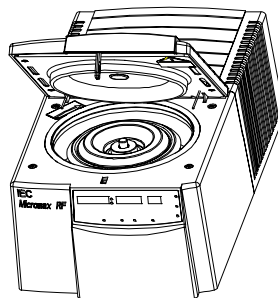


SERVICE MANUAL SM3590

Revision 2



Micromax

Ventilated Microcentrifuge

Cat. No. 3590 -- For 120 VAC, 60 Hz

Cat. No. 3591 -- For 220 - 240 VAC, 50/60 Hz

Cat. No. 3595 -- For 100 VAC, 50/60 Hz

Refrigerated Microcentrifuge

Cat. No. 3592 -- For 120 VAC, 60 Hz

Cat. No. 3593 -- For 220 - 240 VAC, 50 Hz

Cat. No. 3594 -- For 220 - 230 VAC, 60 Hz

Cat. No. 3596 -- For 100 VAC, 50/60 Hz

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1 INTRODUCTION

The Micromax microcentrifuge is a quiet, high-speed bench-top centrifuge for medical, industrial, and scientific laboratories. The unit can achieve centrifugal force of up to 21,000 xg, making it ideal for sedimentation of protein precipitates and separation of blood serum.

NOTE: The Micromax microcentrifuge is available in two versions, ventilated and refrigerated. The parts of this manual that apply to the refrigerated version will be identified as RF only.

The unit reaches full speed within 15 seconds, even when fully loaded, and brakes to a stop in approximately 15 seconds. It features a maintenance-free, brushless motor and an easy-to-use front panel which provides three versatile modes of operation: automatic timed run, momentary spin (pulse) and continuous operation (hold mode). Acceleration and deceleration rates may be controlled to optimize runs - rapid for fast separations or slow for delicate samples. Repeat runs with precisely the same speed and time settings may be achieved at the touch of a button.

Micromax is a variable-speed unit with a range of 1000 to 15,000 RPM. The unit accommodates lightweight, dynamically-balanced polypropylene rotors. The rotors cannot corrode, offer excellent acceleration and deceleration characteristics and totally contain tubes, allowing complete sample recovery even if a tube breaks.

The 891 rotor holds up to 24 sample tubes and provides aerosol containment for biological samples. The 851 rotor holds up to 24 x 1.5-2 mL and 24 x 0.5 mL sample tubes, the 852 rotor holds up to 48 x 0.5 mL or 24 x Microtainer tubes and the 853 rotor holds up to 40 x 0.25 mL/0.4 mL or 6 x 50 mm glass tubes. Also, the 851 rotor has room to accommodate screw-cap microtubes, microtube filters, and micro spin-columns. Section 4.1 provides a speed and force table for these rotors.

A fail-safe cover interlock ensures that the cover is closed before a run can begin and keeps the cover closed until the rotor has reached a safe low speed (below 150 rpm), even in the event of a power failure.

2 INSTALLATION

2.1 Receiving the Unit

IEC ships the centrifuge in a carton that protects it from shipping hazards. Retain the carton and packing material through the warranty period in case you need to ship or return the unit. Please be sure to complete the Warranty Registration Card and return it to IEC.

2.2 Site Preparation

The unit normally resides on a bench-top. The Micromax (ventilated model) can be placed in a cold room (no colder than 0°C) for processing temperature-sensitive samples. When you remove the centrifuge from a cold environment, allow at least two hours for any condensate to evaporate before using.

Note: When used in a cold room environment, some bearing noise may become evident. The bearing lubricant thickens at low temperatures. As the centrifuge speeds up, it is thinned and distributed more evenly. Once this occurs, any noise should subside.

The Specifications at the end of this manual give the dimensions of the unit. Provide clearance of 8 cm (3 inches) at the rear and on both sides for heat dissipation. Provide clearance of 28 cm (11 inches) above the unit to open the cover.

Place the unit on a clean, dry surface to ensure that the suction feet grip the surface firmly. Be sure that the area beneath the unit is clear of debris and loose materials such as paper. The surface must be level to ensure quiet, vibration-free operation. A stable location is important since an improperly-loaded unit can vibrate and the centrifuge must not be permitted to move during operation.

2.3 Power Configuration

The Micromax model numbers, and voltage and frequency requirements are listed in the table below.

MODEL	VOLTAGE	FREQUENCY
3590	120	60 Hz
3591	220 - 240	50/60 Hz
3592 (RF)	120	60 Hz
3593 (RF)	220 - 240	50 Hz
3594 (RF)	220,230	60 Hz
3595	100	50/60
3596 (RF)	100	50/60 Hz*

Ensure that your site is configured to match the centrifuge's power requirements. **Plugging the Micromax into incorrect voltage or frequency will void your warranty.**

* Line Frequency Selection (3596, Micromax RF)

Locate the 50/60 Hz selector switch to the left of the power receptacle at the rear of the centrifuge. Adjust this switch to match the line frequency at the site.

Fuses

Fuses are located at the back of the unit.

To install fuses:

Locate the power entry module on the back side of the unit. The removable fuse drawer is located in the module. A small latch holds the drawer in place. Press this latch, then slide the drawer out.

- Cat. No. 3590: The fuse drawer will have one spare and one active fuse installed at the factory. Fuse is rated for 6.25 Amps (part no. 50606B).
- Cat. No. 3591: The fuse drawer will have two active fuses installed at the factory. Fuse is rated for 4.0 Amps (part no. 43689).
- Cat. No. 3592: The fuse drawer will have one spare and one active fuse installed at the factory. Fuse is rated for 8 Amps (part no. 50606A).

- Cat. No. 3593, 3594: The fuse drawer will have two active fuses installed at the factory. Fuse is rated for 6.3 Amps (part no. 50607A).
- Cat No. 3595: The fuse drawer will have one spare and one active fuse installed at the factory. Fuse is rated for 8.0 Amps (part no. 50021).
- Cat No. 3596: The fuse drawer will have one spare and one active fuse installed at the factory. Fuse is rated for 10.0 Amps (part no. 49998). Note that the frequency selector adjacent to the power entry module must be set for the correct frequency.

Ensure that the fuses are securely in place and reinstall the entire drawer into the power entry module.

Power Cord

IEC provides a power cord with each Micromax centrifuge. The unit requires a grounded power supply (3-prong power outlet). If your facility does not have properly grounded power outlets, arrange for proper grounding. Do not remove the grounding pin from the centrifuge power cord. Do not use an adapter to connect to a 2-prong outlet.

2.4 Moving the Unit

Suction cups located on the base of the unit are a safety feature which adhere it to the work surface to prevent it from moving. To move the unit to another location, insert an object such as a tongue depressor under each suction cup to break the vacuum seal of that cup (taking care not to damage the suction cup surface). When all four cups are disabled, you can easily lift the unit. When the unit is in its new location, ensure that the suction cups fully contact the benchtop again.

2.5 Front Panel

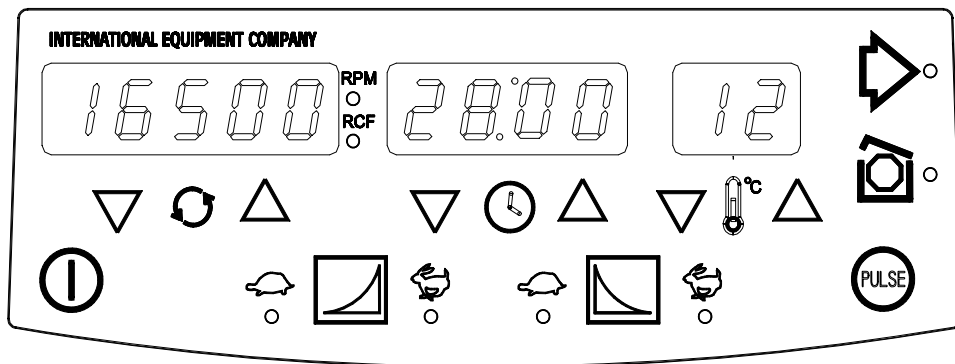


Figure 1: The Front Control Panel



The On/Off button must be on to use the unit. This button applies power to the control panel and refrigeration system (RF only). The red STOP light indicates that the centrifuge is plugged in. (In RF models, temperature is displayed whenever the unit is plugged in.) The On/Off button is inoperative during the actual run. Shut off refrigeration with the On/Off button, but stop a run with the STOP button.

The control panel contains numeric displays for RPM/RCF (SPEED/FORCE), TIME and TEMPERATURE (RF only). These displays have two states or modes: Actual and Set. In the Actual mode, they indicate current run conditions such as:

- rotor speed or force
- elapsed time of, or time remaining in, the run
- actual temperature (RF only).

The display in the Set mode indicates the desired settings for the run and is operative:

- whenever you use the up and down arrows
- briefly at the start of a run
- briefly after the unit is switched ON

When the display shows Actual parameters, the numbers are bright; when the display shows Set parameters, the numbers are dim. The numeric displays can also display warning or error messages (see Section 3.3). Descriptions of the displays appear below.

The displays for the Micromax are:



Speed/Force display: The number in the display above this symbol represents the rotor speed in RPM or force in RCF. When RPM is selected the display indicates revolutions per minute. When RCF is selected the display indicates relative centrifugal force. Press this button to toggle between RPM and RCF. Use the arrow buttons to change the set speed or force. The display shows speed within 100 RPM and never requires calibration. Select speed in increments of 100 RPM from 1000 through 15,000 RPM. Select RCF in increments from 1 - 1000 xg by 50 xg, from 1,000 - 10,000 xg by 100 xg, and from 10,000 - 21,000 by 200 xg.



Time display: The number in the display above this symbol indicates time. Time is displayed as minutes:seconds. You can set time from 1 second to 99 minutes using the arrow buttons. In normal timed mode, the system counts down from set point. In continuous or momentary spin modes, the system counts up.



Temperature display: The number above this symbol represents temperature in whole degrees Celsius from -9 °C through 40 °C (RF only).



Use the arrow buttons to view or change the Set parameters for Speed/Force, Time or Temperature (RF only). The first time the button is pressed, the numeric display simply switches from Actual readings to Set parameters, without changing them. If you press the button again, the selected parameter increases or decreases once for each press. If you hold the button down, the setting changes repeatedly until you release the button.

The longer you hold the button down, the more rapidly the setting changes. Usually, you hold a button down to approach a desired setting, then press the up or down button repeatedly to select the exact setting. When you release the arrow buttons for 3 seconds, the display returns to the Actual readings.



Acceleration/Deceleration: The user has the option of setting either full (rapid) or gentle acceleration and braking. The gentle option may be used to avoid mixing of density gradients or breakup of pellets. A description of the two options follows:



This button is used to increase rotor acceleration (up to 1500 RPM) or rotor deceleration. If the yellow light over the rabbit is lit, then full acceleration/deceleration is selected.



This button is used to decrease rotor acceleration or deceleration. If the yellow light over the turtle is lit, then slow acceleration/deceleration is selected. Slow acceleration takes from 5 to 10 seconds to achieve 1500 RPM, depending on the rotor and its contents. In slow braking, the rotor will coast down from 1500 RPM. If no light is lit, the rotor coasts naturally to a stop.

When using the 851, 852, 853 or 891 rotors the difference in time between full and slow braking is approximately a half second.



This button starts a run. The run is governed by the Set parameters. The associated green light blinks until the rotor reaches the set run speed. Then the light stays on until the end of the run. On some ventilated units only, the cover opens at the end of a run.



This button stops the run, and unlocks the cover when the rotor has slowed to below 150 rpm. (A run will also stop automatically when the set time has elapsed or the momentary run button is released.) The red light will flash as an indication that the rotor is still slowing down (braking). When the run ends, the red light stays on, indicating that the rotor has stopped and the cover can be opened.



The centrifuge will run up to set speed while this button is pressed, and stop when it is released.

2.6 Refrigeration (RF only)

Models 3592, 3593, 3594 and 3596 are refrigerated models. Whenever the cover of one of these units is closed and the unit is switched ON, the refrigeration system begins to cool the rotor chamber to the set temperature.

Note: The unit is not designed for use as a refrigerator. The natural fanning action of rotor serves to maintain a uniform temperature distribution inside the chamber. Therefore, at zero RPM, there is no correlation between set and actual chamber temperatures.

If a run begins and the rotor chamber is not at the specified temperature, the run will not be aborted. If desired, press STOP to discontinue the run and pre-cool the chamber by spinning the rotor (empty) until you are satisfied with the temperature.

If a temperature higher than ambient is specified, the units will not heat the rotor chamber except through the normal heating effect of the equipment (friction and motor heat).

Remove frost or condensation from the rotor chamber by first allowing it to melt and then removing it with a sponge or cloth. When a centrifuge is not in use, turn it off or leave the cover open (disables refrigeration).

2.7 First Run

Plug in the centrifuge. If an arrow key is pressed first, the display will briefly show 10,000 RPM, 1:00 minute and 25 °C (RF only) the default set values. Press the Stop/Open Cover button to release the cover interlock. Open the cover. Remove any loose material from the rotor chamber. Install a rotor, as described in Section 3.1. Close the cover and press it down until it latches.

Use the up or down arrow buttons to select Set parameters. Experiment with the buttons to see how they control the displayed settings. Press and hold a button to scroll quickly. This does not activate the rotor. Note that, when you release all buttons for over 3 seconds, the display returns to Actual readings.

Select an appropriate time, speed and temperature (RF only) and then press the START button. The rotor will accelerate to set speed, spin for the set time, and brake to a stop. Press the Stop/Open Cover button to release the safety interlock.

3.1 Rotor and Accessories

A balanced load is essential with all high-speed centrifuges. An unbalanced load produces vibration and causes excessive wear of motor bearings. Therefore, always load the rotor symmetrically. When using tube adapters, install an adapter in the opposite tube position. The total weight of samples loaded in opposing positions must be equal in weight to within 1.0 gram. The position numbers, present on rotors, identify opposing tube positions.

Samples of different specific gravities can be processed in the same run, provided that the samples of a given type are balanced around the rotor as though they were the only ones in the rotor.

Rotor Installation To install the rotor, lower it straight onto the shaft. Align the holes in the rotor with the positioning pins on the shaft. To do this, hold the rotor in one hand and hold the shaft, as it protrudes through the rotor, with the other hand. Rotate them in opposite directions until the pins line up with the holes and the rotor drops down into position. Do not apply excessive force. Screw the metal locking nut (clockwise) on the shaft to hold the rotor down. Be sure the orange rubber ring is facing downward. Hold the rotor and tighten the nut moderately with your fingers; do not over tighten it.

The 891 rotor cover must be installed prior to the rotor being placed in the centrifuge. Verify that the o-ring seals (2) are in place around the outer and inner perimeters of the rotor. To install the cover, place the rotor on a flat surface and then place the rotor cover on top of the rotor. Using the palm of your hand(s), press down evenly around the cover to fully engage the seals.

The 851, 852 and 853 rotor covers prevent generation of aerodynamic noise during the spin. It also prevents gross aerosol effects in the event of tube failure. It fits snugly over the rotor and pulls off easily. To place it properly, rotate the cover until it drops easily onto the adapter spline. Press down until the rim of the cover contacts the rotor. The spline at the top of the shaft adapter drives the lid during rotation.

Caution: Improper placement of the cover may allow it to come off during a spin.

Rotor Removal To remove the rotor, first remove the cover (851, 852 or 853 only). Then unscrew (counterclockwise) and remove the metal locking nut. The rotor can now be lifted straight out of the rotor chamber. You can refrigerate the rotor without removing the tubes but do not operate the rotor when the rotor temperature is below 0°C.

To remove the 891 rotor cover, place the rotor on a flat surface. Place your thumbs on the inner perimeter of the cover, and your fingers on the outer edge. Pry it up from the outer edges.

3.2 Operating Modes

The Micromax Models offer three operating modes: Timed, Continuous (Hold), and Momentary.

Timed Run To start a timed run or spin:

Select the Set parameters using the control panel buttons (refer to Section 2.5) and then press START.

- **To view the set parameters at any time, press any arrow key.**
- The spin duration may be changed at any time, even during the spin, by pressing the arrow keys until the new desired setting(s) is displayed. If a time less than the elapsed time is programmed (for example, one second), the spin ends immediately. If a time greater than the elapsed time is programmed, the elapsed time continues until the newly selected time is reached (the time does not reset).

The speed and temperature (RF only) may similarly be changed during a run. Three seconds after the parameter's arrow key is released, the centrifuge will adjust to the newly set parameter.

Hold Mode To set Hold (continuous) mode:

Select the Set parameters using the control panel buttons (refer to Section 2.5). Scroll down through zero time on the Time display until the word Hold appears in the display.

This mode is used for runs greater than 99 minutes.

Momentary To operate in the momentary mode:

Select the Set parameters using the control panel buttons (refer to Section 2.5). Press and hold the PULSE button. The run begins when you press the button and ends when you release the button.

NOTE: In this mode the unit displays Set parameters for three seconds, the time display counts upward and displays the elapsed time since you pressed the PULSE button.

In this mode very quick separations can be performed, or you may closely monitor the progress of a run. (This is useful for easily separated samples, for simultaneous mixing of samples, and to deposit condensate droplets at the bottom of the tube.)

3.3 Warning Messages and Error Codes

The **beeper** sounds in three situations:

- Two times on power up.
- Three times at the end of a spin.
- When a warning occurs (three times).

Warnings appear in place of the numeric displays in the following cases:

HEAD This appears if a run is started without loading a rotor into the chamber. Opening the cover resets this warning. This warning is disabled when slow acceleration is selected.

Lid This appears briefly if you press the START button but the cover is not closed. Closing the cover resets the warning.

PFAIL This appears at the end of a power failure that interrupts a run if the rotor is still spinning when power is restored. Press STOP to reset this warning.

Error Codes require factory-authorized maintenance. A typical error means the internal microprocessor has detected impermissible readings or a failure elsewhere in the unit. An error code number appears on the front panel. When an error code is displayed first unplug and reconnect the unit to power and try the run again. If the error code reappears, tell the service personnel which number appeared when you report the problem.

4 APPLICATIONS

Misapplication of any tube can cause tube rupture. To avoid this, never spin tubes faster than their recommended G-force, and never centrifuge disposable tubes more than once. If the tubes are not rated for the needed force, use more suitable tubes. If breakage does occur, residue will be captive in the tube cavity in the rotor. You may be able to recover it by pipetting.

Corrosive solvents Your IEC centrifuge is made of materials designed to resist attack from common laboratory chemicals. The rotor and lid are made of polypropylene and the interior of the rotor chamber is stainless steel. Use covered sample tubes if the samples contain acids or solvents known to attack these materials. Promptly cleaning spills from the rotor and from the sample chamber minimizes the effects of corrosive chemicals. Replace any component that exhibits crazing, frosting, peeling, or similar faults. Do so before any resulting vibration requires more expensive repair. Replace the shaft adapter, rotor, lid, or metal locking nut if they become cracked, scratched, or gouged.

Sample Heating The rotor chambers of Models 3590 and 3591 centrifuges are ventilated during operation. However, during very long runs, some heat inevitably travels to the samples. You can minimize sample heating by placing the unit in a refrigerator or cold room.

4.1 Speed and Force Table

Rotor Cat. No.	No. of Tubes and Tube Size	Adapter Cat. No	Max Speed (RPM)	Max RCF (xg)	Radius (cm)
891 ¹ (Aerosol Contained)	24 x 1.5ml	-	15000	21004	8.35
	24 x 0.6ml B/D Microtainers™	5763**		21256	8.45
	24 x 0.5ml PCR microtubes	5763**		18740	7.45
	24 x 0.4ml microtubes	5764**		21004	8.35
	24 x 0.25ml microtubes	5764**		18237	7.25
851 ²	24 x 1.5ml	-	15000	21004	8.35
	24 x 0.6ml B/D Microtainers™	5763**		21256	8.45
	24 x 0.5 ml microtubes	-		17432	6.93
	24 x 0.5ml PCR microtubes	5763**		18740	7.45
	24 x 0.4ml microtubes	5764**		21004	8.35
	24 x 0.25ml microtubes	5764**		18237	7.25
852 ²	48 x 0.5ml PCR microtubes	-	15000	20124	8.00†
				18866	7.50‡
	24 x B/D Microtainers™	-		21633	8.60†
853 ²	40 x 0.4ml microtubes	-	15000	21130	8.40
	40 x 0.25ml microtubes	-		18866	7.50
	40 x 0.8ml (6x50mm) glass	-		21382	8.50

Microtainers™ is a trademark of Becton Dickinson

* RCF displayed on control panel is based upon radius of rotation for 891 and 851 rotors for 1.5/2.0ml tubes (8.35cm).

** Order 2 pks of adapters separately. IEC 5763 and 5764 are packaged 12/pk.

† Outer row holds 24 tubes

‡ Inner row holds 24 tubes

¹ IEC 891 Rotor

Provides Aerosol Containment and has been tested for microbiological containment by PHLS-CAMR, Porton Down. Meets requirements of US OSHA Bloodborne Pathogen Final Rule: (Regulation 29 CFR Part 1910.1030. Complete with IEC 50417 Aerosol Containment Cover, IEC 50525 Inner and IEC 36597 Outer rubber O-ring seals.

² IEC 851, 852, 853 rotors

4.2 Chemical Resistance Table

	Plastic										Metal					Other			
	PA	PC	PE	PP	PU	NL	DN	CN	NN	PS	TI	SS	AL	MB	MG	RR	BN	VN	PF
Acids, dilute or weak	E	E	E	E	G	E	F	N	F	E	G	G	F	F	N	F	E	E	E
Acids*, strong or conc.	E	N	E	E	F	N	N	N	N	F	N	N	N	N	N	N	F	G	N
Alcohols, aliphatic	E	G	E	E	F	E	E	E	N	E	E	E	E	E	F	E	E	G	E
Aldehydes	G	F	G	G	G	G	G	G	F	N	E	E	E	E	E	E	N	E	E
Bases	E	N	E	E	N	G	N	G	F	E	E	E	E	E	E	G	G	N	N
Esters	G	N	G	G	N	E	G	G	E	N	E	E	E	E	E	N	N	N	E
Hydrocarbons, aliphatic	G	F	G	G	E	N	E	E	E	N	E	E	E	E	E	N	E	E	E
Hydrocarbons, aromatic	F	N	G	F	N	N	E	E	E	N	E	E	E	E	E	N	N	E	E
Hydrocarbons, halogenated	F	N	F	F	N	N	G	E	G	N	E	E	E	E	N	N	N	F	E
Ketones	G	N	G	G	N	N	E	E	E	N	E	G	G	G	E	N	N	N	E
Oxidizing Agents, strong	F	N	F	F	N	N	N	N	N	N	E	F	N	N	N	N	F	E	E
Salts	E	E	E	E	E	E	E	E	E	E	E	F	F	F	N	E	E	E	E

*For Oxidizing Acids, see "Oxidizing Agents, strong".

PA - POLYALLOMER

PC - POLYCARBONATE

PE - POLYETHYLENE

PP - POLYPROPYLENE

PU - POLYURETHANE

NL - MODIFIED PHENYLENE OXIDE (NORYL)

DN - ACETAL HOMOPOLYMER (DELFIN)

CN - ACETAL COPOLYMER (CELCON)

NN - NYLON

PS - POLYSTYRENE

TI - TITANIUM

SS - STAINLESS STEEL

AL - ALUMINUM

MB - MANGANESE BRONZE

MG - MAGNESIUM

RR - RUBBER

BN - BUNA-N

VN - VITON

PF - PHENOLIC FIBER

Classification of Resistance

E= Excellent

G= Good

F= Fair

N= Not Recommended

4.3 Decontamination Table

Compatible Processes For Decontamination																				
Sterilization Methods	Plastic										Metal					Other				
	PA	PC	PE	PP	PU	NL	DN	CN	NN	PS	TI	SS	AL	MB	MG	RR	BN	VN	PF	PT
Mechanical																				
Autoclave*	S	M	U	S	M	U	S	S	S	U	S	S	S	S	S	S	S	M	S	M
Ethylene Oxide Gas	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	U	U	S	S	S
Dry Heat 160°C@2Hrs.	U	U	U	U	U	U	U	U	U	U	S	S	U	S	S	U	U	U	U	U
Chemical																				
Ethanol	S	S	S	S	U	S	S	S	U	M	S	S	S	S	S	S	S	S	S	S
40% Formalin	S	S	S	S	U	S	S	S	S	U	S	S	S	S	S	S	U	S	S	S
Methanol	S	M	S	S	M	S	S	S	U	M	S	S	S	S	S	S	S	U	S	S
2-Propanol	S	S	S	S	M	S	S	S	U	S	S	S	S	S	M	S	S	S	S	S
5% Sodium Hypochlorite**	S	S	S	S	U	S	U	U	U	S	S	M	U	U	U	S	U	S	S	M
3% Hydrogen Peroxide	S	S	S	S	S	S	M	S	U	S	S	S	S	S	U	S	S	S	S	M
100% Hydrogen Peroxide	S	S	S	S	S	U	U	U	U	S	S	S	S	S	S	U	U	S	S	U
5% Phenol Solution	M	U	U	S	U	U	M	M	U	M	M	M	M	M	M	M	U	S	S	U

PA - POLYALLOMER
 PC - POLYCARBONATE
 PE - POLYETHYLENE
 PP - POLYPROPYLENE
 PU - POLYURETHANE
 NL - MODIFIED PHENYLENE OXIDE (NORYL)
 DN - ACETAL HOMOPOLYMER (DELRIN)
 CN - ACETAL COPOLYMER (CELCON)
 NN - NYLON
 PS - POLYSTYRENE

TI - TITANIUM
 SS - STAINLESS STEEL
 AL - ALUMINUM
 MB - MANGANESE BRONZE
 MG - MAGNESIUM
 RR - RUBBER
 BN - BUNA-N
 VN - VITON
 PF - PHENOLIC FIBER
 PT - PAINTED SURFACES

*Autoclaving
 121°C 20 min. @
 2 ATM (15 PSIG)

**Household Bleach

S=SATISFACTORY
 M=MARGINAL
 U=UNSATISFACTORY

WARNING:

This chart describes the material compatibility of various sterilization methods. It does not specify the adequacy of sterilization. Refer to section 4.3 Chemical Resistance Table for material compatibility during centrifugation.

The Micromax centrifuge is maintenance-free. In particular, the drive motor is permanently lubricated and has no brushes to replace.

5.1 Cleaning

Keep your centrifuge clean to ensure good operation and to extend its life. Clean the entire sample chamber, rotor, and lid at the end of each 8-hour shift and right after any spill.

To clean the rotor chamber, cabinet and suction feet, use a damp sponge, warm water, and a mild liquid soap. Do not use acetone. Remove stubborn stains with a plastic scrub pad, not steel wool. Never pour water directly into the sample chamber. Scrub the rotor's tube cavities with a stiff test-tube brush that has end bristles and a non-metallic tip. After cleaning any part, dry it properly, preferably using a clean, absorbent towel.

Decontamination Decontamination is called for if tube breakage occurs and infectious, pathogenic, or radioactive material is released into the unit. If spillage is confined to the polypropylene rotor, it may be sufficient to decontaminate the rotor, which is totally compatible with household bleach at a one-to-ten dilution and radioactivity decontamination washes such as Count-Off.

Sterilization can be done by autoclaving. Remove sample tubes before autoclaving, unless they are completely full of sample; or remove caps, stoppers, and other tube closures, before autoclaving to keep tubes from collapsing under pressure. Autoclave the polypropylene rotor and accessories at 121° C @ 15 psig for 20 minutes. Do not stack rotors during autoclaving. After the rotor cools to the touch, do a normal cleaning as described above.

5.2 Cover Interlock Bypass

If power fails, the cover remains locked. If you need to remove samples from the unit before power is restored, use the cover interlock bypass.

DO NOT ATTEMPT MECHANICAL BYPASS IF ROTOR IS ROTATING

Bypass procedure:

1. **Unplug the centrifuge from electrical power. Do not perform cover interlock bypass unless instrument is removed from live electrical outlet.**
2. At the right front bottom of the centrifuge, remove the small plastic plug.
3. Reach under and pull on the string that is attached to the plug. The latch will open.
4. Replace the plug at the front, right, bottom of the centrifuge.
5. Return the centrifuge to operation.

5.3 Troubleshooting

If the unit fails, follow this procedure:

No motor operation, and no Display lights are lit.

Verify that the unit is plugged into a live electric outlet. Check the circuit at the fuse or circuit breaker, or plug a lamp or other appliance into the outlet to verify it.

If there is power, examine the centrifuge's fuse. Unplug the unit and locate the fuse drawer at the rear of the unit. Remove the fuse drawer according to section 2.3. Examine the fuse. If it is blown, or if you are in doubt, replace it with one of the spare fuses from the plastic bag shipped with the unit (see section 2.3). Plug the centrifuge back in and see if it works. If replacing the fuse did not solve the problem, call IEC for assistance.

No motor operation, but the displays are lit. Check that the cover is properly closed. Press the START button. If you do not hear rotation, call IEC for assistance.

On any other failure or erratic operation, contact IEC or your IEC Distributor for assistance.

5.4 Table of Spare Parts

Cat No.	Description
49856	Rotor Cover (851, 852, 853)
50417	Rotor Cover (891)
65690	Rotor Nut (851, 852, 853)
50469	Rotor Nut (891)
65231	Rotor nut washer
43689*	4 Amp fuse
50606B*	6.25 Amp fuse
50607A*	6.3 Amp fuse
50606A*	8 Amp fuse
50021*	8 Amp fuse
49998*	10 Amp fuse
50524	O-ring (891 rotor - Inner)
36597	O-ring (891 rotor - Outer)
2084	Grease Tube (for O-rings)

* see section 2.3 for fuse selection

5.5 Fuses Not Replaceable By Operator

F1	6.3A	Fast	250V
F2	0.75A	Fast	125V
F3	0.75A	Fast	125V

5.6 Warranty

IEC wants you to be satisfied with the quality of your Micromax centrifuge. We warrantee your IEC centrifuge for one year and IEC rotors for seven years. We will repair or replace any of these products that fails, within this period from the date of its delivery, due to defects in material and workmanship, and we will ship you the repaired product or its replacement at our expense. You must use IEC-approved accessories and genuine IEC spare parts. This warranty does not apply to any instrument that has been repaired without authorization or abused.

THE FOREGOING OBLIGATIONS ARE IN LIEU OF ALL OTHER OBLIGATIONS AND LIABILITIES INCLUDING NEGLIGENCE, AND ALL WARRANTIES, OF MERCHANTABILITY OR OTHERWISE, EXPRESSED OR IMPLIED IN FACT OR BYLAW. THE FOREGOING STATES OUR ENTIRE AND EXCLUSIVE LIABILITY, AND BUYER'S EXCLUSIVE REMEDY, FOR ANY CLAIM OR DAMAGES IN CONNECTION WITH THE SALE OR FURNISHING OF GOODS OR PARTS, THEIR DESIGN, SUITABILITY FOR USE, INSTALLATION, OR OPERATION. IEC WILL IN NO EVENT BE LIABLE FOR ANY SPECIAL OR CONSEQUENTIAL DAMAGES WHATSOEVER AND OUR LIABILITY UNDER NO CIRCUMSTANCES WILL EXCEED THE PURCHASE PRICE FOR THE GOODS FOR WHICH LIABILITY IS CLAIMED. IN SOME INSTANCES, UNITS MAY CONTAIN RECONDITIONED (AS NEW) PARTS.

5.7 Condition of Returned Equipment

Before returning equipment to IEC, you must contact IEC's or your dealer's service department and receive a return goods authorization (RGA). All returned units must be decontaminated, free of radioactivity, and free of hazardous and infectious materials. The RGA paperwork includes a certificate for you to sign indicating that you have performed these steps. IEC will not accept the shipment unless this signed certificate accompanies it. You must prepay transportation to the service depot.

6 SPECIFICATIONS

MODEL	VOLTAGE	FREQUENCY
3590	120	60 Hz
3591	220 - 240	50/60 Hz
3592 (RF)	120	60 Hz
3593 (RF)	220 - 240	50 Hz
3594 (RF)	220, 230	60 Hz
3595	100	50/60 Hz
3596 (RF)	100	50/60 Hz

Maximum Speed	15,000 RPM
Maximum Force	21,000 xg
Maximum Number of Tubes	24 x 24 (1.5 x 0.5 mL) (851 rotor), and 48 x 0.5 mL (852 rotor)
Maximum Sample Volume	60 mL (851 rotor 24 x 2.0 mL and 24 x 0.5 mL)
Operator Controls	
Rotation	1,000 -1,5000 by 100 RPM
Spin Duration	0:01 through 0:59, by 1 sec. 1:00 through 4:45, by 15 sec. 5:00 through 99, by 1 min.
	Momentary Spin mode Continuous (Hold) mode
Repeatability	
Rotation	Within 10 RPM
Spin Timing	0.1 sec.
Temperature (RF only)	+/- 1 °C in the range +4 °C to ambient
Motor	Brushless DC motor (maintenance free)

Refrigeration system (RF only)	Hermetic compressor 1/4 hp
Refrigerant (RF only)	R-404A (HP-62)
Dimensions	
Height	24.9 cm (9.8 in) cover closed 50.3 cm (19.8 in) cover open
Width	30.5 cm (12 in)
Depth	33.8 cm (13.3 in)
Weight 120 VAC	16.4 kg (36 lb.)
Weight 240 VAC	19.3 kg (42.5 lb.)
Dimensions (RF only)	
Height	24.9 cm (9.8 in) cover closed 50.3 cm (19.8 in) cover open
Width	30.5 cm (12 in)
Depth	58.9 cm (23.2 in)
Weight 120 VAC	32 kg (70.5 lb.)
Weight 240 VAC	35 kg (77 lb.)

7.1 Warnings and Cautions

Warnings

Many service procedures require operation with the cabinet removed. The On/Off key, on the control panel, activates the display and the refrigeration system (RF models only) but **does not** remove power from the circuit board or other internal components.

There is no power switch that provides a safe alternative to unplugging the unit.

Do not touch internal electrical components when the power cord is plugged in.

The power cord(s) provided with these units is rated for the centrifuge's highest current demand. Exchange of power cords between equipment may create a fire hazard.

Do not exchange the supplied power cord with cords from other equipment.

The refrigerated Micromax models use pressurized refrigerant gases that are potential asphyxiants. All maintenance on the refrigeration unit should be performed in a well-ventilated area.

Any charging or discharging of refrigerant must be performed by certified refrigeration service personnel, using proper charging and recovery systems.

Cautions

The circuit boards contain electronic devices that can be damaged by static electricity. Service personnel should be properly grounded (such as by wearing a wrist strap) whenever handling or touching the circuit boards or individual components. When transporting a circuit board, always enclose it in a static-protective bag.

7.2 Special Tools

No special tools are required. A multimeter is required to perform diagnostics.

7.3 Troubleshooting

The Micromax has been designed to sense most malfunctions, and to indicate the nature of a problem with a diagnostic message, displayed on the control panel. Diagnostic messages can be divided into two types: *warning messages* and *error codes*. These are explained in the following tables. Warning messages indicate an improper operation condition, and can normally be resolved by correcting the condition and resetting the unit. Error codes may indicate a serious malfunction. In some cases they will be cleared by unplugging the unit and plugging it back in. If the error code repeats, the troubleshooting steps in the tables below are recommended. If this does not resolve the problem, please contact IEC's Technical Service dept. at +(871) 449-8060.

WARNING: The following procedure requires operation of the unit with power applied and the cabinet removed. Use caution to avoid electric shock. See Section 7.1, Warnings and Cautions.

Lid	<p>Indicates the cover was not fully closed when the START button was pressed. Message is cleared by opening the cover.</p> <ul style="list-style-type: none"> • Close lid completely. • Check lid striker (see section 8.1). • Check latch microswitch (see section 8.4).
HEAd	<p>No rotor installed. Message is cleared by opening the cover.</p> <ul style="list-style-type: none"> • Install a rotor.
PFAIL	<p>Power failure detected during run. Message is cleared by pressing the STOP key.</p> <ul style="list-style-type: none"> • Continue normal usage. If problem recurs, see section 10.1, and verify Logic PCB revision of at least rev. 2. • Check power circuit - power entry module, line filter, etc. (see section 9.2).
Err1	<p>No signal from the tachometer has been sensed. Message is cleared by unplugging the centrifuge.</p> <ul style="list-style-type: none"> • After unplugging, applying power and attempting another run, if the error recurs, spin the rotor by hand and watch for a tachometer (speed) indication. If none is displayed, check the Speed Sensor (see section 11.2). • If a tachometer (speed) indication is displayed, check the PCB fuses, and motor. (see sections 10.1, and 11.1).
OSPd	<p>Overspeed. Rotation above 15,200 RPM has been detected. Message is cleared by unplugging the centrifuge.</p> <ul style="list-style-type: none"> • After unplugging, applying power and attempting another run, if the error recurs, check the Power PCB (see section 10).
rEFr	<p>Refrigeration failure. Measured temperature exceeds 45 degrees C. After unplugging, apply power and close the lid. Select a temperature colder than ambient and start a run. If the compressor does not function (chamber does not cool):</p> <ul style="list-style-type: none"> • The Power PCB COMP LED (DS2 - green) should be lit. If not, check the Logic PCB (see section 10). • Check the solid state relay mounted to the baseplate (see section 12.3). • Check the condensing unit and associated electrical components (See section 12).
FSAFE	<p>Hardware fail-safe feature "timed out".</p> <ul style="list-style-type: none"> • After unplugging, applying power and attempting another run, if the error recurs, check the Logic PCB and the Power PCB (see section 10).
COP	<p>COP (Computer Operating Properly) watchdog feature is not enabled.</p> <ul style="list-style-type: none"> • After unplugging, applying power and attempting another run, if the error recurs, check the Logic PCB (see section 10).
COPF	<p>COP watchdog feature has "hung up" or "crashed"..</p> <ul style="list-style-type: none"> • After unplugging, applying power and attempting another run, if the error recurs, check the Logic PCB (see section 10).
ILLOP	<p>Illegal operation. Program has "crashed".</p> <ul style="list-style-type: none"> • After unplugging, applying power and attempting another run, if the error recurs, check the Logic PCB (see section 10).
UndFI	<p>Undefined Interrupt. May be the result of improper microprocessor configuration, improper program execution, or electrical noise.</p> <ul style="list-style-type: none"> • After unplugging, applying power and attempting another run, if the error recurs, check the Logic PCB (see section 10).
Cover won't open	<ul style="list-style-type: none"> • Listen for solenoid when COVER OPEN is pressed. If no sound is heard, check solenoid (see section 8.4) and/or the Power PCB (see section 10). • Power PCB COVER LED (DS5 - red) should be lit when COVER OPEN is pressed. If not, check the Logic PCB (see section 10).
No Braking	<ul style="list-style-type: none"> • Check that brake is selected. • Verify operation by measuring the stop time with and without the brake. See section 11.3 if with brake time is not less than without brake time. • Power PCB BRAKE LED (DS4 - red) should be lit during braking. If not, check Logic PCB (see section 10).

8.1 Cover Assembly

The cover assembly contains the blue plastic outer lid, white painted metal lid liner, hinge springs (2), hinge rod, and latch striker. Early models had a fixed (non adjustable) striker. The adjustable striker can be installed using kit no. 50782A (ventilated) or 50782B (RF models). The striker may require adjustment if a Lid warning appears frequently.

Strike Adjustment

To adjust the cover latch striker:

1. Loosen the locking nut that holds it in place.
2. Adjust the striker by screwing it up or down, to correct its height for locking.
3. Be sure to lock it back into place by tightening the locking nut with a wrench. This will prevent it from loosening when the unit is in operation.

A properly adjusted cover will result in no Lid warning and no air leakage around the sides and front of the cover. If this adjustment does not resolve the Lid message, latch switch adjustment may be required. To check the latch switch alignment, refer to Section 8.4.

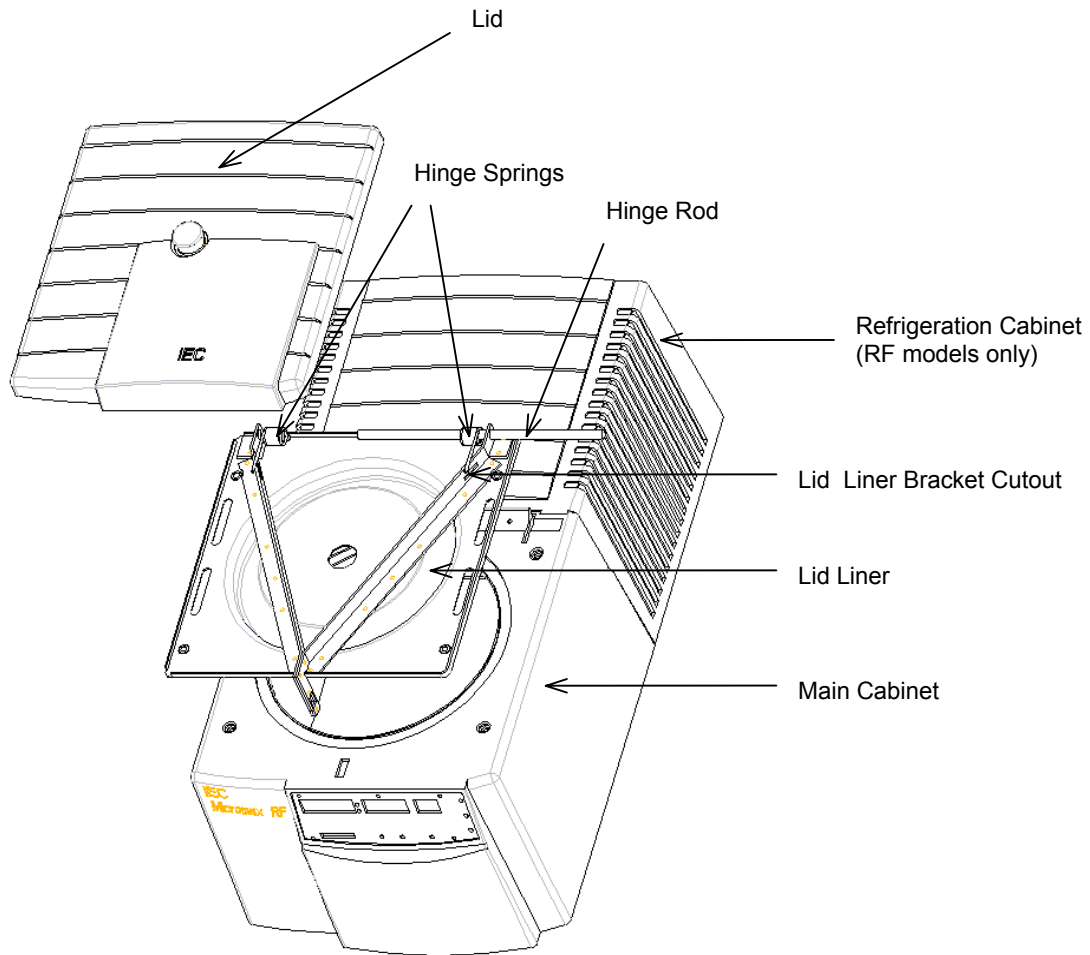
Most service to the unit requires the removal of the cover (lid) and cabinet, as described in the following procedures.

Cover Removal

To remove the cover assembly:

1. Open the cover and unplug the centrifuge.
2. Remove (4) Phillips head screws which attach blue lid to lid liner.
3. Remove the blue lid, while supporting the lid liner.
4. With lid liner raised to remove pressure from the hinge springs, remove spring arms from the cutouts in the lid liner bracket.
5. Remove hinge rod by sliding to the right or left, and remove springs and lid liner.

Note - the two hinge springs are not identical, and can only be properly installed one way.



8.2 Cabinet Housing

Rear Cabinet Section (Refrigerated Units Only)

1. Unplug the centrifuge.
2. Remove (2) screws located on the back of the rear cabinet section.
3. Lift the back of the rear cabinet section away from the base plate of the unit.
4. Remove the rear cabinet section by gently disengaging the two tabs that connect the rear cabinet section to the front cabinet section.

Main Cabinet (All Units)

1. Remove lid per section 8.1.
2. Remove (4) screws located on the top of the cabinet. (This may require removal of a warning label. Be sure to re-apply the label when finished.)
3. On non-refrigerated units, remove (2) screws located on the back of the cabinet. On RF models, remove rear cabinet as mentioned above.
4. Gently lift cabinet partially off of the unit to allow access to the display board ribbon cable and ground wire.

WARNING: At this point it is possible to directly contact the unit's circuit boards and other electronic components. The unit must be unplugged to prevent injury, and the service technician must be grounded. Any contact to the circuit boards without proper grounding can result in damage to components.

WARNING: During certain troubleshooting procedures it is necessary to activate the unit with the cabinet partially removed, so that the control panel is still plugged in. Extreme care must be taken to avoid electrical shock.

5. Disconnect ribbon cable and ground wire. (When reconnecting, reposition the ribbon cable in the tie-down clip mounted on the inside surface of the cabinet. This prevents damage to the cable from the latch mechanism.)
6. Remove cabinet. If operation is required with the cabinet removed, lie the cabinet down on its side while keeping the Display PCB connected.

Lid and Cabinet are replaced by reversing the steps above.

8.3 Gasket(s)

The lid liner engages cover gasket(s) on both units. There is one horizontally mounted and one vertically mounted cover gasket around the guardbowl edge.

Additionally, in RF models, there is a gasket located between the cabinet and the guardbowl. This gasket prevents any water (melted frost) from getting into the electrical portions of the centrifuge. If any gap is visible, the gasket should be replaced, or the gap filled with silicon RTV.

8.4 Latch Assembly

The latch assembly consists of the latch, solenoid, microswitch, plunger/linkage arm assembly, and emergency release cord. The latch closes in two stages, and must be fully closed (two “clicks”) in order to run the centrifuge. By sensing the position of the plunger/linkage arm connecting pin, the microswitch prevents operation of the unit when the lid is open. If an attempt is made to run the unit in this condition, “Lid” error message is displayed on the control panel.

If a “Lid” error message can not be cleared by fully closing the lid, the strike or microswitch may need adjustment. See Section 8.1, Cover Assembly, for strike adjustment instructions.

Checking the Microswitch

The microswitch can be tested using the following procedure:

1. Remove the lid and cabinet (see Sections 8.1 & 8.2).
2. Disconnect connector J/P7 on the logic board (upper board).
3. Measure the resistance across the two microswitch terminals
 - The switch should read open, when the latch is open.
 - The switch should read closed, when the latch is closed.

If the readings are not as expected, the switch is either bad, or a component is not properly positioned.

4. To test the switch itself, open the latch and actuate the microswitch. Resistance readings should be as described above.
5. Make sure the latch, solenoid and microswitch are securely mounted, and that linkage pin engages with the microswitch actuator arm from below.
6. If necessary, bend the microswitch actuator arm to adjust its position so that the readings described in step 4 are obtained.

Solenoid

The solenoid activates release of the latch, when the STOP/COVER OPEN button is pressed, and the rotor has slowed below 150 RPM.

Checking the solenoid:

Resistance of the solenoid coil should be approximately 75 - 80Ω. This can be measured by at J/P12 connector on the power board (lower board) and measuring across the two WHT leads. If the coil resistance is not as expected, replace the solenoid.

To replace a faulty solenoid:

1. Remove the lid and cabinet (see Sections 8.1 & 8.2).

2. Disconnect the wiring to the solenoid at J/P12 on the Power PCB.
3. Remove the retaining nut that secures the solenoid to the containment frame.
4. Leaving the plunger and linkage arm assembly in place within the latch, remove the solenoid.
5. Slide the new solenoid onto the plunger.

Note: The pin that attaches the solenoid plunger to the linkage arm must be positioned below the microswitch arm in order to properly function, and to indicate lid open and lid closed conditions.

6. Carefully apply thread sealant, such as Loctite[®] 242, to the solenoid threads and secure the retaining nut.
7. Reattach the wiring harness.

Checking power to the solenoid:

WARNING: The following procedure requires operation of the unit with power applied and the cabinet removed. Use caution to avoid electric shock. See Section 7.1, Warnings and Cautions.

1. Remove the lid and place the cabinet on its side, leaving the display board connected.
2. Power to the solenoid can be measured at J/P12, across the two white leads. The expected value is 170 volts DC.
3. Close the cover and press the Stop/Open cover button, to activate the solenoid. Power is applied for a fraction of a second. Digital multimeters with peak hold should show approximately 130 VDC. .

9 POWER CIRCUIT

9.1 General

Power is supplied to the unit through the Power Entry Module, located on the back of the unit. The Power Entry Module contains a removable fuse tray containing one or two active fuses, depending on the model number (see section 2.3). In models requiring only one active fuse, a spare fuse is stored in the fuse tray for convenience.

A line filter, transformer, and terminal block are present in the RF models.

9.2 Troubleshooting

AC power

Use the following procedure to verify AC power to the boards and board components:

WARNING: This procedure requires operation of the unit with power applied and the cabinet removed. Use caution to avoid electric shock. See Section 7.1, Warnings and Cautions.

1. Remove the lid and cabinet (see Sections 8.1 & 8.2).
2. With power applied, and using TP1 (GND) for ground, measure the voltage at:
 - TP4 170 VDC
 - TP3 +15 VDC
 - TP2 +5VDC

If voltage is not present, use the wiring diagram to trace back through the fuse(s), transformer, line filter, and power entry module, to locate any failed components or loose wires.

Fuse

If a main fuse blows repeatedly, an internal short needs to be found and corrected. Several spare fuses are required for troubleshooting. Follow this procedure to isolate the cause of a fuse that keeps blowing:

1. Remove lid and cabinet.
2. Remove all connectors at the power board. This includes J8, J9, J10, J11, J12, J13 and J14A, B & C.
3. Plug in the unit. If the fuse blows, check each component from the power entry module to the power board for shorts, and replace as necessary.
4. If no short is found, unplug the unit.
5. Connect the power board to the incoming supply (J9 of Power PCB), and leave all other connectors to the Power PCB disconnected.
6. Plug in the unit.
7. If the fuse blows, replace the power board.
8. Plug components in to the power board one at a time, unplugging and plugging in the unit each time, until the fuse blows. Search for a short in the last component connected before the fuse blew.

Note: for refrigerated units, the refrigeration system will often need to be turned on in order to find a short in the compressor.

10 CIRCUIT BOARDS

10.1 General

Motor Drive

The Micromax electronics consist of three circuit boards, the display board, logic board and the power board.

The display board contains the user interface and display components, including an encoder (U6), inverters (U2 & U5), as well as the display drivers (U1, U3, U4). The membrane keyboard and user interface displays are integral to the embedded system design and are under full microprocessor supervision.

The microcontroller (Logic) circuit board consists of the controlling microprocessor (U5, 68HC11 microcontroller) and associated system software (U12 - 27C256 EPROM). The microcontroller is an embedded system design. It is an eight bit machine with synchronous ports for data and address busses. It also has synchronous and asynchronous serial ports, an eight bit general purpose I/O port, and a four input eight bit analog to digital converter.

U1 is an under voltage sensing circuit which monitors power interruptions, displaying a PFAIL error message when logic voltage drops.

The Power circuit board develops the motor and logic power supply voltage. In addition to the motor drive circuit, the power board supports the following systems: refrigeration, condenser fan, latch solenoid, and the motor brake.

The drive motor is a brushless DC motor. Power is applied to the motor by the 3 phase sequencing of 6 MOSFET transistors (Q5 & Q6, Q7 & Q8, Q9 & Q10) through their associated drivers (U10 & U11, U12 & U13, U14 & U15). Only one pair of the MOSFETS is on at any given time.

Refrigeration

The compressor and condenser fan are both powered through solid state relays (SSR), the compressor through a baseplate mounted SSR and the condenser fan through a power board mounted SSR (U1). Both should be on , along with their corresponding power board LEDs COMP (DS2 - green) & FAN (DS1 - green), whenever cooling is called for.

Latch Solenoid

The cover solenoid is powered by MOSFET Q3. The cover solenoid may only be activated once the rotor has slowed to below 150 rpm.

10.2 LEDs & Test Points

Power PCB LEDs

These are the names and descriptions of the power board Controls and their corresponding LEDs:

FAN (DS1): This green LED Indicates that the condenser fan is activated.

COMP (DS2): This green LED indicates that the refrigeration drive circuit is activated. The refrigeration drive circuit includes the compressor.

FAULT (DS3): This red LED indicates when the motor is at rest. The FAULT LED measures the level of current being applied to the motor during acceleration. This LED is OFF at a steady state speed.

BRAKE (DS4): The red LED indicates when the brake circuit is activated.

COVER (DS5): This red LED indicates when the solenoid is activated.

PCB Test Points

PCB Test Points are as follows:

Power PCB

TP1	GND
TP2	+5VDC
TP3	+15VDC
TP4	+HV (170VDC)
TP5	OSC (15 KHz)
TP6	Tach (1Hz/10RPM)

10.3 Replacing the Circuit Boards

Caution: The circuit boards contain electronic devices that can be damaged by static electricity. Service personnel should be properly grounded (such as by wearing a wrist strap) whenever handling or touching the circuit boards or individual components. When transporting a circuit board, always enclose it in a static-protective bag.

Display Board The display board is located on the inside front surface of the main cabinet, directly beneath the control panel. Remove as follows:

1. Remove the lid and cabinet (see Sections 8.1 & 8.2).
2. Disconnect all connectors from the board.
3. Remove the 5 Phillips head screws that secure the board.
4. Lift the board off.
5. Replace the board by reversing steps 1 - 4.

Logic Board The logic board is located inside the unit, beneath the rotor and guardbowl assembly. It is mounted above the power board on standoffs. Remove as follows:

1. Remove the lid and cabinet (see Sections 8.1 & 8.2).
2. Disconnect all connectors from the board.
3. Unclip each corner of the board from the standoffs, using gentle but firm pressure. Access to the board is possible from either the front of the unit or through the cutout in the sheet metal frame that supports the guardbowl assembly.
4. Lift the board off.
5. Replace the board by reversing steps 1 - 4.

Note:

A recent product improvement to the Micromax series was the addition of a *PULSE* button on the front Membrane Control Panel. This feature allows the user to make a quick spin, lasting as long as the *PULSE* button is pressed. This improvement requires a simultaneous software upgrade to at least revision 3.0. If the software change is not made at the same time the Control Panel is upgraded, then the *PULSE* button will act as the Cover Open button. If the new software is installed on a unit having no *PULSE* button, then the Cover Open button starts a short spin which ends when the button is released.

For ordering spares, use the following guidelines:

Part Description	NO PULSE Feature	PULSE Feature
Logic PCB	44476 Kit	50615
Control Panel (Ventilated)	50595A Kit	50614A
Control Panel (RF)	50595B Kit	50614B

The 44476 Kit will include a 50615 PCB with the older software (revision 2.7) already installed. This PCB works with the original panel that does not have a *PULSE* button.

The 50595 Membrane Control Panel Kit will include a 50614 Membrane Panel, an EPROM (software version of at least 3.0), and instructions on how to install the software on the original Logic PCB. This kit will upgrade a non *PULSE* button unit to one with the *PULSE* feature.

Power Board

The power board is mounted on the base of the unit, below the logic board. Remove as follows:

1. Remove the lid and cabinet (see Sections 8.1 & 8.2).
2. Remove logic board per instructions above.
3. Disconnect all connectors from the power board.
4. Unscrew the 5 plastic standoffs that secure the board to the base. Access to the standoffs is possible from either the front of the unit or through the cutouts in the sheet metal frame that supports the guardbowl assembly.
5. Remove the 4 screws that secure to clamp bar to the base.
6. Remove 1 screw that secures the front right corner of the board to the base.
7. Lift the board off. It may be easier to remove the PCB by first removing the solenoid (see section 8.4).
8. Replace the board by reversing steps 1 - 7.

CAUTION: Mosfet devices are mounted on the underside of the front edge of the power board. These devices generate heat. They must be in good thermal contact, but electrically isolated from the aluminum heat sink. The silpad material that is between the Mosfets and the heat sink must be clean and undamaged when reinstalling the board. If your model does not have a heat sink, order IEC KIT NO. 44475 to replace the PCB and add the heat sink.

11 DRIVE ASSEMBLY

11.1 Motor

The Micromax utilizes a brushless DC drive motor with built in Hall effect speed sensors.

Some electrical motor characteristics can be checked, when the unit is unplugged. These procedures are outlined in this section.

Test

To measure the resistance of the motor, use the following procedure:

1. Remove the lid and cabinet (see sections 8.1 & 8.2).
2. Remove connector J/P14A (red), J/P14B (brown), and J/P14C (orange) from power board.
3. Measure the resistance between each pair of wires (red/brown, red/orange, brown/orange). Expected resistance value is approximately 1Ω .
4. If an open circuit is detected, or if any lead does *not* read open with respect to ground, replace the motor.

Motor Replacement

Use the following procedure to replace the motor:

1. Remove the lid and cabinet (see section 8.1 & 8.2).
2. Remove the rotor.
3. Remove the rotor adapter. The adapter is removed by loosening the two Allen screws ($3/32''$) in it and lifting it off.
4. Remove the black rubber motor boot. The motor boot is a molded part which has a channel that fits onto the guardbowl (no adhesives hold it in place). To remove it, grab a portion and peel it away from the guardbowl.
5. Disconnect motor wires from power board at J/P13, J/P14A, J/P14B, and J/P14C.
6. The brake resistor wires may be ty-wrapped to the motor wires. If so, cut and remove the ty-wraps.

7. Turning the unit on its side*, remove the 4 screws from the motor mounting plate. These are accessible through the hole in the unit's base plate.
8. Partially lift the motor out through the opening in the guardbowl.
9. Reach through the opening in the guardbowl and disconnect the motor ground wire from the base of the motor.
10. Replace the motor in the same fashion, reversing the steps.

***Caution:** On RF models, once the centrifuge has been turned over on its side, and the returned to its normal position (on all four suction cup feet) it must be allowed to stand for 24 hours before use. Serious refrigeration system damage can result if the compressor oil is not allowed to completely settle.

11.2 Speed Sensor

The Speed sensor is a set of three hall effect type sensors located at the bottom of the motor. It does not require calibration or adjustment. Its accuracy (+/- 10 rpm) can be verified by strobing the motor shaft through the viewport in the cover. It is integral to the motor and replacement requires replacement of the motor as a unit.

The sensor(s) and magnetic disk can be inspected by removing the cover at the bottom of the motor (2 screws). This sensor indicates not only the speed of rotation, but also position of the armature for the powering of the three phases at maximum efficiency. The sensor disk should not be loose, with respect to the shaft. This disk is mounted and fixed to the motor shaft at a specific location, and is synchronized to the armature. If its location (relative to the shaft) has changed, the motor will be misfiring and unable to attain maximum speeds. This requires replacement of the motor, as synchronization in the field is not possible.

The sensor(s) are located on the small printed circuit board within the motor. All three should be located with good proximity to the magnetic disk. If any gap appears to be too great the sensors can be carefully manipulated back towards the disk. Take care not to locate them too close, as the disk may rub on and damage them.

Test

WARNING: This procedure requires operation of the unit with power applied and the cabinet removed. Use caution to avoid electric shock. See Section 7.1, Warnings and Cautions.

1. Remove the lid and place the cabinet on its side, leaving the display board connected.
2. Power to the speed sensor can be verified across test points TP1 (GND) and TP6 (Tach) of the Power PCB.
3. Turning the motor shaft slowly should produce a fluctuation between 0 and 5VDC (square wave).
4. The frequency output of the speed sensor can be measured across the same points using an oscilloscope or a multimeter with frequency capability. The speed sensor produces a frequency signal of 1 Hz/10RPM.

The speed sensor is an integral part of the motor assembly, and is not available separately. If tests to the speed sensor uncover a fault, the motor must be replaced (see Section 11.1).

11.3 Brake

The brake applies reversed voltage to the motor during deceleration.

The brake requires service if, with a fully loaded rotor and operating at that rotor's maximum allowable speed, the deceleration time in the brake mode is not less than the deceleration time in coast (no brake).

Test

Use this procedure to verify operation of the braking system:

WARNING: This procedure requires operation of the unit with power applied and the cabinet removed. Use caution to avoid electric shock. See Section 7.1, Warnings and Cautions.

1. Remove the lid and place the cabinet on its side, leaving the display board connected.
2. Locate TP1 (GND) and J11, pin 3 (YEL) on the Power PCB.
3. Verify DC braking voltage across these locations. Expected measurement should be approximately 170 VDC.
4. Plug the unit in and verify that a properly loaded rotor is installed.
5. Select an appropriate speed and time, and start a run.
6. During a run, this voltage should drop slightly (3 - 10 VDC).
7. If voltage is not present, verify resistance of the brake resistor at J11 pins 1 (RED) and 3 (YEL). The expected value is approximately 50Ω.
8. If the resistor is good, replace the Power PC board.

12 REFRIGERATION

12.1 General

The Refrigerated Micromax is capable of maintaining a guard bowl temperature of 4° C at ambient temperatures up to 22° C. The units should be able to maintain those temperatures within $\pm 2^{\circ}$ C of the set point. The unit is charged with 3.9 oz. of HP62 (R-04A) refrigerant.

Note: The compressor has a 60 second time delay before re-starting.

Both refrigerated and ventilated models require ventilation for proper air flow. Allow a minimum of 8 cm (3 inches) clearance on all vented sides of the unit. Insure that the condenser fins and ventilation grill are free of dust and dirt. Do not operate the refrigeration system, if the condenser fan is not working correctly.

The compressor in the refrigerated unit is controlled by a solid state relay. The solid state relay acts as a switch which receives a low voltage signal (5VDC) from the Power PC board to either turn it on or off. The signal originates at the Logic PC board and passes through the Power PC board which then supplies the low voltage and low current signal to the solid state relay coil. The relay contact is then made, providing 120VAC to the compressor, turning it on. If the 5VDC signal from the Power PC board or the Logic PC board is lost, the compressor will shut off.

12.2 Condensing Unit

Service of the condensing unit should be performed by qualified personnel only, with the proper refrigerant recovery systems.

The condensing unit consists of the compressor, the condenser fan and their related electrical components.

Test

Use the following procedure, to verify voltage to the compressor:

WARNING: This procedure requires operation of the unit with power applied and the cabinet removed. Use caution to avoid electric shock. See Section 7.1, Warnings and Cautions.

1. Unplug the unit.
2. Remove lid and place the cabinet on its side, leaving the control panel plugged in.
3. Plug in the unit.
4. Close the latch.
5. Set temperature below ambient. The compressor should turn on within one minute. Use a voltmeter to measure the AC voltage at the electrical box across the BLU and BLK wires which go directly into the compressor.
6. The voltage applied to the compressor should be approximately 120 volts AC (or the actual in-line voltage).
7. If voltage is present, but the compressor does not start, check the starting capacitor.
8. If voltage is not present and the COMP LED on the Power PC board is lit, check the solid state relay (see Section 12.3).

To verify voltage to the condenser fan:

WARNING: This procedure requires operation of the unit with power applied and the cabinet removed. Use caution to avoid electric shock. See Section 7.1, Warnings and Cautions.

1. Remove the refrigeration cabinet.
2. Measure across the two leads to the fan (WHT & ORG).
3. When cooling is called for, this should read approximately 120 VAC.

12.3 Refrigeration Relay

The solid state relay (SSR) powers the compressor on a low voltage signal from the Power PCB. To test the SSR, use the following procedure:

WARNING: This procedure requires operation of the unit with power applied and the cabinet removed. Use caution to avoid electric shock. See Section 7.1, Warnings and Cautions.

1. Unplug the unit.
2. Remove lid and place the cabinet on its side, leaving the control panel plugged in.
3. Plug in the unit.
4. Close the latch.
5. Measure the DC voltage across J10 of the Power PCB, pins 1 (RED) and 2 (GRY). When the refrigeration system is activated (COMP LED - DS2 green is lit), there should be 5 VDC present. If not, replace the Power PCB.
6. If the 5 VDC is present, verify the voltage at the compressor. If voltage of 120VAC is not found at the compressor, check the Pressure Switch and look for any loose connections. If everything seems good, replace the relay.

12.4 Thermistor

The thermistor is located inside the chamber of the refrigerated model, beneath the rotor. You can verify its operation by taking its resistance at various temperatures. Follow this procedure to do so:

1. Open the cover.
2. Unplug the unit.
3. Remove the lid and cabinet (see Sections 8.1 & 8.2).
4. Locate J/P5 connector, on the Logic board and disconnect it.
5. Measure the resistance across the two pins.
 - At 25° C (approx. room temperature) the resistance should be 2.25 k Ω .
 - At 0° C (achieved by packing ice around thermistor) the resistance should be 7.35 k Ω .

If these values are not verified, or if an open or short circuit are detected, the thermistor should be replaced.

Replace

Use the following procedure to replace the thermistor:

1. Open the cover.
2. Unplug the unit.
3. Remove the lid and cabinet (see Sections 8.1 & 8.2).
4. Remove rotor.
5. Locate the thermistor inside the guardbowl. The thermistor is held in place with a rubber grommet. The body of the thermistor can be accessed through the cutout in the side of the guardbowl containment frame.
6. Push the thermistor down through the bottom of the guardbowl.
7. Unplug the thermistor from the logic board 44476, at J/P 5.
8. Install the new thermistor by reversing the steps above. The tip of the thermistor should be located approximately 1/2 inch above the surface of the guardbowl.

12.5 Pressure Switch

The refrigerated units also include a pressure switch. This pressure switch acts as a safety device for the refrigeration system. The pressure switch is brazed into the high pressure tubing run between the compressor and the condenser. If the pressure in the refrigeration system exceeds a pressure of 500 psi, the pressure switch will 'open', shutting the compressor off.

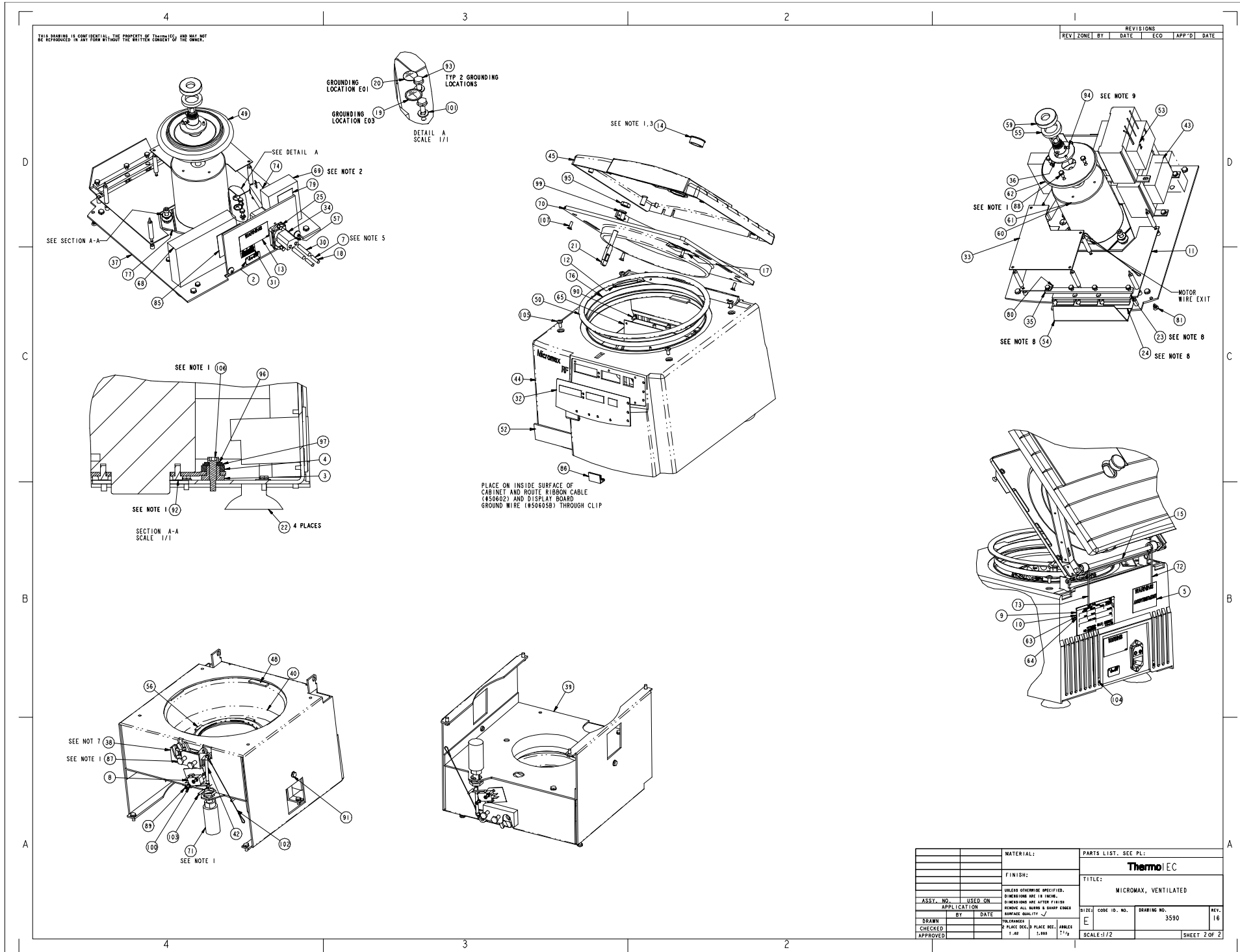
Replacement of the pressure switch should be done by a qualified refrigeration person.

13 DRAWINGS

Drawings included in this section are:

3590	Micromax, Ventilated (3 Pages)
3592	Micromax, Refrigerated (3 Pages)
10878	System Schematic, Ventilated Micromax
10872	System Schematic, Refrigerated Micromax
10873	Display Board Schematic
44474	Display Board Layout
PL44474	Display Board Parts List
10874	Motor Drive Board Schematic (2 Pages)
44475	Motor Drive (Power) Board Layout
PL44475	Motor Drive (Power) Board Parts List
10876	Logic Board Schematic (2 Pages)
50614	Logic Board Layout
PL50614	Logic Board Parts List

Note: At time of publication, these drawings were accurate. Changes do occur. If you have any questions regarding these drawings, contact IEC Technical Support at +(781) 449-8060.



REVISIONS	REV	ZONE	BY	DATE	ECO	APP'D	DATE
MATERIAL:							
PARTS LIST, SEE PL:							
FINISH:							
TITLE: ThermoIEC							
MICROMAX, VENTILATED							
ASSEMBLY NO.	USED ON	APPLICATION	BY	DATE	SIZE	CODE ID. NO.	DRAWING NO.
UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. DIMENSIONS ARE AFTER FINISH SURFACE QUALITY.		FINISH: UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE AFTER FINISH SURFACE QUALITY.		REV. 16			
DRAWN	CHECKED	APPROVED	TOLERANCES	PLACE DEC. PLACE INC.	ANGLES	SCALE: 1/2	SHEET 2 OF 2
			1.40	1.400	1/16		

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REVISIONS table with columns: REV, ZONE, BY, DATE, ECD, APP'D, DATE. Contains 16 revision entries.

Main parts list table with columns: ITEM, QTY, PART NO., DESCRIPTION, BULK ITEM, NOT SHOWN, PART. Lists various components like SYSTEM SCHEMATIC, LABEL, BATTERY MOUNT, etc.

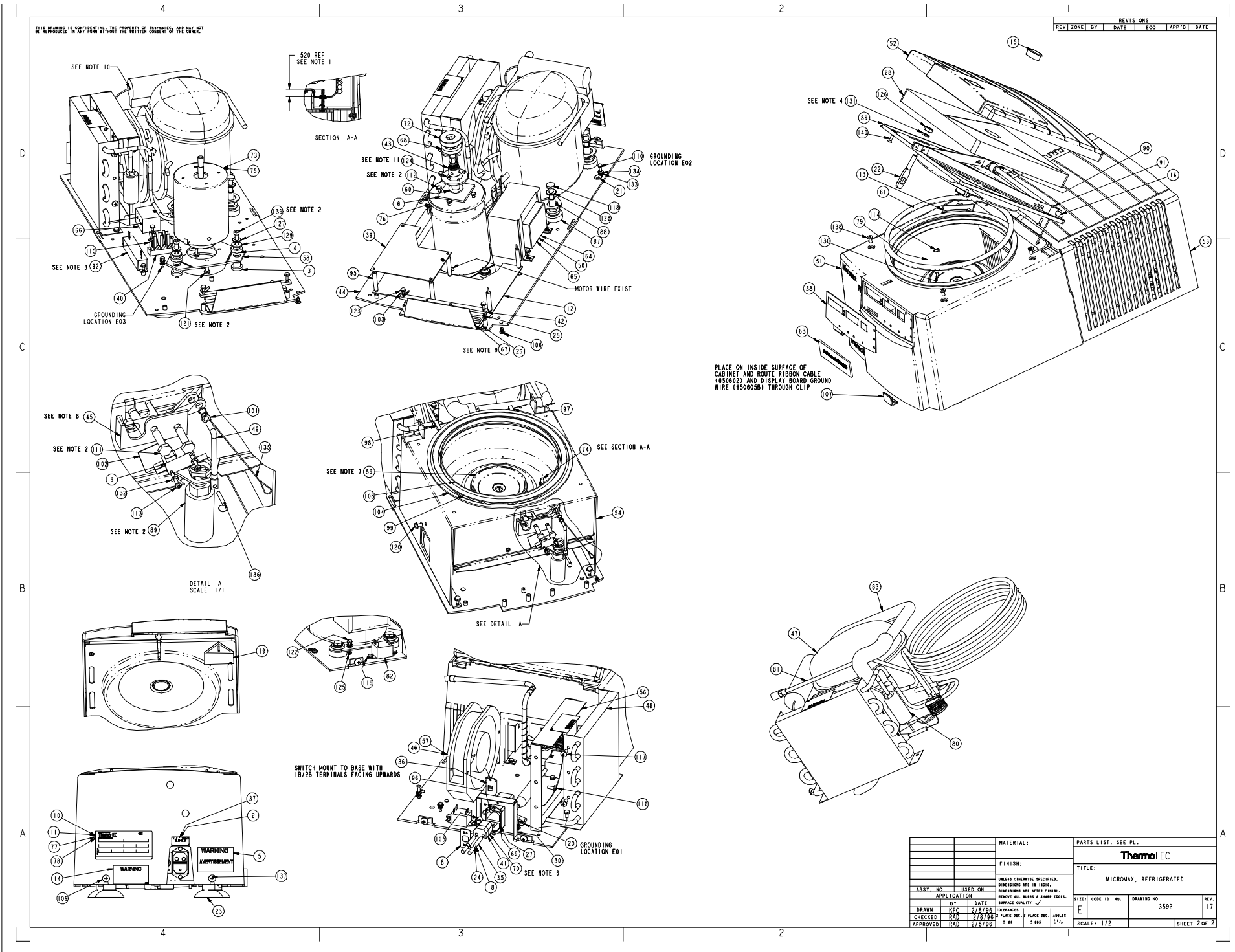
D C B A

TABLEAU MODEL vs PART NO. table with columns: PART NO., DESCRIPTION, PART NO., and multiple columns for model variants (3590, 3590F, 3591, 3595, 5520, 5521, 5525, 5590, 5591).

- NOTES: 1. APPLY LOCTITE 242 TO SHOULDER SCREWS, MOTOR TRIM HEX HEAD & WHIZ LOCK SCREWS... 2. PERMANENTLY MARK "MOT", ".625" HIGH, RED CHARACTERS... 3. TIGHTEN NUT SO THAT FLAT ON NUT IS PARALLEL TO FRONT OF LID LINER...

PROENGINEER MODEL 3590, ASM THIS ASSEMBLY DRAWING IS TO BE USED FOR ASSEMBLIES 3590, 3591, 3595, 5520, 5521, 5525, 5519

Material and parts list table with columns: MATERIAL, PARTS LIST, SEE PL., FINISH, TITLE, MICROMAX, VENTILATED, SIZE, CODE, DRAWING NO., REV., DATE, PLACE DEC, PLACE DEC, PLACE DEC, PLACE DEC, SCALE, SHEET OF.



ITEM	QTY	PART NO.	DESCRIPTION	BULK ITEM	NOT SHOWN
1	1	10872	SISTEN SCHEMATIC, REFRIGERATED		
2	1	40346	LABEL, FUSE SLOZ/BLO 250V		
3	3	40768	BARRY MOUNT, RUBBER		
4	3	40769	BARRY MOUNT, RING		
5	1	41170	LABEL, HIGH LEAKAGE		
6	1	43335	VOLTAG SECTOR LABEL		
7	1	43335	VOLTAG SECTOR LABEL		
8	1	43354	MICROWITCH		
9	1	44102	DATA PLATE-FORMA		
10	1	44105	DATA PLATE-FORMA		
11	1	44878	POWER BOARD ASSY		
12	1	45274	LABEL, ROTATION		
13	2	48998	LABEL, MARKING		
14	2	48118	VIEWPORT, MICROM1512		
15	1	48300	WINGE PIN		
16	1	48956	ROTOR LID		NOT SHOWN
18	2	48998	FUSE, TYPE T, 10A		
19	1	50011	LABEL, CAUTION		
20	1	50127	LABEL, PROTECTIVE EARTH GROUND SYMBOL		
21	2	50128	LABEL, SECONDARY CHASSIS GROUND SYMBOL		
22	1	50146	STRICH		
23	4	50146	SUCTION FOOT		
24	2	50159	FUSE, 10.0A, 250V		
25	1	50533	INSULATION PAD		
26	1	50534	SILPAD, PC BD		
27	1	50537	POWER ENTRY MODULE		
28	1	50538	FOAM INSULATION, LID		
29	1	50566	INSULATION TAPE, 1/8" X 1/8"		
30	1	50596	POWER MODULE BRACKET		WRAP AROUND CAP TURE
31	1	50600	BRANCH HARNESS		
32	1	50601	LOGIC BOARD HARNESS		
33	1	50602	DISPLAY BOARD HARNESS		
34	1	50603	COVER, HARNESS-MICROMAX		
35	2	50609	VOLTAG SELECTOR SWITC		
36	1	50609	VOLTAG SELECTOR SWITC		
37	1	50611	LABEL, FUSE TYPE T, 250V		
38	1	50614	MEMBRANE PANEL		
39	1	50615	LOGIC BOARD ASSY (W/ PULSE)		
40	1	50618	TERMINAL BLOCK		
41	1	50619	FUSE DRAWER		
42	1	50620	CLAMP BAR		
43	1	50621	ROTOR ADAPTER ASSEMBLY		
44	1	50622	BASE PLATE, REFRIGERATED		
45	1	50628	LATCH, MICROMAX		ASSEMBLY
46	1	50627	FAN		ASSEMBLY
47	1	50628	FAN		ASSEMBLY
48	1	50629	COMPRESSOR		
49	1	50635	LINK ARM		
50	1	50638	TRANSFORMER, REFRIGERATED UNIT (230V)		
51	1	50639	MAIN CABINET		
52	1	50640	LID		
53	1	50642	REFRIGERATOR CABINET		
54	1	50644	GUARD BOW ASSEMBLY		ASSEMBLY
55	1	50646	WIRING HARNESS, POWER - REF.		
56	1	50646	CONDENSER SHIELD		NOT SHOWN
57	1	50721	FAN		
58	1	50775	MOTOR MOUNTING PLATE		
59	1	50789	MOTOR BOOT		
60	1	50790	DISC, MOISTURE		

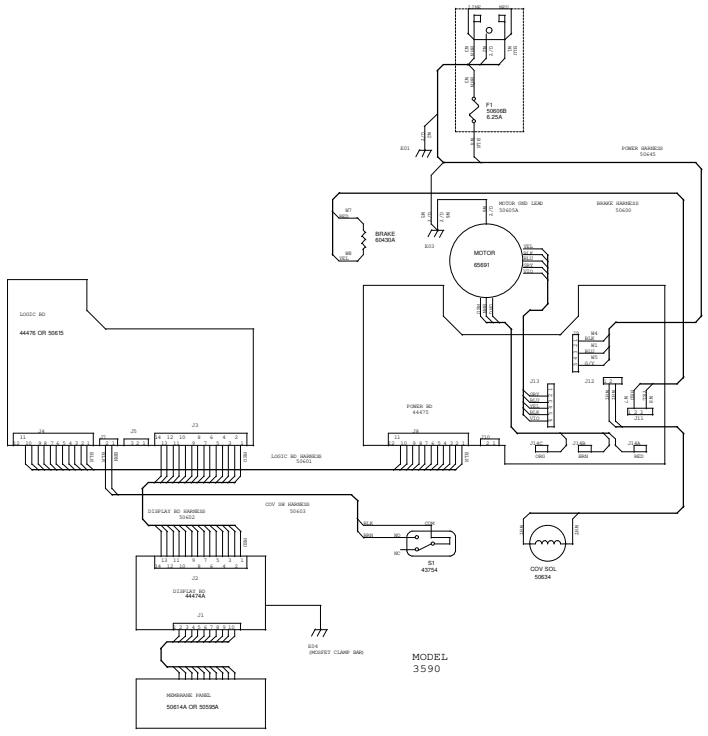
PART NO.	DESCRIPTION	PART NO.	TABULATION MODEL vs. PART NO.										
			3602	3602P	3600	3604	3690	0622	0623	0620	0602	0600	0604
40346	LABEL, FUSE SLOZ/BLO 250V	40346	40346N	40346N	N	N	40346P	40346N	N	40346P	40346N	N	N
41170	LABEL, HIGH LEAKAGE	41170	41170	41170	N	N	N	41170	N	N	41170	N	N
43312	POWER CORD, INT'L	43312	N	N	43312	43312	N	N	43312	43312	N	43312	43312
43335	VOLTAG SECTOR LABEL	43335	N	N	N	N	43335	N	N	43335	N	N	N
44102	DATA PLATE-FORMA	44102	N	N	N	N	N	44102F	44102G	44102H	44102I	44102P	44102P
44105	DATA PLATE-FORMA	44105	N	N	N	N	N	44105L	N	N	44105U	N	N
48956	ROTOR LID	48956	N	48956	N	N	N	N	N	N	N	N	N
48998	FUSE, TYPE T, 10A	48998	48998	48998	N	N	N	48998	N	N	48998	N	N
50159	FUSE, 10.0A, 250V	50159	N	N	N	N	50159	N	N	50159	N	N	N
50537	POWER ENTRY MODULE	50537	N	N	50537C	N	N	50537C	50537C	N	N	50537C	50537C
50606	FUSE, 1/4 X 1/4 X 1/4	50606	50606A	50606A	N	N	50606A	50606A	N	N	50606A	N	N
50609	VOLTAG SELECTOR SWITC	50609	N	N	N	N	50609A	N	N	50609A	N	N	N
50611	LABEL, FUSE TYPE T, 250V	50611	N	N	50611B	50611B	N	50611B	50611B	N	50611B	50611B	50611B
50614	MEMBRANE PANEL	50614	50614B	50614B	50614B	50614B	50614B	50614B	50614B	50614B	50614F	50614F	50614F
50615	LOGIC BOARD ASSY (W/ PULSE)	50615	50615A	50615A	50615A	50615A	50615A	50615B	50615B	50615B	50615A	50615A	50615A
50619	FUSE DRAWER	50619	50619B	50619B	50619A	N	50619B	50619A	50619A	N	50619B	50619A	50619A
50627	FAN	50627	50627	50627	50627	N	50627	50627	50627	N	50627	50627	50627
50628	COMPRESSOR	50628	50628A	50628A	50628A	50628A	50628A	50628A	50628A	50628A	50628A	50628B	50628B
50638	TRANSFORMER, REFRIGERATED UNIT (230V)	50638	N	N	50638	N	50638	50638	N	N	50638	N	50638
50639	MAIN CABINET	50639	50639B	50639B	50639B	50639B	50639	50639	50639	50639	50639	50639	50639
50640	LID	50640	50640A	50640A	50640A	50640A	50640A	50640B	50640B	50640B	50640B	50640B	50640B
50721	FAN	50721	N	50721	N	50721	N	50721	N	N	50721	N	N
50775	MOTOR MOUNTING PLATE	50775	50775	50775	50775	50775	50775A	50775A	50775A	50775A	50775	50775	50775
53440	ROTOR 24 X 24 PLCS (1.5ML X 0.5ML)	53440	N	53440	N	N	N	N	N	N	N	N	N
58620	LABEL, FORM MICROCENTRIFUGE (IMP)	58620	N	N	N	N	58620A	58620A	58620A	58620A	58620B	58620B	58620B
61266	TRANSFORMER, 124V, 60 Hz	61266	N	N	N	61266	N	N	61266	N	61266	N	61266
61268	TRANSFORMER, JAPANESE UNIT, 100V	61268	N	N	N	61268	N	N	61268	N	61268	N	61268
65358	POWER ENTRY MODULE	65358	65358	65358	N	65358	65358	N	N	65358	65358	N	N
65359	FUSE DRAWER	65359	N	N	N	N	65359	N	N	65359	N	N	N
65687	POWER CORD	65687	65687	65687	65687	65687	65687	65687	N	65687	65687	N	N
65691	MOTOR	65691	65691	65691	65691	65691	65720	65720	65720	65720	65691	65691	65691
65720	MOTOR	65720	N	N	N	N	65720	65720	65720	65720	N	N	N
65726	MOTOR SHIELD	65726	N	N	N	N	65726	65726	65726	65726	N	N	N
66014	DATA LABEL W/ REFRIGERANT	66014	N	N	66014A	N	N	N	N	N	N	N	N
66016	DATA LABEL CSA-NRTL/C W/ REFRIGERANT	66016	66016A	66016A	N	N	N	N	N	N	N	N	N
H10340	10-24 X .375 TRIM HEX HEAD M/S18-8	H10340	N	N	N	N	H10340	H10340	H10340	H10340	N	N	N
OP. MANUAL	OPERATORS MANUAL	OP. MANUAL	OM3590	OM3590	OM3590	OM3590	OM3590	OM5520	OM5520	OM5520	OM5590	OM5590	OM5590
P0023	SHIPMENT PACKAGING, ROTOR	P0023	N	N	N	N	N	N	N	N	N	N	N
P0063	CARTON	P0063A	N	N	N	N	P0063A	N	N	N	P0063A	N	N
P0064	CARTON REFRIGERATED (INT)	P0064	N	N	P0064	P0064	P0064	P0064	P0064	P0064	P0064	P0064	P0064
P0207	FOAM PAD MMAX (INT)	P0207	N	N	P0207	P0207	P0207	P0207	P0207	P0207	P0207	P0207	P0207

ITEM	QTY	PART NO.	DESCRIPTION		
121	4	H183315	10-24 X .375 WHIZ LOCK, ZN	PART	
122	1	H183317	8-32 X .500 WHIZ LOCK, ZN	PART	
123	4	H183318	8-32 X .375 WHIZ LOCK, ZN	PART	
124	2	H255199	10-32 X 1/8 SET SCREW	PART	
125	1	H302382	WHIZ LOCK NUT 8-32, ZN	PART	
126	1	H303024	5/16-24 HEX. NUT, SS	PART	
127	3	H401111	1/4" FLAT WASHER, SS	PART	
128	4	H401518	5/16" FLAT WASHER, SS	PART	
129	3	H402150	1/4" WASHER, TRM B L 134 OD, .281 ID, .04 THK, SS	PART	
130	1	H414151	#8 INTERNAL LOCK WASHER, SS	PART	
131	1	H419192	5/16 LOCK WASHER SPLIT, SS	PART	
132	2	H424011	#4 INTERNAL LOCK WASHER, SS	PART	
133	3	H424133	#8 INTERNAL LOCK WASHER, SS	PART	
134	4	H425181	#8 INTERNAL LOCK WASHER, SS	PART	
135	1	H500002	LATCH RELEASE CORD	PART	
136	1	H511398	ROLL PIN, 1/8 DIA, 5/16 LG, SST	PART	
137	1	H550001	STAKE FASTENER, 510FPC20086	PART	
138	4	H550002	STAKE FASTENER, 510FPC20086	PART	
139	3	H733000	1/4X285 SHOULDER SCREW, AL ST	PART	
140	4	H900053	4-10X500 PLASTIC FLAT HEAD, PHIL HD	PART	
141	1	OP. MANUAL	OPERATORS MANUAL		NOT SHOWN
142	3	P0023	SHIPMENT PACKAGING, ROTOR		NOT SHOWN
143	1	P0063	ANTI-STATIC BAG 30X25		NOT SHOWN
144	1	P0061	FRONT END PACK		NOT SHOWN
145	1	P0062	BACK END PACK		NOT SHOWN
146	1	P0063	SHIPMENT PACKAGING, ROTOR		NOT SHOWN
147	1	P0064	CARTON REFRIGERATED (INT)		NOT SHOWN
148	2	P0161	COVER FOAM		NOT SHOWN
149	1	P0207	FOAM PAD MMAX (INT)		NOT SHOWN

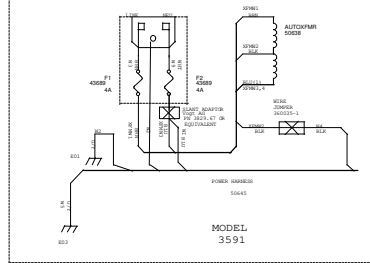
- NOTES:
- SET HEIGHT OF TEMPERATURE SENSOR (PART NO. 65692) BY ADJUSTING PROBE BODY FLUSH WITH GUARDBOWL ASSY BOTTOM PLATE.
 - APPLY LOCTITE 242 TO SHOULDER SCREW, MOTOR TRIMHEX HEAD & WHIZ LOCK SCREWS.
 - PERMANENTLY MARK "HOT", #25" HIGH, RED CHARACTERS CENTERED, ON TOP SURFACE OF RESISTOR (PART NO. 60435-A).
 - TIGHTEN SO THAT FLAT ON NUT IS PARALLEL TO FRONT OF LID LINER
 - GROUND PER IEC SPEC #38582.
 - INSTALL ACTIVE FUSES IN FUSE DRAWER: PACK SPARE FUSES WITH OPERATOR'S MANUAL (#3593, 3594, 5523, 5524), IN FUSE DRAWER (#3592, 3596, 5522, 5526, 5527)
 - ASSEMBLE MOTOR BOOT WITH HIGH VACUUM GREASE BETWEEN MOTOR BOOT & GUARDBOWL.
 - ADHERE SILPAD (50534) TO HEAT SINK (63016) ADHERE INSULATION PAD (50633) TO CLAMP BAR (50620)
 - PRIOR TO WIRING COMPRESSOR, REMOVE COMPRESSOR CAP & TURN 180° SUCH THAT WIRES ARE AT OPPOSITE END OF CAP & SCRAPE GROUND LEAD MOUNTING SURFACE FOR CONTACT.
 - APPLY LOCTITE 242 TO SETSCREW THREADS BEFORE ASSEMBLY, USE AS LITTLE AS POSSIBLE TO AVOID GETTING LOCTITE ON MOTOR SHAFT OR OTHER ADAPTER SURFACES

MATERIAL:		PARTS LIST. SEE PL:
FINISH:		ThermlEC
ASSY. NO. _____ USED ON _____	APPLICATION _____	TITLE: MICROMAX, REFRIGERATED
DRAWN BY _____ DATE _____	CHECKED BY _____	SIZE: CODE ID NO. _____ DRAWING NO. 3592
APPROVED BY _____ DATE _____	PLACED BY: _____ DATE: _____	SCALE: 1/2" _____ SHEET 1 OF 2

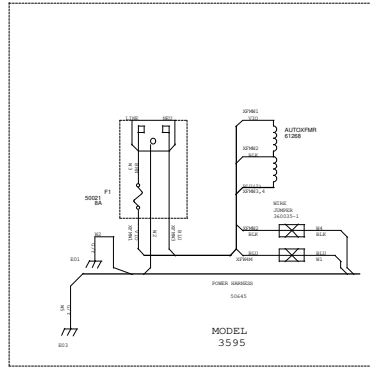
REVISIONS						
NO.	BY	DATE	DESCRIPTION	APP'D.	DATE	BY
1	DMW	4-12-79	ISSUED	DMW	4-22-79	
2	DMW	4-22-79	REVISED	DMW	4-22-79	
3	DMW	4-22-79	REVISED	DMW	4-22-79	
4	DMW	4-22-79	REVISED	DMW	4-22-79	
5	DMW	4-22-79	REVISED	DMW	4-22-79	
6	DMW	3-18-88	REVISED	DMW	3-18-88	
7	DMW	02-24-99	REVISED	DMW	02-24-99	



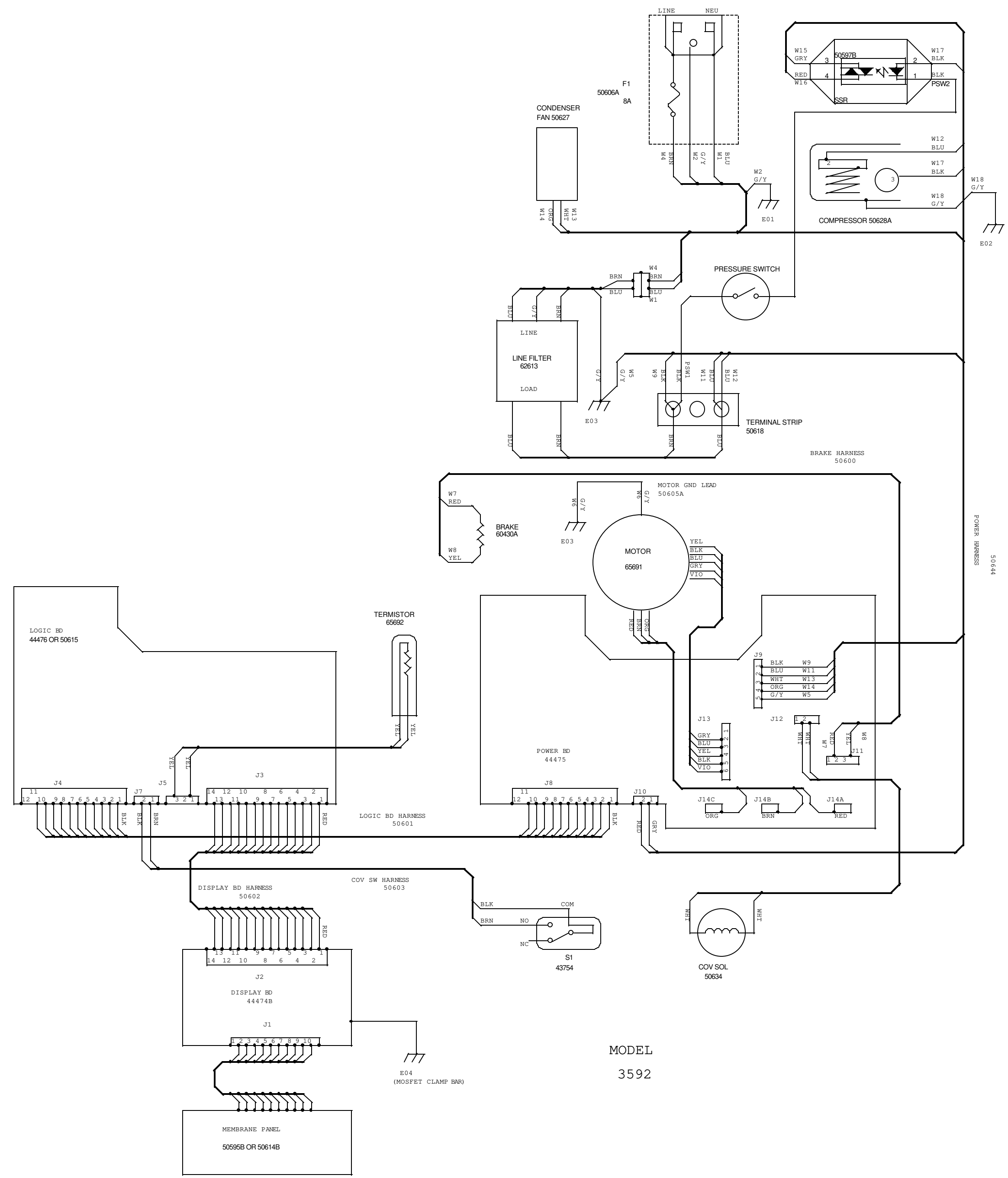
MODEL 3590



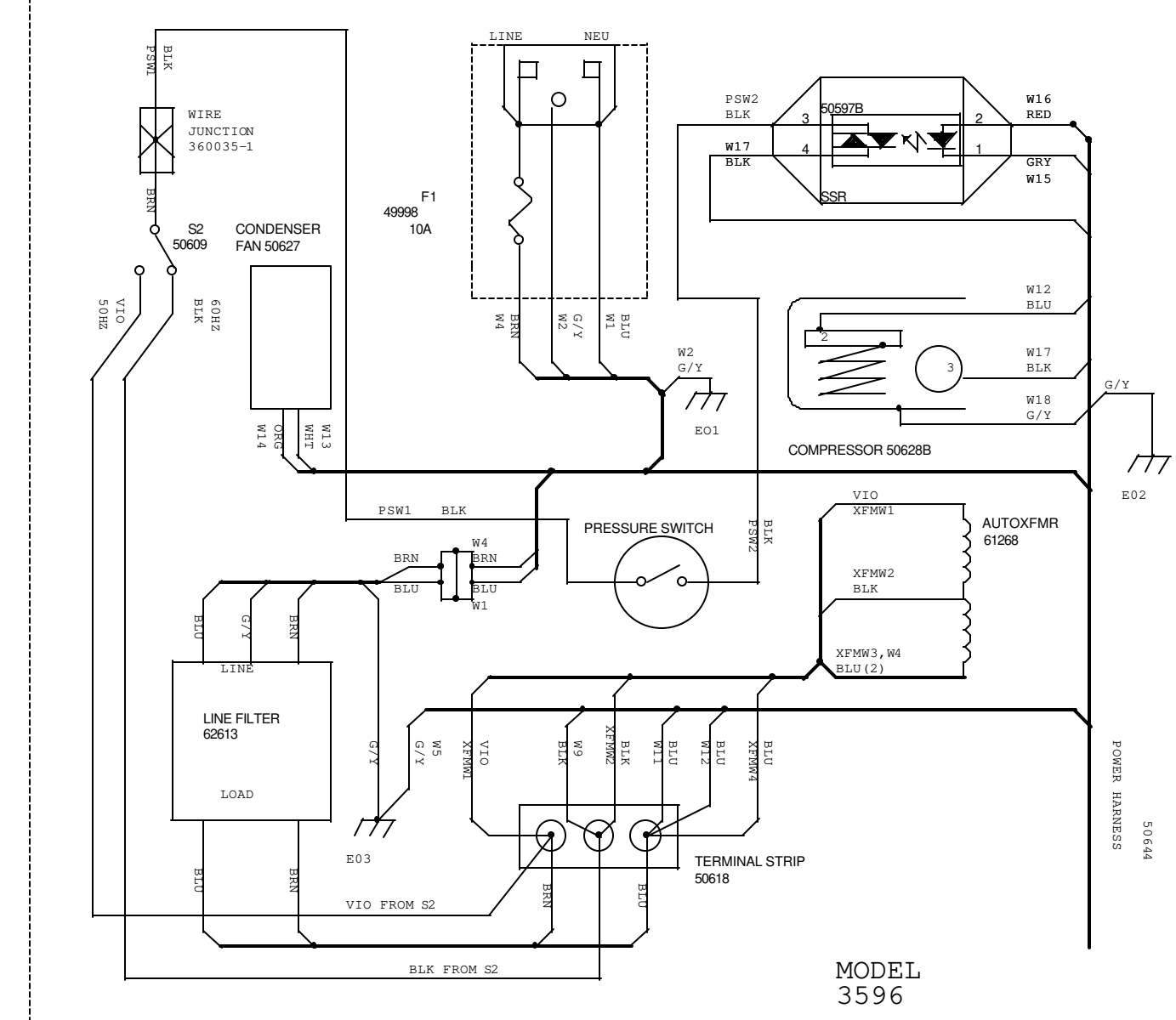
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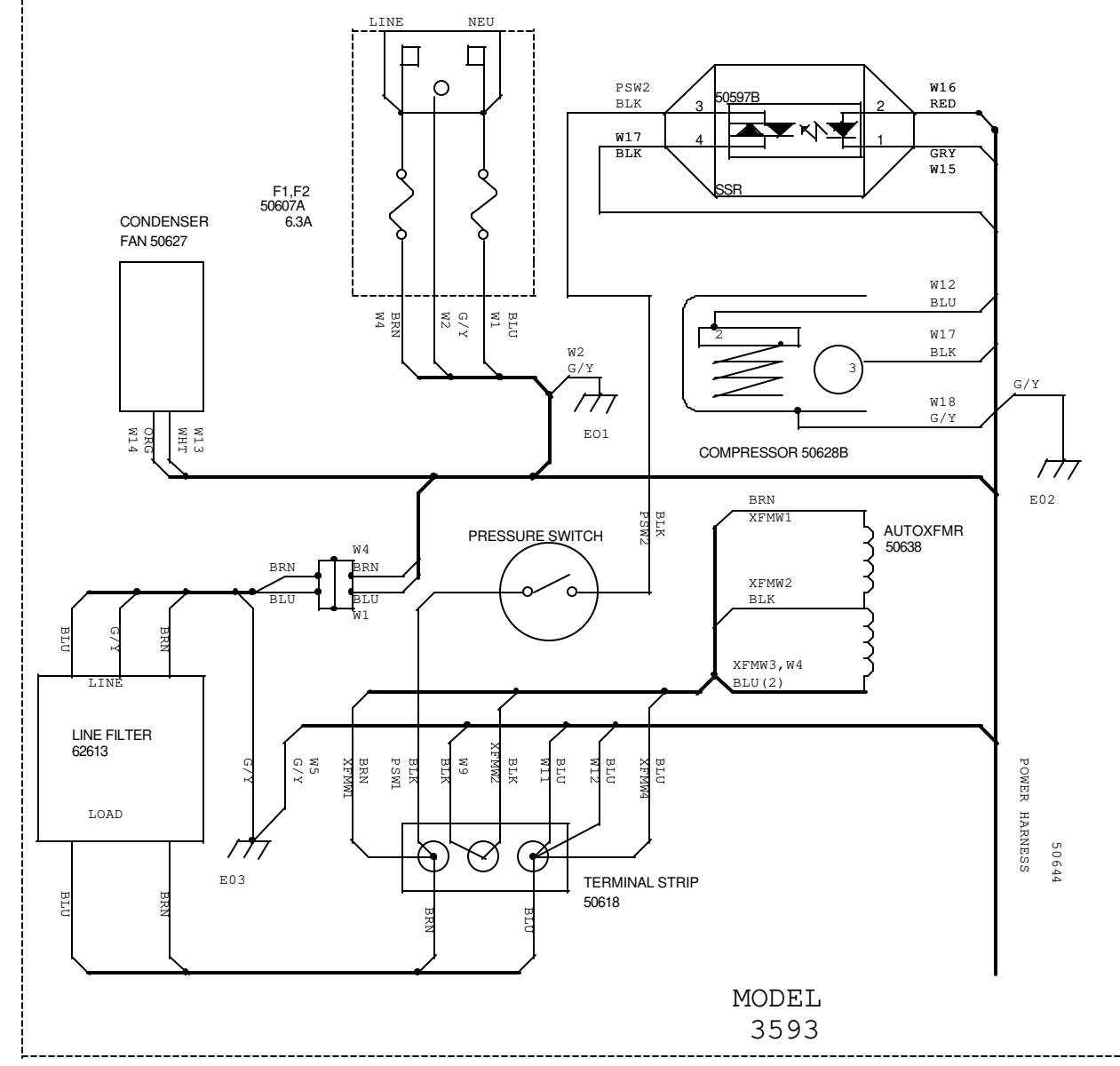
MODEL 3595



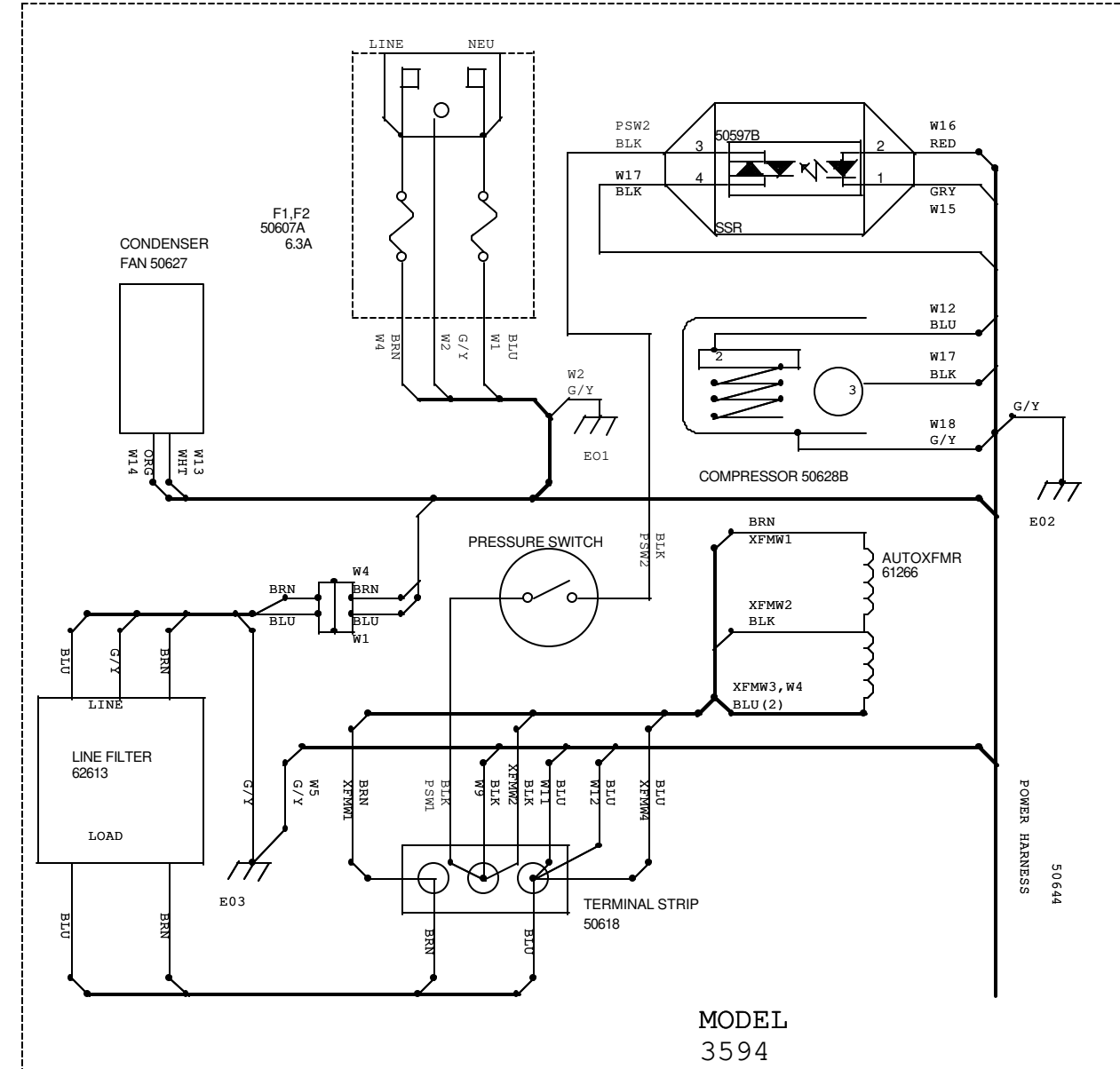
MODEL
3592



MODEL
3596



MODEL
3593



MODEL
3594

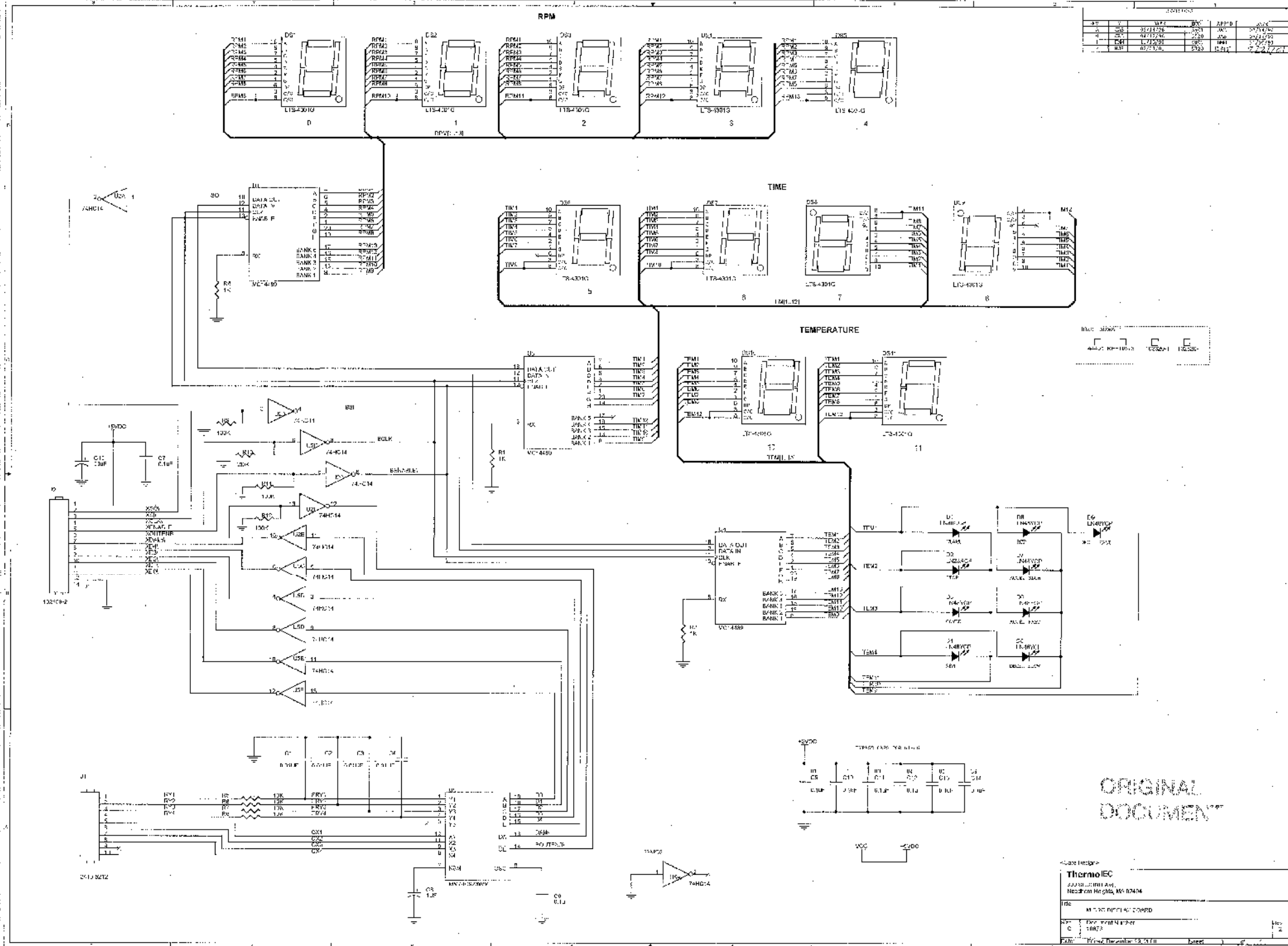
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0	JAB	4/18/96	3520	JAB	4/29/96
1	JAB	6/03/96	3553	JAB	6/03/96
2	JAB	8/12/96	3636	JAB	8/12/96
3	JAB	10/16/96	3724	JAB	10/16/96
4	SEL	3/14/98	4440	DM	3/16/98

INTERNATIONAL EQUIPMENT COMPANY
300 SECOND AVE
NEEDHAM HEIGHTS, MA 02194

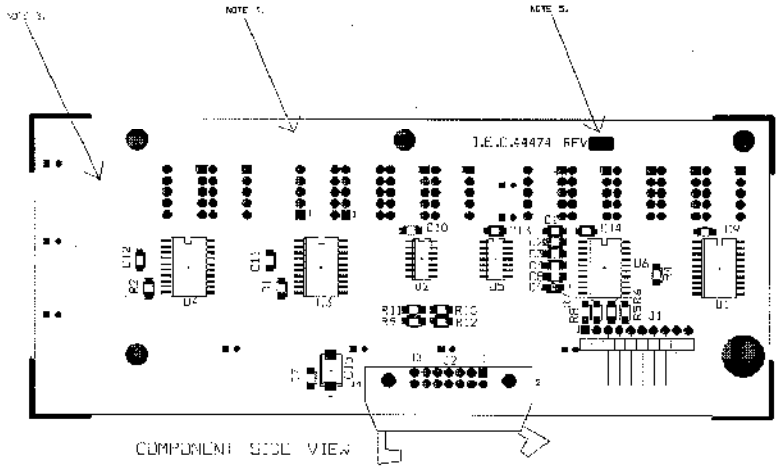
TYPE SYSTEM SCHEMATIC, REFRIGERATED MICROMAX

Size D Document Number 10672

Date: Wednesday, February 28, 2001 Sheet 1 of 1



REVISIONS						
REV	DATE	BY	DATE	APP'D	DATE	
4	--	JE	02/15/96	3401	JE	02/15/96
3	--	JE	04/12/96	3820	JE	04/12/96
1	--	JR	01/03/97	3724	JB	01/03/97
2	--	DM	12/09/98	4601	DM	12/09/98
5	--	HJR	02/22/01	5000	DM	02/22/01



- NOTES:
1. SEE PAGE INDICATE THE FOLLOWING:
 - a. PIN # OF MULTILEAD DEVICES (DIP, SIP, PLCC, etc.)
 - b. POLARITY PINS OF DIODES/COMPONENTS.
 - c. RESISTOR, CAPACITOR, etc., VALUE.
 2. ESTABLISH AND CLAY SYMBOL ON OPPOSITE SIDE OF P.C.B. BOARD OTHER OTHER COMPONENTS HAVE BEEN ASSEMBLED.
 3. PLACE SENSOR I.E. HERE
 4. PLACE MOUNTING SCREW IN THESE PLACES
 5. PLACE LABEL ACCORDING TO THE BOARD NUMBER HERE

ORIGINAL DOCUMENT

REF: SCHEMATIC NO. C10873

CHECKED BY: _____ DATE: _____		DRAWN BY: _____ DATE: _____		APPROVED BY: _____ DATE: _____	
I.E.C. A4474 RFV		I.E.C. A4474 RFV		I.E.C. A4474 RFV	
ASSEMBLY DRAWING		DISPLAY BOARD		444/2	
SCALE: 1:1		SHEET: 1 OF 2		DATE: 02/22/01	

Part Number: 44477B

Revision Level: 7

<u>Part Number</u>	<u>Description</u>	<u>Part Reference</u>	<u>Qty</u>
UCN0003-01	Microcontroller Motorola MC68HCP11E0FN	U13	1
TPT0000-00	TEST POINT, SOLDER TERMINAL, TURRET, 0.063" --- Mill-max 2108-2-00-44-00-00-07-0	TP1 TP2 TP3 TP4 TP5	5
SPC0006-00	PAD BIVAR CI-192-028	For X1 MNT1	1
SOC0002-00	SOCKET,IC,28 PIN DIP,.6 C-C CIRCUIT ASSY CA-28MSC-1F	For U10	1
SOC0001-00	SOCKET,IC,24 PIN DIP,.6 C-C CIRCUIT ASSY CA-24MSC-1F	For U12	1
RES0171-01	RES, MF, 4.7K, 1/8W, 5%, SM Dale CRCW1206472JRT1	R1 R5 R9 R11 R12 R13 R66	7
RES0162-01	RES, MF, 20K,1/8W, 5%, SM Dale CRCW1206203JRT1	R22	1
RES0161-01	RES 390 Dale CRCW1206391JRT1	R19 R21	2
RES0138-01	RES 680R Dale CRCW1206681JRT1	R39 R40 R41 R42 R43 R44 R45 R46 R47 R48 R49	11
RES0089-01	RES 330K Dale CRCW1206334JRT1	R17 R18	2
RES0082-01	RES 3.32K, 1% Dale CRCW12063321FRT1	R3	1
RES0063-01	RES 2.87k, 1% Dale CRCW12062871FRT1	R7	1
RES0054-01	RES, MF, 1M,1/8W, 5%, SM Dale CRCW1206105JRT1	R16 R57 R58 R59	4

Part Number: 44477B

Revision Level: 7

<u>Part Number</u>	<u>Description</u>	<u>Part Reference</u>	<u>Qty</u>
RES0050-01	RES, MF, 1K,1/8W, 1%, SM Dale CRCW12061001FRT1	R10 R30 R31 R32 R61	5
RES0028-01	RES 10M Dale CRCW1206106JRT1	R14	1
RES0022-01	RES, MF, 10K, 1/8W, 5%, SM Dale CRCW1206103JRT1	R15 R33 R34 R35 R36 R37 R38	7
RES0017-01	RES, MF, 100K,1/8W, 5%, SM Dale CRCW1206104JRT1	R2 R4 R23 R24 R25 R26 R27 R28 R29 R50 R51 R52 R53 R54 R55 R56 R62 R63 R64 R65	20
RES0011-01	RES, MF, 100R, 1/8W, 5%, SM Dale CRCW1206101JRT1	R20	1
RES0005-01	RES 1.1K Dale CRCW12061101FRT1	R6 R8	2
REF35463	TEST PROCEDURE PC BD	REF2	1
REF10879	SCHEMATIC,PC BD	REF1	1
OPT0014-00	IC,OPTO-ISOL GE H11A1	U6 U7 U9	3
LED0027-00	DISPLAY, 7 SEG Lite-On LTS-4301G	DS1 DS2 DS3 DS4 DS5 DS6 DS7 DS8 DS9 DS10 DS11 DS12 DS13 DS14	14
ICD0065-00	EPROM,IEC P/N 51425 National NM27C256Q120	U10	1
ICD0050-01	IC,CMOS,QUAD,2 INPUT OR Motorola MC74HC32D	U2 U22	2
ICD0049-01	IC,CMOS,3 TO 8 DECODER Motorola MC74HC138D	U5	1

Part Number: 44477B

Revision Level: 7

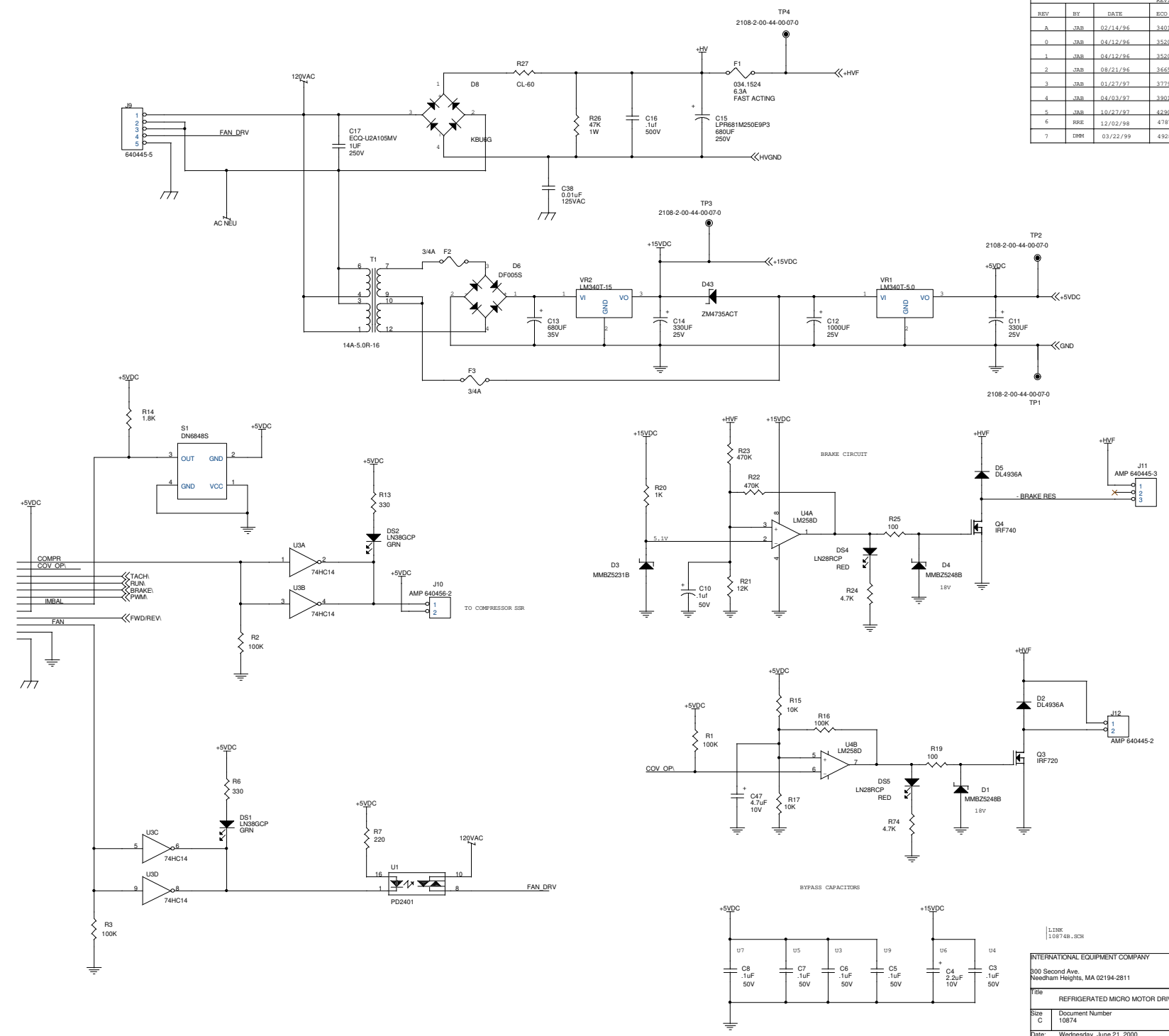
<u>Part Number</u>	<u>Description</u>	<u>Part Reference</u>	<u>Qty</u>
ICD0048-01	IC,CMOS,HEX D FLIP-FLOP W/COMMON CLOCK ----- Motorola MC74HC174D	U19 U20 U21	3
ICD0045-01	IC,CMOS,OCTAL,3-STATE ----- Motorola MC74HC374ADW	U11	1
ICD0015-01	IC,CMOS,HEX,SCHMITT INV, 74HC14, SOIC ----- Motorola MC74HC14D	U1 U3 U4 U15	4
ICD0013-00	IC,RAM,CMOS,NON-VOL,2KX8 ----- Dallas DS1220AD-200	U12	1
ICD0007-01	IC,CMOS,OCTAL,3-STATE ----- Motorola MC74HC373ADW	U14	1
ICA0010-01	IC,U/V SENSE, 5V, MC34064, SO-8 ----- Motorola MC33064D-5	U8	1
ICA0007-01	DISPLAY DRIVERS ----- Motorola MC14489ADW	U16 U17 U18	3
DIO0005-01	DIODE,SIGNAL ----- Vishay/Lite-On MMBD4148	D1 D2 D3 D4 D5 D6	6
CRY0000-00	CRYSTAL 8.000MHz ----- ECS Int'l Inc. ECS-80-32-4	X1	1
CON0069-00	CONNECTOR, 12 PIN ----- 3M 2412-5212	J1 J2	2
CON0067-00	HEADER, 14 PIN ----- Amp 1-640456-4	J3	1
CON0063-00	CONNECTOR ----- Molex 52018-6615	J4	1
CON0027-00	HEADER, 3 PIN ----- Amp 640456-3	J6	1

Part Number: 44477B

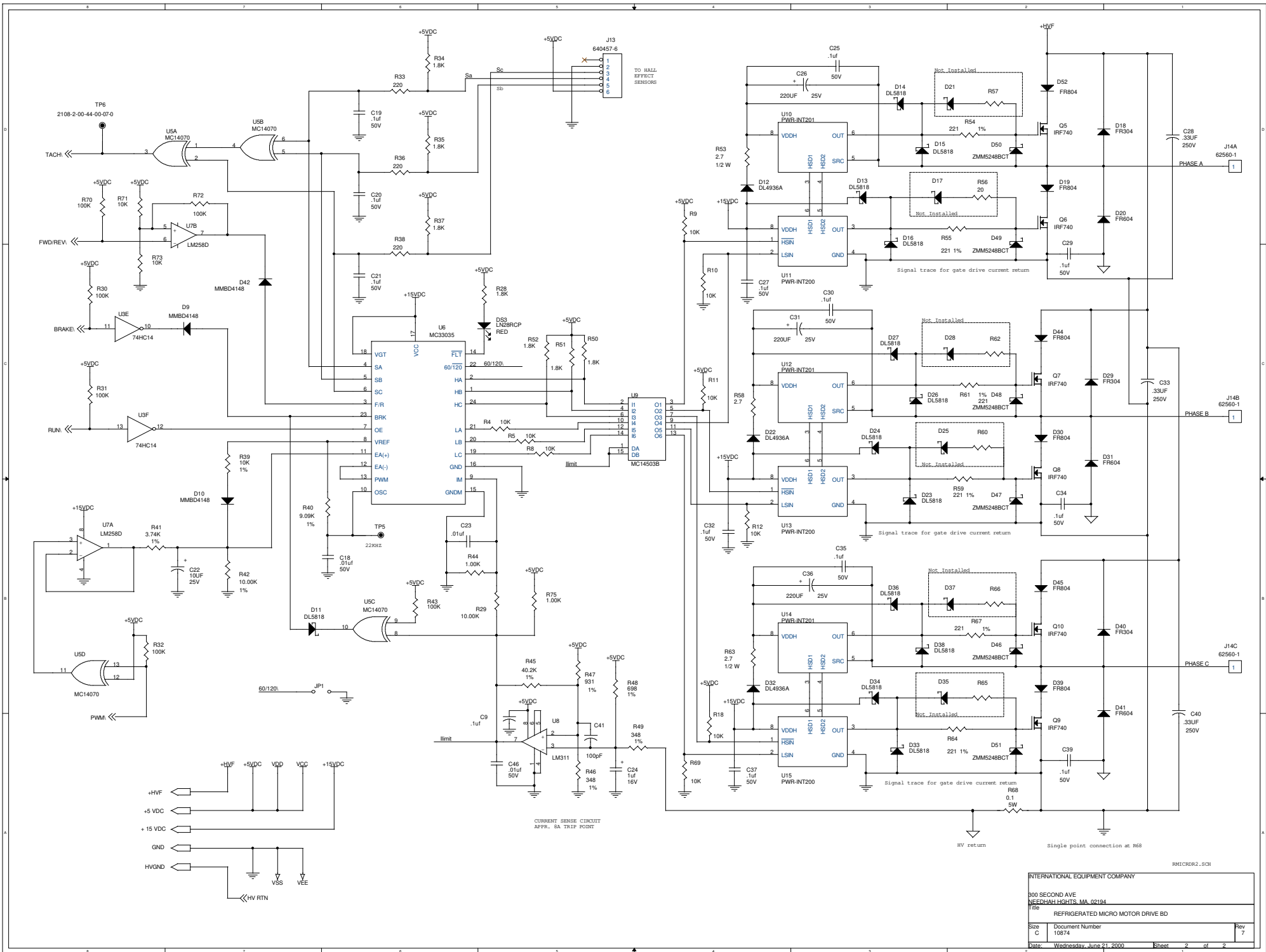
Revision Level: 7

<u>Part Number</u>	<u>Description</u>	<u>Part Reference</u>	<u>Qty</u>
CON0006-00	HEADER,2 PIN, FRICTION LOCK, 0.100" PITCH	J5	1
	Amp 640456-2		
CAP0209-00	Cap 2200pF, 50V	C39	1
	Kemet C1206C222K5GAC		
CAP0148-00	CAP 2.2UF,10V	C17 C20 C23 C28 C31 C33	6
	Panasonic ECS-T1AY225R		
CAP0146-00	CAP 22UF,10V	C12	1
	Panasonic ECS-T1AC226R		
CAP0145-00	CAP 150UF,10V	C13	1
	AVX TPSD157K010R01M		
CAP0128-00	CAP 1uf,16V	C5 C18	2
	Panasonic ECS-H1CY105R		
CAP0127-00	CAP 0.01uf, 50V, 10%, Z5U, SM	C38	1
	Kemet C1206C103K5UAC		
CAP0110-00	CAP 1000pF,50V	C10 C34 C35 C36 C37	5
	Kemet C1206C102K5GAC		
CAP0106-00	CAP, X7R, 0.1uF, 50V, 10%, SM	C1 C2 C3 C4 C6 C7 C11 C14 C15 C16 C19 C21 C22 C24 C25 C26 C27 C29 C30 C32	20
	Kemet C1206C104K5RAC		
CAP0062-00	CAP MONO CER,22pF,50V	C8 C9	2
	Kemet C1206C220K5GAC		
BPR0000-00	Beeper, Piezo, PC MNT	B1	1
	Projects Unlimited AI-550KS		
44457	ARTWORK,PC BD	PCB1	1

REVISIONS					
REV	BY	DATE	ECO	APP'D	DATE
A	JAB	02/14/96	1401	JAB	02/14/96
0	JAB	04/12/96	1520	JAB	04/12/96
1	JAB	04/12/96	1520	JAB	04/29/96
2	JAB	08/21/96	1665	JAB	08/21/96
3	JAB	01/27/97	1779	JAB	01/27/97
4	JAB	04/03/97	1891	JAB	04/03/97
5	JAB	10/27/97	4230	JAB	10/27/97
6	RRE	12/02/98	4787	RRE	12/02/98
7	DMH	03/22/99	4928	DMH	03/22/99

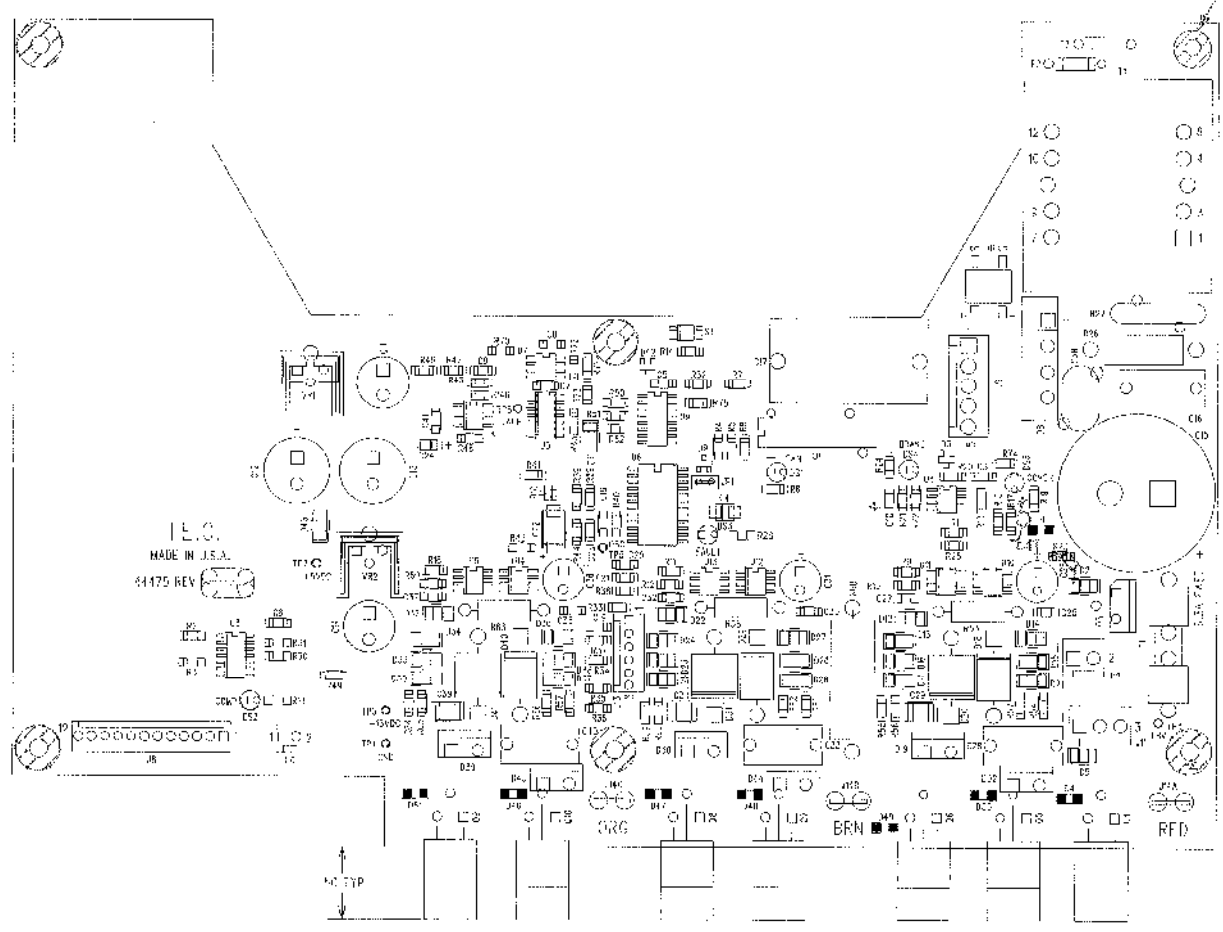


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INTERNATIONAL EQUIPMENT COMPANY 300 Second Ave. Needham Heights, MA 02194-2811	
REFRIGERATED MICRO MOTOR DRIVE BD	
Size C	Document Number 10874
Date: Wednesday, June 21, 2000	Sheet 1 of 2



REVISIONS						
REV	ZONE	BY	DATE	FIG	APP'D	DATE
0		JAB	05/02/96	3520	JAB	05/02/96
1		JAB	05/02/96	3520	JAB	05/02/96
2		JAD	06/25/96	3553	JAB	08/25/96
3		JAB	06/27/96	3685	JAB	08/21/96
4		JAB	01/27/97	3779	JAB	01/27/97
5		JAB	01/27/97	3779	JAB	01/27/97
6		JAB	01/27/97	3779	JAB	01/27/97
7		JAB	01/27/97	3779	JAB	01/27/97
8		JAB	04/04/97	3931	JAB	04/04/97
9		JAB	10/28/97	4131	JAB	11/18/97
10		JAB	10/28/97	4236	JAB	11/18/97
11		D.J.A.	05/19/99	4500	JAB	05/19/99
12		PL	06/19/99	4700	JAB	06/19/99
13		JAN	08/18/99	4928	JAN	08/18/99
14		JAD	09/22/99	5033	JAD	12-6-99

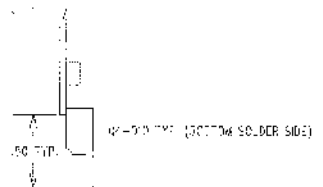
SEE NOTE 3 (6 PLACES)



AS VIEWED FROM COMPONENT SIDE

NOTES

- 1. SQUARE PADS INDICATE THE FOLLOWING:
 - A. POSITION OF WIRELEAD DEVICES (DIPS, S-S PINS, ETC.)
 - B. LOCATION OF DISCRETE COMPONENTS (CATHODE, ANODE, -V, ETC.)
- 2. DIODE MOUNTED ON OPPOSITE SIDE OF PCB BOARD.
 - A. CAT MOUNTED (DIP, S-S, PINS, ETC.)
 - B. ANODE MOUNTED (DIP, S-S, PINS, ETC.)
- 3. DIODE MOUNTED ON OPPOSITE SIDE OF PCB BOARD.
 - A. CAT MOUNTED (DIP, S-S, PINS, ETC.)
 - B. ANODE MOUNTED (DIP, S-S, PINS, ETC.)
- 4. DIODE MOUNTED ON OPPOSITE SIDE OF PCB BOARD.
 - A. CAT MOUNTED (DIP, S-S, PINS, ETC.)
 - B. ANODE MOUNTED (DIP, S-S, PINS, ETC.)
- 5. APPLY OPERATIONAL CONTROLS TO ENTIRE ASSEMBLY EXCEPT WHERE INDICATED ON THE BILL OF MATERIALS AND IN MOUNTING AREA. INDICATED ON THIS POINT IS NEARLY EXHAUSTIVE. THE WORKER OF DUTY MUST BE MAINTAINED. PREPARED COMPLETELY UNDER SUPERVISOR OF MANUFACTURING BOARD.



ORIGINAL DOCUMENT

SCHEMATIC REF. NO. C10874

INTERNATIONAL EQUIPMENT CO.																				
<table border="1"> <tr><th>APP'D</th><th>DATE</th><th>BY</th></tr> <tr><td> </td><td> </td><td> </td></tr> </table>	APP'D	DATE	BY				<table border="1"> <tr><th>REVISION</th><th>DATE</th><th>BY</th></tr> <tr><td> </td><td> </td><td> </td></tr> </table>	REVISION	DATE	BY				<table border="1"> <tr><th>REV</th><th>DATE</th><th>BY</th></tr> <tr><td> </td><td> </td><td> </td></tr> </table>	REV	DATE	BY			
APP'D	DATE	BY																		
REVISION	DATE	BY																		
REV	DATE	BY																		
<p>IN THE USA ONLY: REPAIR ALL PARTS & WELDS TO ORIGINAL SPECIFICATIONS UNLESS OTHERWISE SPECIFIED.</p> <p>REWORKED BY: <input checked="" type="checkbox"/> (Signature)</p> <p>WELDED BY: <input checked="" type="checkbox"/> (Signature)</p>	<table border="1"> <tr><th>PROJECT / APPROVAL</th><th>DATE</th><th>BY</th></tr> <tr><td> </td><td> </td><td> </td></tr> </table>	PROJECT / APPROVAL	DATE	BY				<table border="1"> <tr><th>REV</th><th>DATE</th><th>BY</th></tr> <tr><td> </td><td> </td><td> </td></tr> </table>	REV	DATE	BY									
PROJECT / APPROVAL	DATE	BY																		
REV	DATE	BY																		
<p>ASSEMBLY DRAWING</p> <p>REF. MICROWAX MOTOR DRIVE</p>	<p>44475</p>	<p>114</p>																		

REFRIGERATED MICROMAX MOTOR DRIVE BD

ASSY PN 44475

REV 14

ITEM	QTY	REFERENCE	PART/ MANUF.	PKG	CONFORMAL COATING
1	15	C3,C5,C6,C7,C8,C9 C19,C20,C21, C25,C27,C30,C32, C35,C37	Capacitor .1UF@50VDC Panasonic ECU-V1H104KBM	SMT 1206	YES
2	1	C16	Capacitor .1UF@400VDC Panasonic ECQ-E4104KF SPRAGUE 5GP10	Thru-Hole PE.10	YES
3	3	C18,C23,C46	Capacitor .01uF@50VDC Panasonic ECU-V1H103KBM	SMT 1206	YES
4	1	C15	Capacitor 680UF@250VDC AreoM LPR681M250E9P3	Thru-Hole AMLRP	YES
5	1	C13	Capacitor 680UF@35VDC ILLINOIS CAP 687CKR035M	Thru-Hole	YES
6	2	C11,C14	Capacitor 330UF@25VDC NICHICON UVX1E331MPA	Thru-Hole	YES
7	1	C22	Capacitor 10UF@25VDC Panasonic ECS-H1ED106R	SMT SIZE D	YES
8	3	C26,C31,C36	Capacitor 220UF@25V NICHICON UVX1E221MPA	Thru-Hole	YES
9	3	C28,C33,C40	Capacitor .33UF@250VDC NICHICON QXJ2E334KTPT NIC NRM334K250	Thru-Hole	YES

REFRIGERATED MICROMAX MOTOR DRIVE BD

ASSY PN 44475 REV 14

ITEM	QTY	REFERENCE	PART/ MANUF.	PKG	CONFORMAL COATING
10	1	C38	Capacitor 0.01UF@125VAC Panasonic ECK-DRS103ME	Thru-Hole PM.0033	YES
11	2	DS1,DS2	Diffused Solid State Green PANASONIC LN38GCP	Thru-Hole LED	YES
12	3	DS3,DS4,DS5	Diffused Solid State PANASONIC LN28RCP	Thru-Hole LED	YES
13	8	D1,D4,D46,D47,D48, D49,D50,D51	Zener 18V, 1/2 Watt Motorala ZMM5248BCT DIODES INC ZMM5248BT	SMT DL-35	YES
14	1	D3	Zener 5.1V, 1/2 Watt Motorala MMBZ5231B	SMT SOT-23	YES
15	5	D2,D5,D12,D22,D32	Rectifier, Fast Recovery 400V, 1A Motorola DL4936A	SMT DL-41	YES
16	1	D6	Bridge Rectifier 50V, 1A Diodes Inc DF005S	SMT SMBR4	YES
17	1	D8	Bridge Rectifier DIODES INC KBU6G	Thru-Hole BR4UP	YES
18	2	D9,D10	Diode Motorala MMBD4148	SMT SOT-23	YES
19	13	D11,D13,D14,D15,D16, D33,D34, D36, D38	Rectifier D23,D24, D26,D27, DL5818	SMT Schottky Barrier	YES DL-41

REFRIGERATED MICROMAX MOTOR DRIVE BD

ASSY PN 44475 REV 14

ITEM	QTY	REFERENCE	PART/	PKG	CONFORMAL
20	3	D18,D29,D40	400V, 3A Diodes Inc. FR304	- D027	YES
			, 8A Diodes Inc. FR804	- T0220 2	NO
22	3	D20,D31,D41	Rectifier, Fast Recovery	Thru Hole	
23	2	FH1,FH2	Fuse Holder	Thru Hole	
			Signal Wire Un insulated	-	YES
25	1		AMP, MTA.100 1 640456 2	- HD.100 12U	NO
26	1	J9	Connector	Thru Hole -	
			AMP, MTA.100 640456 6	- HD.100 6U	NO
28	1	J12	Connector	Thru Hole -	
			AMP, MTA.156 640445 3	- HD.156 3U	NO
30	3		PCB, 250 TAB	- HD.250 1U	NO

REFRIGERATED MICROMAX MOTOR DRIVE BD

ASSY PN 44475 REV 14

ITEM	QTY	REFERENCE	PART/ MANUF.	PKG	CONFORMAL COATING
31	7	Q4,Q5,Q6,Q7,Q8,Q9,Q10	FET 400V, 10 A International Rectifier IRF740	Thru-Hole TO-220AB	NO
32	1	Q3	FET 400V, 3.3 A International Rectifier IRF720	Thru-Hole TO-220AB	YES
33	10	R1,R2,R3, R16, R30,R31,R32,R43, R70,R72	Resistor 100K Ω , 5% Dale CRCW1206104JRT1	SMT 1206	YES
34	2	R6,R13	Resistor 330 Ω , 5% Dale CRCW1206331JRT1	SMT 1206	YES
35	4	R7,R33,R36,R38	Resistor 220 Ω , 5% Dale CRCW1206221JRT1	SMT 1206	YES
36	2	R19,R25	Resistor 100 Ω , 5% Dale CRCW1206101JRT1	SMT 1206	YES
37	3	R20,R44,R75	Resistor 1K Ω , 1% Dale CRCW12061001FRT1	SMT 1206	YES
38	2	R24,R74	Resistor 4.7K Ω , 5% Dale CRCW1206472JRT1	SMT 1206	YES
39	8	R14,R28,R34,R35,R37,R50, R51,R52	Resistor 1.8K Ω , 5% Dale CRCW1206182JRT1	SMT 1206	YES

REFRIGERATED MICROMAX MOTOR DRIVE BD

ASSY PN 44475 REV 14

ITEM	QTY	REFERENCE	PART/ MANUF.	PKG	CONFORMAL COATING
40	16	R4,R5,R8, R15,R17, R29,R39,R42,R71,R73 R9-R12,R18,R69	Resistor 10K Ω , 1% Dale CRCW12061020FRT1	SMT 1206	YES
41	1	R21	Resistor 12K Ω , 5% Dale CRCW1206123JRT1	SMT 1206	YES
42	1	R22	Resistor 470K Ω , 5% Dale CRCW1206474JRT1	SMT 1206	YES
43	1	R26	Resistor, 1 Watt 47K Ω , 5%	Thru-Hole R1W	YES
44	1	R27	Inrush Current KEYSTONE Limiter CL-60	Thru-Hole	YES
45	1	R40	Resistor 9.09K Ω , 1% Dale CRCW12069091FRT1	SMT 1206	YES
46	1	R41	Resistor 3.74K Ω , 1% Dale CRCW12063741FRT1	SMT 1206	YES
47	1	R48	Resistor 698 Ω , 1% Dale CRCW12066980FRT1	SMT 1206	YES
48	1	R45	Resistor 40.2K Ω , 1% Dale CRCW12064022FRT1	SMT 1206	YES
49					
50	2	R46,R49	Resistor 348 Ω , 1% Dale	SMT 1206	YES

REFRIGERATED MICROMAX MOTOR DRIVE BD

ASSY PN 44475 REV 14

ITEM	QTY	REFERENCE	PART/ MANUF.	PKG	CONFORMAL COATING
			CRCW12063480FRT1		
51	3	R53,R58,R63	Resistor, 1/2 Watt 2.7 Ω , 5% Phillips 5053CX2R700J	Thru-Hole R1/2W	YES
52	6	R54,R55,R59,R61,R64,R67	Resistor 221 Ω , 1% Dale CRCW12062210FRT1	SMT 1206	YES
53					
54	1	R68	Resistor, 5 Watt .1 Ω , 1% Memcor-Truohm SL5-0.1 DALE LVR-5.0-0.1 Ω	Thru-hole R5W	YES
55	6	TP1,TP2,TP3,TP4,TP5,TP6	Test Point MILLMAX 2108-2-00-44-00-07-0	Thru-Hole	YES
56	1	T1	Transformer Signal 14A-5.0R-16	Thru-Hole TRAN1-16	YES
57	2	U4,U7	Op-Amp Motorala LM258D	SMT DIP8\SO	YES
58	1	U3	Inverter Schmitt Trigger Motorala MC74HC14D	SMT DIP14\SO	YES
59	1	U6	DC Brushless Motor Controller Motorala MC33035DW	SMT DIP24\SOL	YES
60	1	U5	Exclusive OR Motorala MC14070BD	SMT DIP14\SO	YES

REFRIGERATED MICROMAX MOTOR DRIVE BD

ASSY PN 44475

REV 14

ITEM	QTY	REFERENCE	PART/ MANUF.	PKG	CONFORMAL COATING
61	1	U9	TRISTATE HEX INVERTER Motorola MC14503D	SMT DIP16\SO	YES
62	3	U10,U12,U14	Mosfet Driver POWER INT PWR-INT201TFI	SMT DIP8\SO	YES
63	3	U11,U13,U15	Mosfet Driver POWER INT PWR-INT200TFI	SMT DIP8\SO	YES
64	1	VR1	Voltage Regulator 5V, 1.5A National LM340T-5.0	Thru-Hole T0-220AB	NO
65	1	VR2	Voltage Regulator 15V, 1.5A National LM340T-15	Thru-Hole T0-220AB	NO
66	2	HS1,HS2	HEATSINK For VR1,VR2 AAVID 5968B	Thru-Hole	NO
67	1	U8	COMPARATOR MOTOROLA LM311D	SMT DIP8/SO	YES
68	1	U1	SSR CP CLAIRE PD2401 x 7 IR DPA4119 CRYDOM DPA4119	Thru-Hole	YES
69	1	J10	CONNECTOR,2 PIN AMP 640456-2	Thru-Hole HD.100-2U	YES
70	1	C17	CAPACITOR,XTYPE 1UF,250VAC PANASONIC ECQ-U2A105MV	Thru-Hole	YES
71	1	F1	FUSE,5X20MM SCHURTER 034.1524	N/A	NO

REFRIGERATED MICROMAX MOTOR DRIVE BD

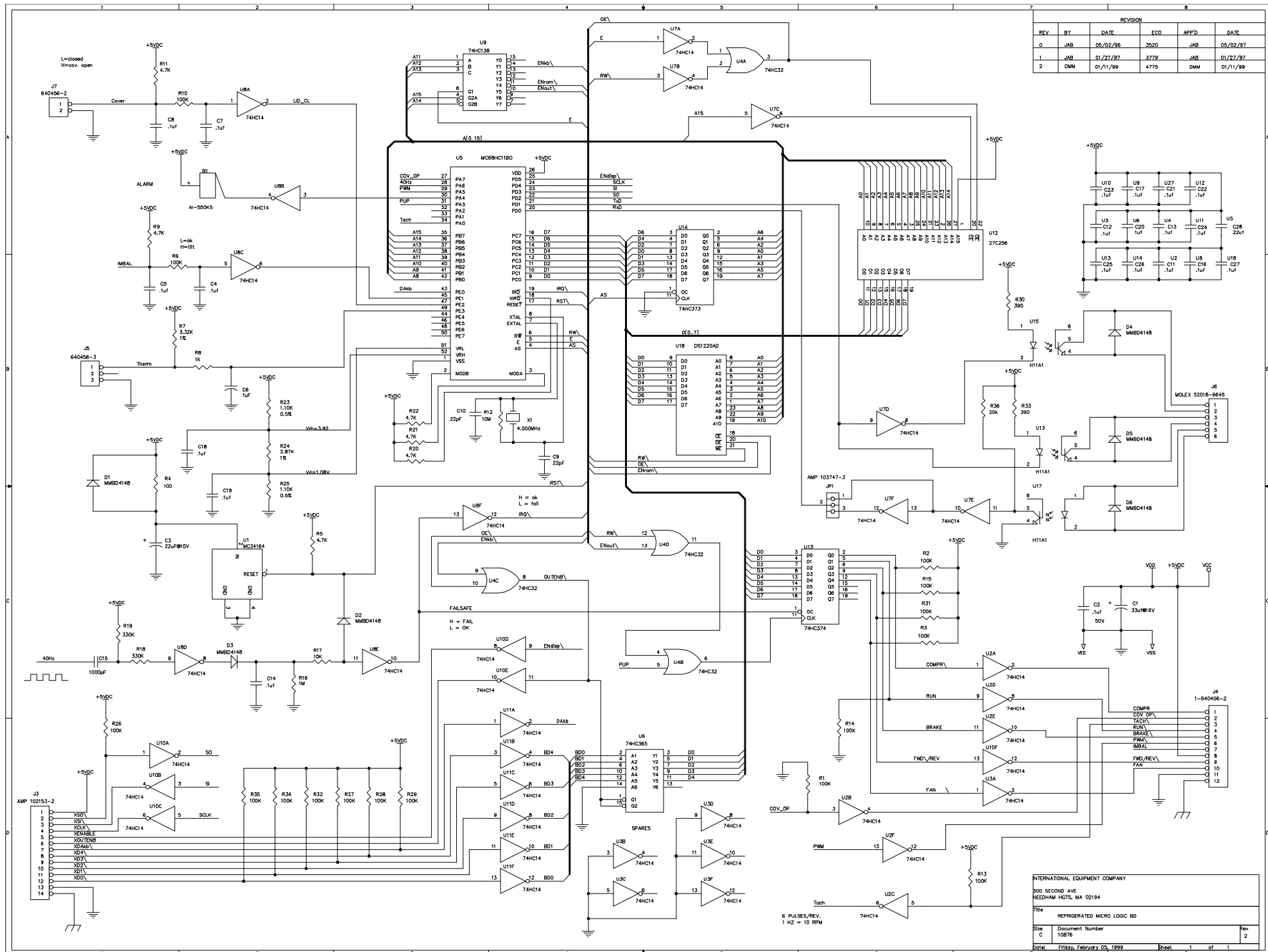
ASSY PN 44475 REV 14

ITEM	QTY	REFERENCE	PART/ MANUF.	PKG	CONFORMAL COATING
72	REF	PCB	44452	N/A	N/A
73	REF	SCHEMATIC	10874	N/A	N/A
74	1	C41	CAPACITOR 100pF,50V PANASONIC ECU-V1H101JCH	SMT 1206	YES
75	1	C12	Capacitor 1000UF@25VDC ILLINOIS CAP 108CKR025M	Thru-Hole	YES
76	1	R47	Resistor 931Ω, 1% Dale CRCW12069310FRT1	SMT 1206	YES
77	1	C24	Capacitor 1uF, 16V Panasonic ECS-H1CY105R	SMT SIZE A	YES
78	A/R	FOR Q3 TAB	Tape Insulation Kapton	N/A	N/A
79	1	C4	Capacitor 2.2UF, 20VDC,Tant Panasonic ECS-H1DX225R	SMT SIZE B	YES
80	REF	35462	TEST FIXTURE / PROCEDURE	N/A	N/A
82	2	F2,F3	Fuse 3/4A, Fast Acting LittleFuse - Pico II 251.750	Thru-Hole	YES
83	1	D43	Zener Diode DIODES INC. ZM4735ACT	SMT DL-41	YES
84	3	C29,C34,C39	Capacitor Mono-Cer 1uF, 50V NIC	SMT 1812	YES

REFRIGERATED MICROMAX MOTOR DRIVE BD

ASSY PN 44475 REV 14

ITEM	QTY	REFERENCE	PART/ MANUF.	PKG	CONFORMAL COATING
85	1	C47	NMC1812X7R105K50 VITRAMON VJ1812Y105KXAMT Capacitor 4.7 uF, 10V PANASONIC ECS-F1AE475K	thru-hole	YES
86	A/R		Conformal Coating Chemtronics Konform AR200		
87	3	R23	Resistor, 1/4 Watt 470K Ω , 5% 250WVDC NIC NCF25J474TR	Thru-Hole	YES
88	1	C10	Capacitor 0.1uF, 35V Panasonic ECS-H1VY104R	SMT case "Y" Tant	YES



REVISION						
REV	BY	DATE	ECO	APP'D	DATE	
0	JAB	05/02/96	3520	JAB	05/02/97	
1	JAB	01/27/97	3779	JAB	01/27/97	
2	DMM	01/11/99	4775	DMM	01/11/99	

INTERNATIONAL EQUIPMENT COMPANY
 300 SECOND AVE
 NEEDHAM HCTS, MA 02194
 File REFRIGERATED MICRO LOGIC BD
 Doc 10876
 Date: Friday, February 05, 1999 Sheet 1 of 1

6

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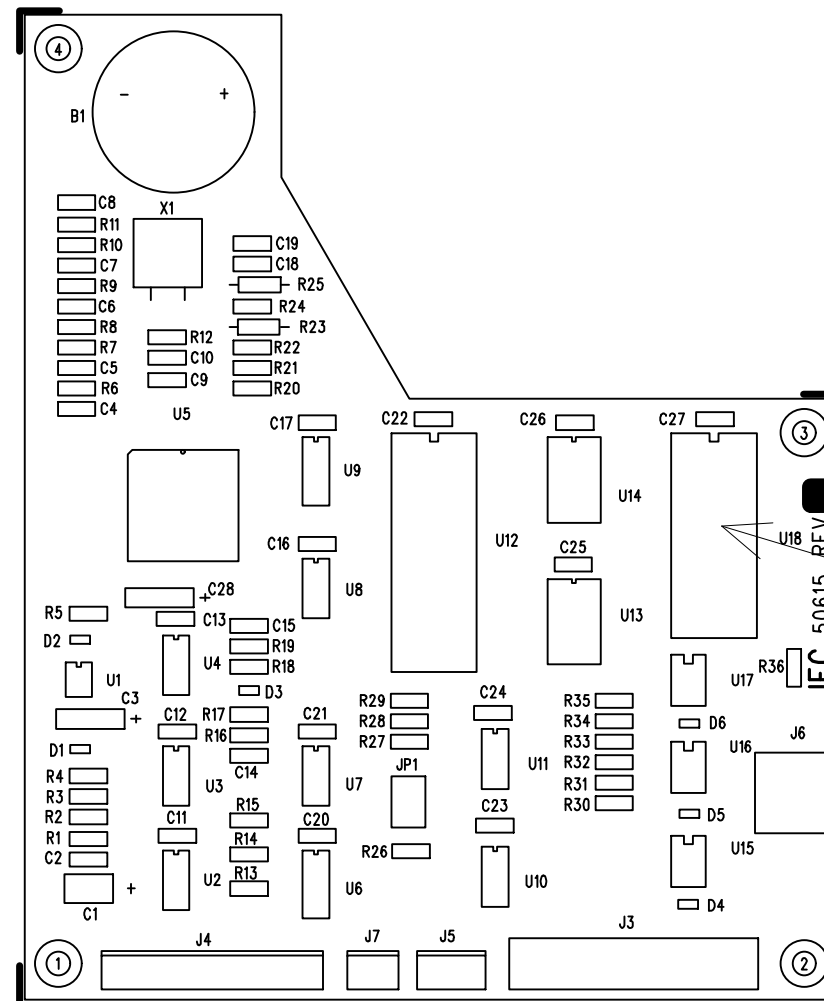
4

3

2

1

REVISION RECORD						
REV:	ZONE:	BY:	DATE:	ECO NO:	APPROVED:	DATE:
0	---	JB	07/24/97	4003	JB	07/24/97
1	---	PL	03/30/98	4447		
2	---	CM	04/27/98	4493	CM	04/27/98
3	---	DMM	12/23/98	4775	DMM	12/23/98
4	---	RAE	09/14/00	5486	RAD	09/26/00



NOTES:

- 1. VENDOR I.D. AND SERIAL NUMBER TO BE IN THIS AREA.
- 2. APPLY CONFORMAL COATING TO ENTIRE ASSEMBLY EXCEPT WHERE INDICATED ON THE BILL OF MATERIALS. MINIMUM THICKNESS OF COATING TO BE 0.003". REMOVE COATING FROM INNER SURFACES OF 4 MOUNTING HOLES.

SEE NOTE 1.

ASSEMBLY DRAWING

COMPANY: INTERNATIONAL EQUIPMENT COMANY			
TITLE: ASSEMBLY DRAWING REFRIGERATED MICROMAX LOGIC PCB ARTWORK			
CODE:	SIZE: B	DRAWING NO: 50615	REV: 4
SCALE: 1/1		SHEET: 1 OF 1	

DRAWN: RAE	DATED: 09/26/00
CHECKED: HJR	DATED: 09/26/00
QUALITY CONTROL:	DATED:
RELEASED:	DATED:

USED ON : MICROMAX

ASSY : REFRIGERATED MICRO LOGIC BD (PULSE KEY FEATURE)

<u>ITEM</u>	<u>QTY</u>	<u>REFERENCE</u>	<u>PART/MANUF.</u>	<u>PACKAGE</u>	<u>CONFORMAL COATING</u>
1	1	PCB MACHINED	44454 REV 3		YES
2	1	B1	TRANSDUCER AI-550KS Projects Unlimited	T-HOLE	NO
3	1	C1	CAPACITOR 33UF@16V Panasonic ECS-H1CD336R	SMT Case "D"	YES
4	1	C6	CAPACITOR 1uf 16V Panasonic ECS-H1CY105R	SMT 1206	YES
5	21	C2,C4,C5,C7,C8,C11, C12,C13,C14,C16,C17, C18,C19,C20,C21,C22, C23,C24,C25,C26,C27	CAPACITOR .1uf 50V C1206C104K5RAC Kemet	SMT 1206	YES
6	2	C3.C28	CAPACITOR 22uF@10V ECS-T1AC226R Panasonic	SMT Case "C"	YES
7	2	C10,C9	CAPACITOR 22 pF 50V Kemet C1206C220K5GAC	SMT 1206	YES
8	1	C15	CAPACITOR 1000pf Kemet C1206C102K5GAC	SMT 1206	YES
9	6	D1,D2,D3,D4,D5, D6	DIODE MMBD4148 National	SOT-23	YES
10	1	JPI	JUMPER 103747-3 Amp	T-HOLE	NO
11	1	J3	CONNECTOR 102153-2 Amp	T-HOLE	NO

9/12/02

ELECTRONICS ASSY PARTS LIST

PN 50615 REV 4

USED ON : MICROMAX

ASSY : REFRIGERATED MICRO LOGIC BD (PULSE KEY FEATURE)

<u>ITEM</u>	<u>QTY</u>	<u>REFERENCE</u>	<u>PART/MANUF.</u>	<u>PACKAGE</u>	<u>CONFORMAL COATING</u>
12	1	J4	CONNECTOR 1-640456-2 Amp	T-HOLE	NO
13	1	J5	CONNECTOR 640456-3 Amp	T-HOLE NO	
14	1	J6	CONNECTOR 52018-6645 Molex	T-HOLE NO	
15	6	R5,R9,R11,R20,R21, R22	RESISTOR 4.7K CRCW1206472JRT1 Dale	SMT 1206	NO
16	16	R1,R2,R3,R6,R10, R13,R14,R15,R26, R27,R28,R29,R31, R32,R34,R35	RESISTOR 100K CRCW1206104JRT1 Dale	SMT 1206	NO
17	1	R7	RESISTOR 3.32K 1% CRCW12063321FRT1 Dale	SMT 1206	NO
18	2	R23,R25	RESISTOR 1.10K 0.5% CMF-551101DT1 Dale	T-HOLE 1/10W	NO
19	1	R24	RESISTOR 2.87K 1% CRCW12062871FRT1 Dale	SMT 1206	NO

9/12/02

ELECTRONICS ASSY PARTS LIST

PN 50615 REV 4

USED ON : MICROMAX

ASSY : REFRIGERATED MICRO LOGIC BD (PULSE KEY FEATURE)

<u>ITEM</u>	<u>QTY</u>	<u>REFERENCE</u>	<u>PART/MANUF.</u>	<u>PACKAGE</u>	<u>CONFORMAL COATING</u>
20	1	R8	RESISTOR 1K CRCW1206102JRT1 Dale	SMT 1206	YES
21	1	R4	RESISTOR 100 CRCW1206101JRT1 Dale	SMT 1206	YES
22	1	R12	RESISTOR 10M CRCW1206106JRT1 Dale	SMT 1206	YES
23	1	R17	RESISTOR 10K CRCW1206103JRT1 Dale	SMT 1206	YES
24	1	R16	RESISTOR 1M CRCW1206105JRT1 Dale	SMT 1206	YES
25	2	R19,R18	RESISTOR 330K CRCW1206334JRT1 Dale	SMT 1206	YES
26	2	R33,R30	RESISTOR 390 CRCW1206391JRT1 Dale	SMT 1206	YES
27	1	R36	RESISTOR 20K CRCW1206203JRT1 Dale	SMT 1206	YES
29	6	U2,U3,U7,U8,U10, U11	HEX INVERTER 74HC14AD Motorola	SMT	YES
30	1	U4	OR GATE, 2 INPUT 74HC32AD Motorola	SMT	YES

9/12/02

ELECTRONICS ASSY PARTS LIST

PN 50615 REV 4

USED ON : MICROMAX

ASSY : REFRIGERATED MICRO LOGIC BD (PULSE KEY FEATURE)

<u>ITEM</u>	<u>QTY</u>	<u>REFERENCE</u>	<u>PART/MANUF.</u>	<u>PACKAGE</u>	<u>CONFORMAL COATING</u>
31	1	U9	DECODER/ MULTIPLEXER 74HC138AD Motorola	SMT YES	
32	1	U5	MICROCONTROLLER MC68HCP11E0FN3R2 Motorola	SMT	YES
33	1	U13	3-STATE NON- INVERTING D FLIP-FLOP 74HC374ADW Motorola	SMT	YES
35	3	U15,U16,U17	OPTOCOUPLER H11A1 GE OR QT	T-HOLE	YES
36					
37	1	U6	3-STATE NON- INVERTING BUFFER W/COMMON ENABLE SN74HC365D TI	SMT	YES
38	1	U1	UNDERVOLTAGE SENSING CIRCUIT MC34164D-5 MC33164D-5	SMT	YES
39	1	X1	CRYSTAL 4.000 MHz FOX040A	T-HOLE YES	
40	1	J7	CONNECTOR 640456-2 AMP	T-HOLE NO	
41	1	U12	28 PIN DIP SOCKET I.C. 28 Pin, .6C-C CA-28MSC-1F OR CA-28MS-1F	T-HOLE	NO
42	REF	10876 REV1	SCHEMATIC,LOGIC		N/A
42	1	U14	Latch 74HC373ADW Motorola	SMT	YES

9/12/02

ELECTRONICS ASSY PARTS LIST

PN 50615 REV 4

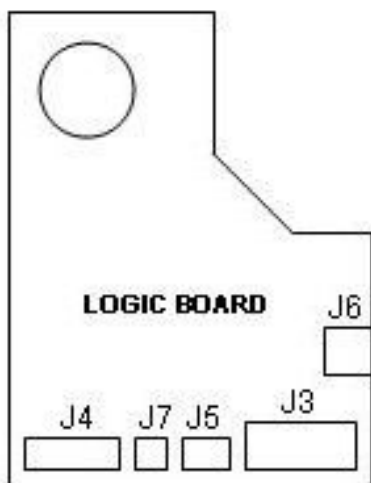
USED ON : MICROMAX

ASSY : REFRIGERATED MICRO LOGIC BD (PULSE KEY FEATURE)

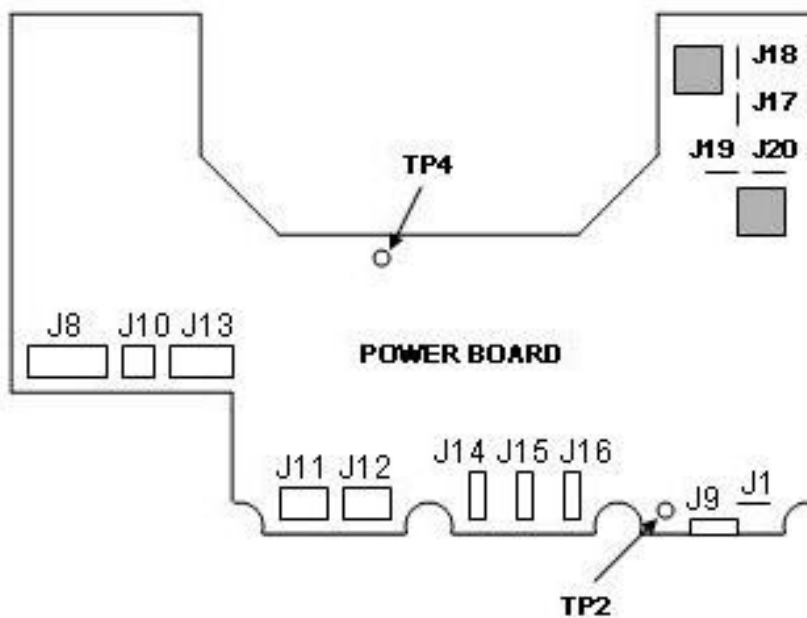
<u>ITEM</u>	<u>QTY</u>	<u>REFERENCE</u>	<u>PART/MANUF.</u>	<u>PACKAGE</u>	<u>CONFORMAL COATING</u>
43	REF	35462 REV2	TEST FIXTURE/PROCEDURE		N/A
44	A/R (2-3 MILS)		CONFROMAL COATING CHEMTRONIC KON FORM AR2000 OR KON FORM SR2000		N/A

Current Power Test-Point Values for Micromax and Microlite Series Centrifuges

New instruments and retrofit kits have test point values and locations which differ from the original configuration noted in the service manual. Please use the following as a guide:



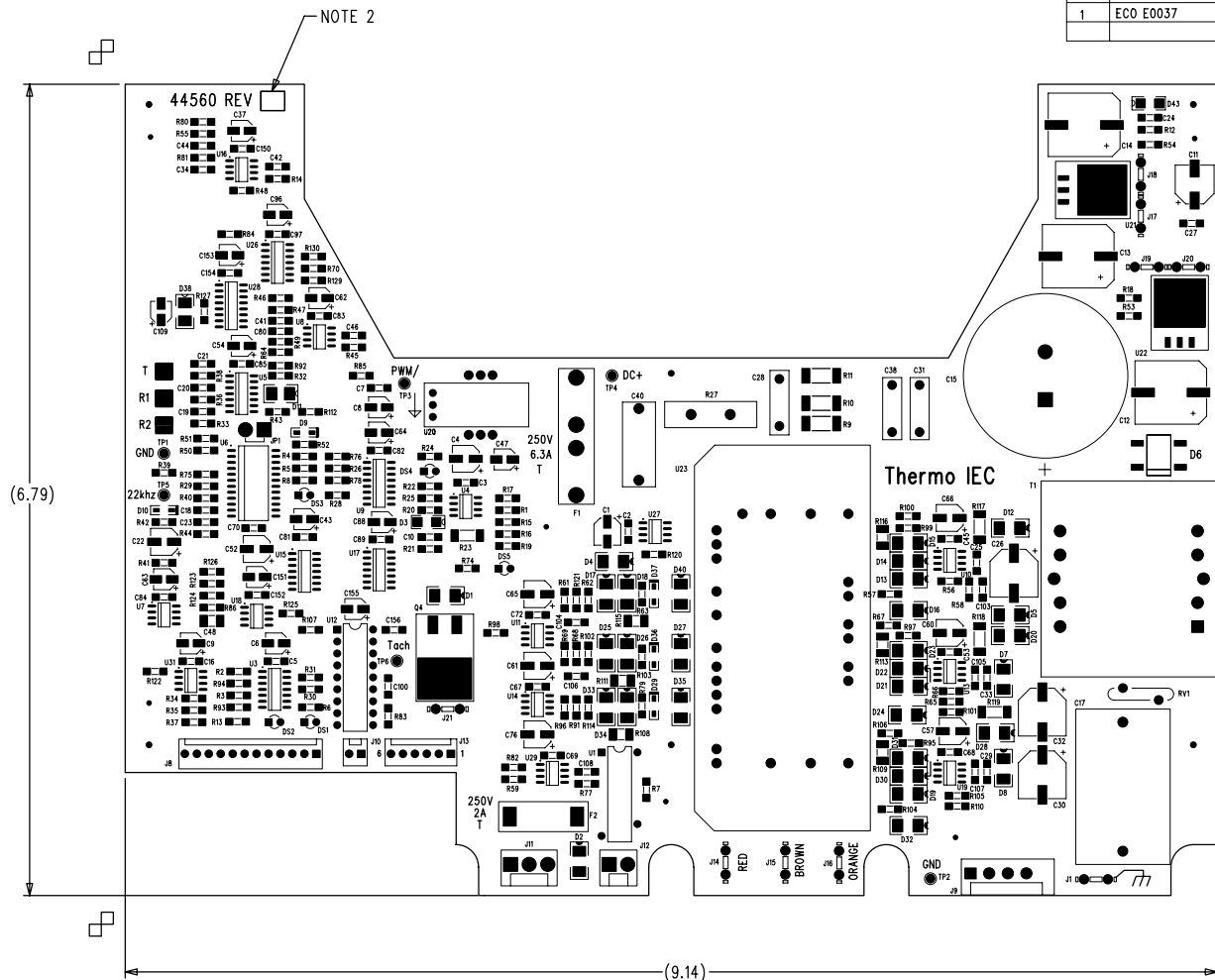
NOT TO SCALE!



Test Points:	
*Ground	TP2
170VDC Min. 159VDC	TP4
15VDC	J17-or- J18
5VDC (Logic)	J19-or- J20

DO NOT SCALE DRAWING

REVISIONS				
REV.	E.C.O. OR CHANGE DESCRIPTION	BY	APPR.	DATE
A	ECO 6120	CJS		3-15-02
B	ECO 6314	CJS		9-9-02
0	ECO 6411	JZ		
1	ECO E0037	JZ		



NOTES: UNLESS OTHERWISE SPECIFIED:

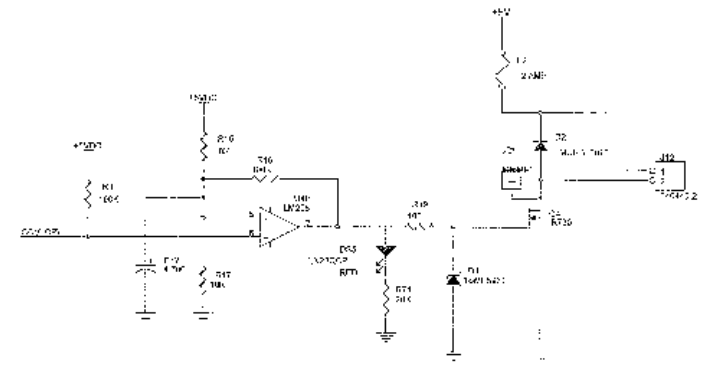
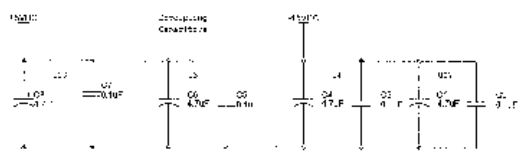
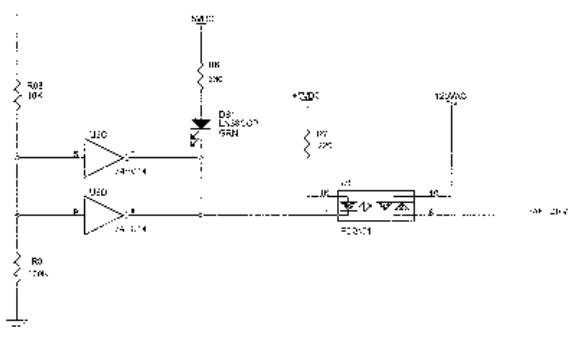
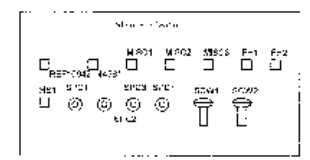
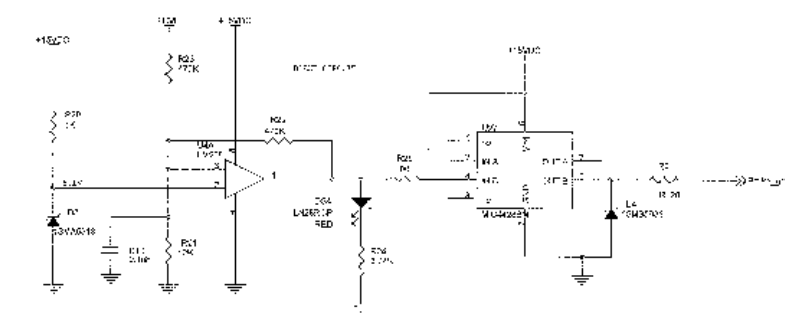
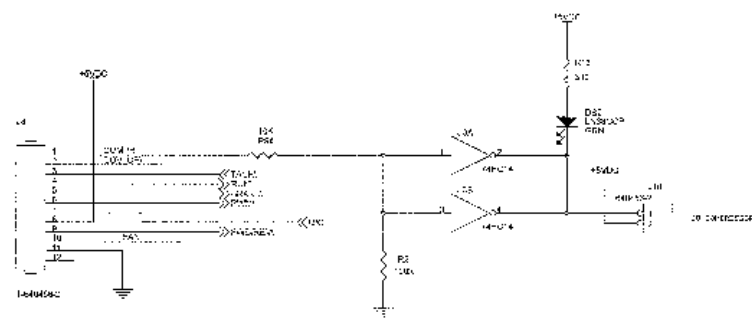
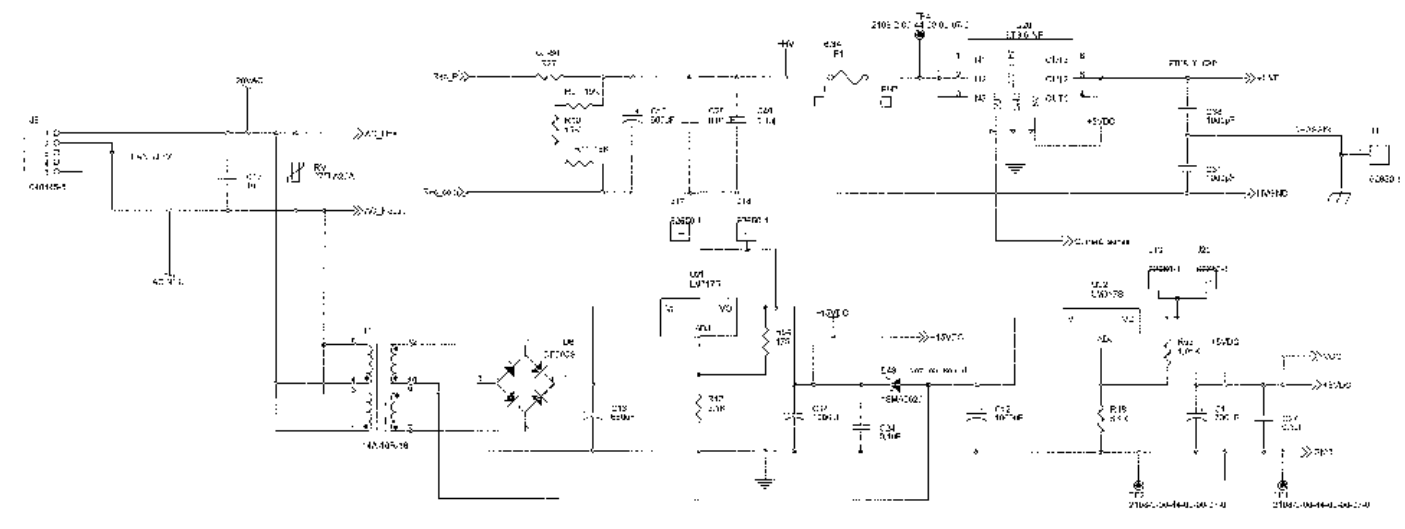
1. WORKMANSHIP TO BE EQUAL TO AND COMPLIANT WITH THE REQUIREMENTS OF IPC-A-610.
2. MARK REVISION NUMBER WHERE SHOWN.
3. THIS ASSEMBLY CONTAINS ELECTROSTATIC DISCHARGE (ESD) SENSITIVE DEVICES; STATIC-FREE HANDLING IS REQUIRED.
4. DESIGNATIONS ARE FOR REFERENCE ONLY AND MAY NOT APPEAR AS SEEN ON ACTUAL ASSEMBLY.
5. DIMENSIONS SHOWN SPECIFY MAXIMUM ENVELOPE LIMITS FOR THE FINISHED ASSEMBLY.
6. ORIENTATION OF POLARIZED CAPACITORS IS DENOTED BY A PLUS (+) SIGN. POLARITY IS IDENTIFIED ON THE PART.
7. REFER TO ASI44560 FOR OTHER ASSEMBLY INSTRUCTIONS.

COMPONENT SIDE (LAYER 1)

PROPRIETARY NOTE
 INFORMATION DISCLOSED HEREIN IS THE PROPERTY OF INTERNATIONAL EQUIPMENT COMPANY AND SHALL NOT BE USED FOR ANY OTHER PURPOSE EXCEPT AS SPECIFIED BETWEEN THE RECIPIENT AND INTERNATIONAL EQUIPMENT COMPANY

MATERIAL		SIGNATURES		DATE		Thermo IEC				
SEE SEPARATE BILL OF MATERIALS		DRAWN Design Net		3-15-02		TITLE				
ALL DIMENSIONS ARE GIVEN IN INCHES		ENGR.				MICHOMAX MOTOR DRIVE ASSEMBLY DRAWING				
TOLERANCES UNLESS OTHERWISE SPECIFIED		APPROVED				SIZE		PROJ. NO.	DWG. NO.	REV
.X .1 in.		ISSUED				C			44560	1
.XX .01 in.						SCALE		NONE	FILE:	SHEET 1 OF 1
.XXX .005 in.										
ANGLES P 1/2D										
APPLICATION	NEXT ASSY	USED ON								

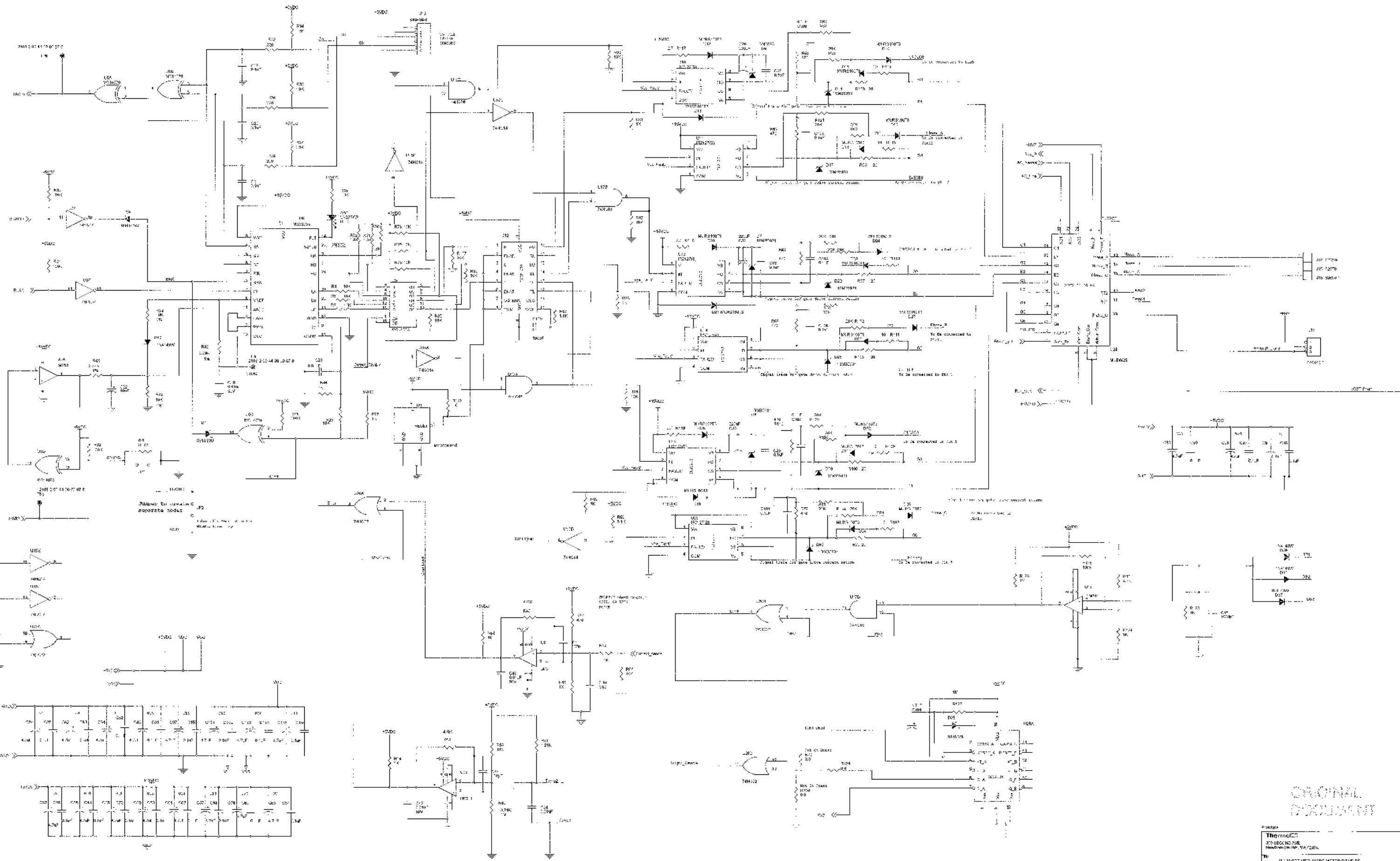
REV	DATE	BY	CHKD
1	10-21-62	DKB	DKB
2	10-21-62	DKB	DKB



ORIGINAL DOCUMENT

ThermoFO
200 SECOND ST
MERRIMACK, N.H. 03004

REPROCESSED MICROFILM FROM
DATE: 10/21/62
BY: [Signature]



ORIGINAL
DOCUMENT

Project:	THEORETICAL
Drawn by:	775 SECOND AVE
Checked by:	NEW YORK, N.Y. 10017
Date:	11-15-60
Scale:	AS SHOWN
Sheet:	1 of 1