETHOXYETHANOL		Glycol Ethers	110-80-5	164°F	**.38**	LOW
2-HEPTANONE	MAK	Ketones	110-43-0	102°F	**.40**	MEDIUM
CYCLOHEXANONE		Ketones	108-94-1	111°F	**.29**	MEDIUM
AROMATIC-100	SC#100	Aromatic Hydrocarbons		111°F	**.20**	HIGH
DIISOBUTYL KETONE	DIBK	Ketones	108-83-8	120°F	**.19**	MEDIUM
1-PENTANOL	Amyl Alcohol	Alcohols	71-41-0		**.15**	LOW
DIACETONE ALCOHOL		Ketones	123-42-2	133°F	**.12**	LOW
2-BUTOXYETHANOL	Butyl Cellosolve	Glycol Ethers	111-76-2	154°F	**.07**	LOW
CYCLOHEXANOL		Alcohols	108-93-0	111°F	**.05**	LOW
AROMATIC-150	SC#150	Aromatic Hydrocarbons		149°F	**.004**	HIGH
AROMATIC-200		Aromatic Hydrocarbons		203°F	**.003**	HIGH

FASTER ↓ SLOWER

* CAS Number: Chemical Abstract Service Number.
** Using the Ransburg Meter.
*** Solventborne Configuration Only.
† Information Obtained From: http://solvdb.ncms.org
Evaporation Rate is Based Upon Butyl Acetate Having a Rate of 1.0

NOTE: This page provides resistivity determination and control information that we feel is necessary when using Ransburg equipment.

VISCOSITY CONVERSION CHART

Poise	Centipoise	Parlin 7	Parlin 10	Fisher 1	Fisher 2	Ford Cup 3	Ford Cup 4	Gardner - Holdt Bubble	Gardner - Lithographic	Krebs Unit KU	Saybolt Universal SSU	Zahn 1	Zahn 2	Zahn 3	Zahn 4	Zahn 5	Sears Craftsman Cup	Din Cup 4
.1	10	27	11	20			5	A-4			60	30	16					10
.15	15	30	12	25			8	A-3			80	34	17					11
.2	20	32	13	30	15	12	10				100	37	18					12
.25	25	37	14	35	17	15	12	A-2			130	41	19					13
.3	30	43	15	39	18	19	14	A-1			160	44	20					14
.4	40	50	16	50	21	25	18	A			210	52	22				19	15
.5	50	57	17		24	29	22			30	260	60	24				20	16
.6	60	64	18		29	33	25	B		33	320	68	27				21	18
.7	70		20		33	36	28			35	370		30				23	21
.8	80		22		39	41	31	C		37	430		34				24	23
.9	90		23		44	45	32			38	480		37	10			26	25
1.0	100		25		50	50	34	D		40	530		41	12	10		27	27
1.2	120		30		62	58	41	E		43	580		49	14	11		31	31
1.4	140		32			66	45	F		46	690		58	16	13		34	34
1.6	160		37				50	G		48	790		66	18	14		38	38
1.8	180		41				54		000	50	900		74	20	16		40	43
2.0	200		45				58	H		52	1000		82	23	17	10	44	46
2.2	220						62	I		54	1100			25	18	11		51
2.4	240						65	J		56	1200			27	20	12		55
2.6	260						68			58	1280			30	21	13		58
2.8	280						70	K		59	1380			32	22	14		63
3.0	300						74	L		60	1475			34	24	15		68
3.2	320							M			1530			36	25	16		72
3.4	340							N			1630			39	26	17		76
3.6	360							O		62	1730			41	28	18		82
3.8	380										1850			43	29	19		86
4.0	400							P		64	1950			46	30	20		90
4.2	420										2050			48	32	21		95
4.4	440							Q			2160			50	33	22		100
4.6	460							R		66	2270			52	34	23		104
4.8	480								00	67	2380			54	36	24		109
5.0	500							S		68	2480			57	37	25		112
5.5	550							T		69	2660			63	40	27		124
6.0	600							U		71	2900			68	44	30		135
7.0	700									74	3375				51	35		160
8.0	800								0	77	3380				58	40		172
9.0	900							V		81	4300				64	45		195
10.0	1000							W		85	4600					49		218
11.0	1100									88	5200					55		
12.0	1200									92	5620					59		

VISCOSITY CONVERSION CHART (Continued)

Poise	Centipoise	Parlin 7	Parlin 10	Fisher 1	Fisher 2	Ford Cup 3	Ford Cup 4	Gardner - Holdt Bubble	Gardner - Lithographic	Krebs Unit KU	Saybolt Universal SSU	Zahn 1	Zahn 2	Zahn 3	Zahn 4	Zahn 5	Sears Craftsman Cup	Din Cup 4
13.0	1300							X		95	6100					64		
14.0	1400								1	96	6480							
15.0	1500									98	7000							
16.0	1600									100	7500							
17.0	1700									101	8000							
18.0	1800							Y			8500							
19.0	1900										9000							
20.0	2000									103	9400							
21.0	2100										9850							
22.0	2200										10300							
23.0	2300							Z	2	105	10750							
24.0	2400									109	11200							
25.0	2500							Z-1		114	11600							
30.0	3000									121	14500							
35.0	3500							Z-2	3	129	16500							
40.0	4000									133	18500							
45.0	4500							Z-3		136	21000							
50.0	5000										23500							
55.0	5500										26000							
60.0	6000							Z-4	4		2800							
65.0	6500										30000							
70.0	7000										32500							
75.0	7500										35000							
80.0	8000										37000							
85.0	8500										39500							
90.0	9000										41000							
95.0	9500										43000							
100.0	10000							Z-5	5		46500							
110.0	11000										51000							
120.0	12000										55005							
130.0	13000										60000							
140.0	14000										65000							
150.0	15000							Z-6			67500							
160.0	16000										74000							
170.0	17000										83500							
180.0	18000										83500							
190.0	19000										88000							
200.0	20000										93000							
300.0	30000										140000							

Note: All viscosity comparisons are as accurate as possible with existing information. Comparisons are made with a material having a specific gravity of 1.0.

VOLUMETRIC CONTENT OF HOSE OR TUBE (English Units)

I.D. (inches)	cc/ft.	Cross Section (sq. in.)	Length				
			5ft. (60”)	10ft. (120”)	15ft. (180”)	25ft. (300”)	50ft. (600”)
1/8	2.4	.012	.003 gal. .4 fl. oz.	.006 gal. .8 fl. oz.	.010 gal. 1.2 fl. oz.	.016 gal. 2.0 fl. oz.	.032 gal. 4.1 fl. oz.
3/16	5.4	.028	.007 gal. .9 fl. oz.	.014 gal. 1.8 fl. oz.	.022 gal. 2.8 fl. oz.	.036 gal. 4.6 fl. oz.	.072 gal. 9.2 fl. oz.
1/4	9.7	.049	.013 gal. 1.6 fl. oz.	.025 gal. 3.3 fl. oz.	.038 gal. 4.9 fl. oz.	.064 gal. 8.2 fl. oz.	.127 gal. 16.3 fl. oz.
5/16	15.1	.077	.020 gal. 2.5 fl. oz.	.040 gal. 5.1 fl. oz.	.060 gal. 7.6 fl. oz.	.100 gal. 12.7 fl. oz.	.199 gal. 25.5 fl. oz.
3/8	21.7	.110	.029 gal. 3.7 fl. oz.	.057 gal. 7.3 fl. oz.	.086 gal. 11.0 fl. oz.	.143 gal. 18.4 fl. oz.	.287 gal. 36.7 fl. oz.
1/2	38.6	.196	.051 gal. 6.5 fl. oz.	.102 gal. 13.1 fl. oz.	.153 gal. 19.6 fl. oz.	.255 gal. 32.6 fl. oz.	.510 gal. 65.3 fl. oz.

VOLUMETRIC CONTENT OF HOSE OR TUBE (Metric Units)

I.D. (mm)	cc/m	Cross Section (mm^2)	Length				
			1.5m	3.0m	4.5m	6.0m	7.5m
3.6	10.2	10.2	15.3 cc	30.5 cc	45.8 cc	61.1 cc	76.3 cc
5.6	24.6	24.6	36.9 cc	73.9 cc	110.8 cc	147.8 cc	184.7 cc
6.8	36.3	36.3	54.5 cc	109.0 cc	163.4 cc	217.9 cc	272.4 cc
8.8	60.8	60.8	91.2 cc	182.5 cc	273.7 cc	364.9 cc	456.2 cc

MANUAL CHANGE SUMMARY

This manual was published to supercede Service Manuals **LN-9622-00.4 Evolver MicroPak Controller** to make the following changes:

1. Removed logo & brand names.

2. Updated Discrete I/O Module part number.

Ransburg

Manufacturing
1910 North Wayne Street
Angola, Indiana 46703-9100
Telephone: 260-665-8800
Fax: 260-665-8516

Technical Service — Assistance
320 Philips Ave.
Toledo, Ohio 43612-1493
Telephone (toll free): 800-233-3366
Fax: 419-470-2233

Technical Support Representative will direct you to the appropriate telephone number for ordering Spare Parts.

Form No. LN-9622-00.5
Litho in U.S.A.
04/13