Leprecon®

LD-1200, LD-2400 AND LD-6000 INSTALLATION AND SERVICE MANUAL

LEPRECON LD-1200, LD-2400 & LD-6000
Installation & Service Manual

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Before 12/1/93 dial area code 313

INTRODUCTION

We have attempted in this manual to provide as much information as we can on the operation and application of Leprecon dimmers. This is a very complex and potentially dangerous field. Dealing with powerline voltage and currents that have the potential to cause great harm to people and property is serious business, and you, the installer or user, bear the responsibility to see that all proper precautions are taken. If you are unsure of any of this, please seek qualified help. Though we have made every effort to present information that is accurate, we accept no responsibility for it's accuracy or completeness, as we have no control over it's interpretation or implementation.

We recommend these books for further information:

1) ***National Electrical Code Handbook*** (for code & safety in electrical wiring) From National Fire Protection Assoc.,470 Atlantic Ave., Boston, Mass. 02210, or your local electrical supply or I.B.E.W. Union office.

2) Your county or city electrical inspector (for local code books.)

3) ***GTE Sylvania Lighting Handbook*** (for technical theory, information on lamps, dimmers, light). from CAE, or: GTE Sylvania Lighting Center, Danvers, Mass. 01923

4) ***Lighting the Stage,*** By Willard Bellman, Chandler Publishing

5) ***"Theatre Crafts"*** Magazine, P.O. Box 630, Holmes, PA 19043-0630

6) ***"Lighting Dimensions"***Magazine, P.O. Box 425, Mount Morris, IL 61054-0425

PROPER SYSTEM GROUNDING

The ground serves two purposes: Its primary purpose is to connect all conductive parts of the system which can be touched by a person to earth ground potential so that a person with some other part of his body grounded will not become a conductor of electrical current (get hurt or killed) because of electrical leakage (perfect insulation doesn't exist) or because of a fault in equipment wiring.

Its secondary purpose is to shield the current carrying and electrical noise generating components in a system by connecting chassis and enclosures solidly to ground potential. In a situation where lots of sensitive audio equipment (much of it improperly grounded) co- exists, this function is very important.

An essential ingredient to safe, consistent, reliable, and quiet operation of a lighting system is that the neutral and ground are not connected together at *any* point in the lighting system or in the House Service *except* at the main transformer or service entrance, where the neutral is bonded to earth ground. Except at this one point, neutral and ground are totally separate, totally isolated, and very different conductors. The hot legs conduct power from the service through the dimmers to the load. The neutral conducts any current not balanced between hot legs from the load back to the service. The neutral is a current carrying conductor: By definition a potential difference exists between any two points of a current carrying conductor. (Current flows only when a potential difference exists.) The only point at which the neutral and ground are at the same potential when *any* current is flowing in the neutral is at the *one* common point where the neutral and ground are physically tied together.

Connecting the ground to the neutral at any point other than the single bonding point at the *main* service causes neutral current to flow through the "Ground" conductor; It is not longer at ground potential; It is no longer a ground; its function for safety and optimum system operation is impaired.

Please — before you attach your system to main power, perform this simple test. Connect an ohmeter between your neutral and ground. If you read other than infinite resistance, you have a ground-neutral fault which you must correct for your own safety, and for the proper operation of your system. Track it down and correct it. It's also a good idea to test all outlets, fixtures, and other powered devices for sound safety ground connections on a regular basis.

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Leprecon®

Pro Lighting Equipment

LEPRECON DIMMERS IN CABINETS & RACKS

Leprecon dimmers can be mounted in most cabinets with rails set up for 'E.I.A.' standard relay rack panels 19" wide. Care should be taken to assure that cooling air can enter the rack interior and exit the front. No fans are required, as the dimmers contain their own fans, and heat build up cannot occur as long as this "in the back, out the front" circulation pattern isn't inhibited or contained. Fresh, cooling air — not recycled warmed air — must be provided. For racks used in touring applications, rear bracing must be provided to each dimmer. A rack rear brace kit (CAE # RB K) is available for this. Rack shock mounting is recommended and, if dusty environments are encountered, an air filter for the intake cooling air would be desirable.

When assembling your own rack system, be sure electrical code and safety provisions, and weight capacities and ventilation are adequate.

CAE manufactures a complete line of racks, components, accessories, and turnkey systems. Contact factory for details.

NOTES ON LEPRECON DIMMER POWER & LOAD PANELS

LD series dimmers have removable, interchangeable power & load panels. This feature is not intended for repeated insertion and removal, but is for convenience in dealer stocking and initial system set-up.

To remove a panel, remove the screws along its top & bottom, then carefully set the dimmer on its face on a padded surface, and pry the panel outward at it's *outside* edge, top & bottom, with even pressure with two flat blade screwdrivers.

To insert a panel, slip it in and gently "feel" the connectors into alignment and partial engagement until the panel is about 1/8" from the chassis — then rap the outside edge sharply to seat the connector, and screw the panel down. This takes some patience and must not be forced. Removing the cover the first few times you do it to see what's going on inside is helpful.

SUGGESTED LOAD CONNECTOR BRANDS & SOURCES

Hubbell — Twistlocks, valise plugs, Kellums cord grips.

Union Connector Co. — Stage plugs, sockets, panels.

Veam — Multi-pin connectors.

Pyle-National — "Star-Line" multi-pin connectors (classiest option — the "Cadillac" in construction & price)

Sine Products — Multi-Pin connectors interchangable with "Star-Line" (cheaper & better delivery than Pyle just as good)

Amphenol — "MS" type multi-pin connectors (leave off the locking ring — they work better longer!) (Inexpensive option)

Cinch-Jones — (Lowest cost multi-pins — not too solid, but inexpensive.)

Beyond suggesting these lines, we cannot make recommendations or give instructions for multi-pin load connector systems. Each case is different.

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SETTING UP LEPRECON DIMMERS — POWER WIRING

Notice: *Power and load wiring are critical elements in any lighting system. With the voltages and power involved, lives and property can be endangered by improper hookups. You must be fully qualified and certain that you know what you're doing, or have a qualified electrician do it!*

Do not under any circumstances attach a dimmer to any circuit of higher current capacity than it requires without adding protective circuit breakers (30 or 60 amp.)

This information is believed to be accurate, but CAE accepts no responsibility for the proper installation of this equipment. It is the responsibility of the installer to insure that all safety precautions are taken and all applicable code requirements and standards are observed and met.

Power — two 120 volt 60 HZ. Circuits ("X" & "Y") must be provided to each dimmer, along with a neutral (Nx & Ny, normally tied together) and a safety ground (G). A two pole (or two single pole) circuit breaker must be provided to protect the branch circuits. Their ratings should be 30 AMPS/pole for the LD-1200, or 60 AMPS/pole for the LD-2400. Be sure all wiring meets any applicable code requirements and is properly installed. Any open wiring must be fully enclosed, carefully routed, and protected from abuse and personal contact. Wire sizes suggested by The National Electrical Code (N.E.C.) are:

	30 AMP	60 AMP
Type THWN (75° C) insulated wire in free air	#12GA	#8GA
same, in conduit	#10GA	#6GA
Type SO, (60° C) 600 volt portable cordage (4 conductors, 2 carrying current)	#8Ga 4 con. (#8-4SO)	#4GA 4 con. (#4-4SO)

Note! *The equipment or safety ground is the single most important conductor. All metal parts in the system should be securely attached to it. See "Proper system grounding." See the N.E.C. for ground wire size requirements.*

"TP" Terminal Strip Power Panel has screw terminals for X, Y, Nx, Ny, and ground, protected by a back-box with covers. Punch the back-box hole to the required size for cable strain relief or conduit, & wire according to labels. The back-box may be removed and wiring done "open" if the rack rear is enclosed with metal and protected per code requirements.

"BP" Blank Power Panel includes a blank panel and an internal connector with 24" wire tails. Punch the panel for desired connector or cable. Cut and strip wires as required, and terminate as required for your application. (Two wires, parallelled, per circuit-Black = X, Red = Y, White and White-Red = X & Y neutral, Green = Ground.) Has 3½" × 2½" available panel space, 1¾" deep.

"OP" Open Power Connector includes a connector to plug directly into the dimmer, with 24" wire tails. Can be used only if the dimmer rear, which remains open, is protected from personal contact and fire hazard by a metal box. The lead color code and termination are identical to the blank power panel.

Note: *On the above panels, neutrals for "X" & "Y" are separate and must both be tied to neutral in a shared neutral system.*

"HP" Hubbel Twistlock Power Panel — Has 4 wire 30 AMP (2 pole plus-neutral and ground) connector. Suitable for LD-1200 only because of ampacity.

"UP" U-Ground Power Panel – Has 2 - 15 AMP male U-ground inlets . . . 1 per 3 channels. Only useable with LD-1200 at reduced power rating. (1800 watts per 3 channels)

"PP" Patch Bay Power – Has 18 panel mounted AMP powerlock terminals for load neutrals, 6 for load grounds, and wire tails for power connections (x, y, neutral, & ground). This panel involves exposed wiring so the dimmer rear must be protected from personal contact & fire hazard by a metal cabinet. This option is useful only in large lighting systems with multi-circuit load cables where it is desirable to be able to re-patch neutrals or series loads.

"DP" Direct Power Panel with a 10 contact AMP powerlock connector and handle which plugs directly into dimmer through access hole in metal cover plate (included).

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LOAD WIRING

Load wiring is less difficult than power wiring because the circuits are over-current protected by the dimmer circuit breakers, and currents are in the more familiar range of 10 to 20 AMPS. (Care should still be taken, of course.) The major complication in load wiring is the number of load circuits and the need in larger systems to patch and connect large numbers of circuits from loads in different locations to the desired dimmer channel outputs.

Wiring: Each load circuit should have cable rated for the dimmer output ampacity — not the individual load rating. The same is true for connectors. Cables for individual circuits should have a hot, a neutral, and a safety ground, and connectors should too. Multi-load cables can have a shared ground rated for the highest ampacity circuit in the cable — not the sum of ampacitys — since a fault is unlikely to occur in more than one circuit at once. Neutrals can be shared if the wiring to the dimmers is fixed as to phase of each circuit. Note that ampacity of wires in cable or in duct or otherwise tightly enclosed should be derated because of heat build-up. See the applicable code book chart.

"UL" U-Ground Load Panels may be used only on LD-1200's, as the outlets are rated at 15 AMPS, and should not be wired to 20 AMP circuits.

"SL" Stage Pin Load Panels may be used for either. (You can usually use a higher rated connector than required, but never a lower rated one.)

Remember that the required connector rating is determined by the maximum current capacity (ampacity) of the source -i.e. the dimmer circuit breaker — not the actual current drawn by the load.

"TL" Terminal Strip Load Panels have a "back-box" that can be punched to accomodate a connector or a cable clamp. If the dimmer rear is enclosed in an approved metal outer box, the back box may be removed and load wires terminated direct to the strips. This is the most popular arrangement. There are terminals for hots 1-6, neutrals 1-6, and a couple of parallelled grounds.

"BL" Blank Load Panels can be punched for connectors or cable clamps. The internal connector is provided with 18" wire tails. These may be terminated to connectors or to a cable with butt splices, wire nuts, quick-connects, etc. as required. Oranges are hots, greys are neutrals, greens are ground. Leads are numbered.

"DL" Direct Load Panel with a 14 contact AMP powerlock connector and handle which plugs directly into dimmer through access hole in metal cover plate (included).

"OL" Open Load Connector provides easy plugging and unplugging of the load connector, and is the least expensive option. The connector is provided with 36" tails to be terminated as required. The dimmer rear must be enclosed in an approved metal enclosure if you take this route – for fire and personal protection. Coding same as BL. Has 7½" × 2½" available panel space 1¼" deep.

"PL" Patch Load Panel provides 4 paralleled AMP powerlock single contact connectors per channel (24 total). For patching loads (in the rear of an approved enclosed rack only, as above). Tails with powerlocks on their ends are wired to the desired load connectors. This makes alteration of dimmer channel to load connector wiring easy, and is particularly useful in many-circuit systems with multi-pin load connector setups.

Color coding is suggested, rather than numbering, because it's easier to spot in a crowded rack. A wide strip for the "tens" and a narrow one for the "ones," using electrical tape or heat shrink tubing. works well. We recommend the EIA resistor color code:

Black - 0	Yellow - 4	Gray - 8
Brown - 1	Green - 5	White - 9
Red - 2	Blue - 6	Black - 0
Orange - 3	Violet - 7	

***NOTE** — 3 phase service is shown (120-208v 3Ø-i.e. 120vac from any hot leg (x,y, or z) to neutral, 280vac between any 2 hot legs.) A single phase 110-220v service would have only hot legs X and Y, with 120vac between eitner hot leg and neutral, and 240vac between the two hots.*

A Discussion of multiphase power systems is beyond the scope of this manual, and is largely irrelevant because all entertainment lighting power is used as single phase 120vac, and loads are wired from a hot to the neutral. Be sure to avoid industrial services with one or more legs over 120vac relative to neutral! (i.e. 220-420, 3 phase delta with no neutral, or 120-240-208 "wild leg" services with one leg 240 volts relative to neutral.)

This information is for educational purposes only! Only qualified electricians should work with electrical power systems, and installer is responsible for seeing that all installations meet applicable code and safety requirements.

CABLE DATA

Note that the connector and cable ampacity required is determined by the ampacity of the breaker or fuse protecting the circuit and not by the current drawn by the load attached to it.

Standard Color Code for Electrical Wiring

Green-Safety Ground
White-Neutral
Black-Hot (Leg "X")
Red-Hot (Leg "Y")
Blue-Hot (Leg "Z" of 3 phase systems)

Be sure to check all capacities and code requirements with the application engineering and code books. This table is for reference only. Long rungs may require larger gauge to minimize voltage drop. Code ratings are generally based on wire temperature rise, not voltage drop!

ARTICLE 520-53 SECTION F: Each conductor shall have an ampacity not less than the rating of the circuit breaker which it supplies.

ARTICLE 520-53 SECTION N: In portable equipment designed for 3 phase, 4 wire with ground supply, the supply neutral terminal shall have ampacity equal to twice the ampacity of the largest ungrounded supply terminal.

Code article numbers are shown in parenthesis.

WIRE AMPACITY TABLE FROM 1990 N.E.C.

	SINGLE CONDUCTOR WIRE *			PORTABLE CORDAGE			
WIRE SIZE AWG	75 C (167-F) (310-17) TYPE THWN	90 C (194 F) (310-17) TYPE THHN	150 C (302 F) TYPE SRML	30 C 86 F (400-5) TYPE-S (2-COND)	30 C 86 F (400-5) TYPE-S (3-COND)	SAFETY GOUND (250-95) MIN-SIZE FOR90C WIRE	RESISTANCE DHMS PER THOUSAND FEET
18	-	18	-	7	10	18	6.51
16	-	24	-	10	13	16	4.10
14	30	35	40	15	18	14	2.57
12	35	40	50	20	25	12	1.62
10	50	55	70	25	30	10	1.018
8	70	80	95	35	40	8	.653
6	95	105	130	45	55	6	.410
4	125	140	175	60	70	6	.259
3	145	165	-	-	-	6	-
2	170	190	230	80	95	6	.162
1	195	220	-	-	-	4	-
0	230	260	310	-	-	4	.051
00	265	300	360	-	-	4	.081
000	310	350	415	-	-	3	.064
0000	360	405	490	-	-	3	.051

*Ampacities of single insulated conductors, 0-2000 volts,in free air, based on ambient air temperature of 30C

LEPRECON DIMMER CONTROL INPUT

Control Voltage: Leprecon dimmers and controllers are shipped trimmed for 0 to 10 volt control range. We recommend this as a standard in any systems trimmable to it because it's easy to measure, to use, and to relate to. (5v = 5/10 or 50%, 9v = 9/10 or 90%, etc.). If you must retrim to a different range to be compatible with another un-trimmable type of dimmer or controller, see "Trimming Procedures".

Control Connectors: Every LD dimmer has parallelled male and female control connectors. Pins 1-6 are control inputs 1-6, Pin 8 is common, Pin 7 is not connected. Connectors are Cinch-Jones P-308CCT and S-308CCT or equivalent. We suggest that female (S) connectors be used on a multi cable (snake) ends, because male pins are easily bent in handling.

Control Grounding The control common should be totally isolated throughout the system; it should *not* be connected to ground or neutral in the board, stage boxes, or dimmers. Some dimmers have grounded control commons. This won't be a problem in itself, but will aggravate other possible faults. The dimmer chassis must be tied to the safety ground. If the control commons are also tied there, any grounding errors or faults can cause large currents to flow in the small control cable leads, causing damage including burnt out cables and dangerous voltages in the control system.

CONTROL CABLE CONNECTORS FOR LEPRECON PRODUCTS

CAE sells cables for Leprecon dimmers, but some customers prefer to make their own for their specialized applications. Here are the connection details on Leprecon products. 22 gauge stranded wire is fine for control runs of any length.

Note: *Consoles have recessed male ("deep base") connectors. Dimmers have 1 each male and female. We suggest you use females on cables whenever possible to minimize bent pins.*

1) DIMMER -8 pin "Jones" - pin 1-6 = channels 1-6, pin 8 = control common.
(cable female = C.J. #S308-CCT; CAE #07-1089)
(cable male = C.J. #P308-CCT, CAE #07-1038)

2) DIMMER -with "ribbon cable header" input option #RRC: Pin 1-6 = channel 1-6, pin 9 & 10 = control common.
(Cable female = 3M #equivalent — CAE #07-0050)
(Crimps to 10 conductor — 050"CTR. 28GA. stranded ribbon cable-color coded)

3) LP250 - same as 1 above, but pin 7 has 28 vdc behind a 470 resistor to drive fan on-off relays on some dimmers.

4) LP-500 and LP-1001 -15 pin "Jones" — pin 1-12 = channels 1-12, pin 15 is common control, pin 13 is fan on-off.
(Cable fem. = C.J. #S315-CCT; CAE #07-1040)
(Cable male = C.J. #P315-CCT; CAE #07-1039)

5) LP-750 and LP-900 and LP-1000 -27 pin "Jones" - pin 1-24 = channels 1-24 (or 1-18), pins 26 & 27 are control common, pin 25 is fan on-off.
(Cable fem. = C.J. #S327-CCT; CAE #07-1059
(Cable male = CJ. #P327-CCT; CAE #07-1060

We recommend you put heat shrink over cable jacket under the cable clamp, and teflon tubing (8 gauge thin wall) over each soldered terminal with wire.

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TRIMMING LEPRECON DIMMERS

Note: *Leprecon products are factory trimmed for 0-10V control range. We suggest a 0-10 volt trim unless circumstances require otherwise (i.e., unless compatibility with non-trimmable dimmers or consoles is required.)*

Tools: digital meter, oscilloscope with 10X probe, ground fault protected outlet, control voltage source, test load & connectors as required.

1) Check console trim and adjust as necessary.
2) Hook up console (or a variable voltage supply) to dimmer control input, with some provisions for reading control input voltage with meter.
3) Hook up power to dimmer. Ground carefully and use a ground-fault-breaker-protected test circuit. Attach at least a 600 watt load, and a scope 10X probe, to the output of channel 1. BE CAREFUL!
4) Bring up dimmer channel 1 – adjust scope to display a full cycle of the output waveform. (Trigger scope off "line," and ground scope to chassis – not to neutral. Some ripple will result, but it's safer than t ying scope common to neutral).
5) **A)** Bring the control input up to full, or 100%. Adjust "Maximum 1-3" trimmer until the scope shows almost "100% on", then carefully adjust it until 100% is reached.

   B) Bring the control input to minimum level. Adjust "Minimum 1-3" trimmer until the scope shows minimal output, then carefully adjust it until the output just disappears (or, if preheat is desired, until the desired level of preheat is reached, as measured with an RMS meter on the output or graduations on the scope screen).

   C) Repeat A) and B) to fine tune.

   D) Move the control input from minimum to maximum and observe that the output moves smoothly from zero to full on.

   E) Repeat D) with second and third channels. Readjusting trimmers should not be necessary.

   F) Repeat A) through E) with channels 4 through 6.

Note: *To suit operator preferences, it may be desirable to adjust the preheat up, or the "high end" down. This can be done "by eye" on one channel, then establishing the desired output levels by RMS meter or scope and adjusting all dimmers accordingly.*

Keep in mind when using digital meters that the "apparent accuracy" – often to 1/10 of 1% of full reading – can be misleading. The meter itself isn't better than ± 2 or 3% accuracy! Trim accurate within 5% is generally quite adequate. The important thing is to trim to a standard, rather than by eye or guess. The eye is a very relative instrument.

Notes on Preheat: Some systems with short cable runs or extra high cold filament inrush currents, such as seriesed low voltage "aircraft" lamps, exhibit inrush high enough to trip load circuit breakers when a channel is bumped from cold to full. Setting the preheat so the dimmer delivers 2 to 5 volts to the lamps with console down will solve this problem.

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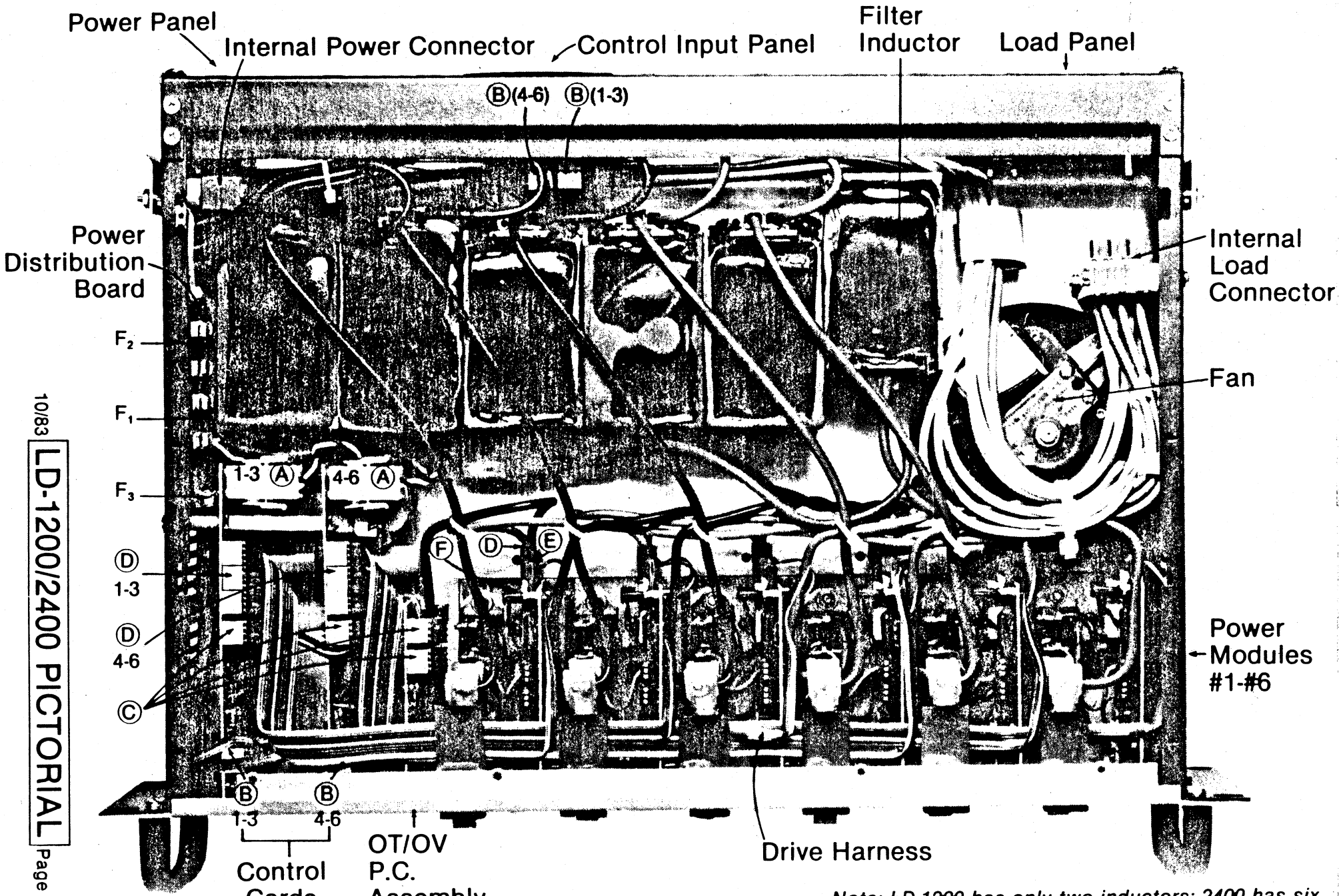
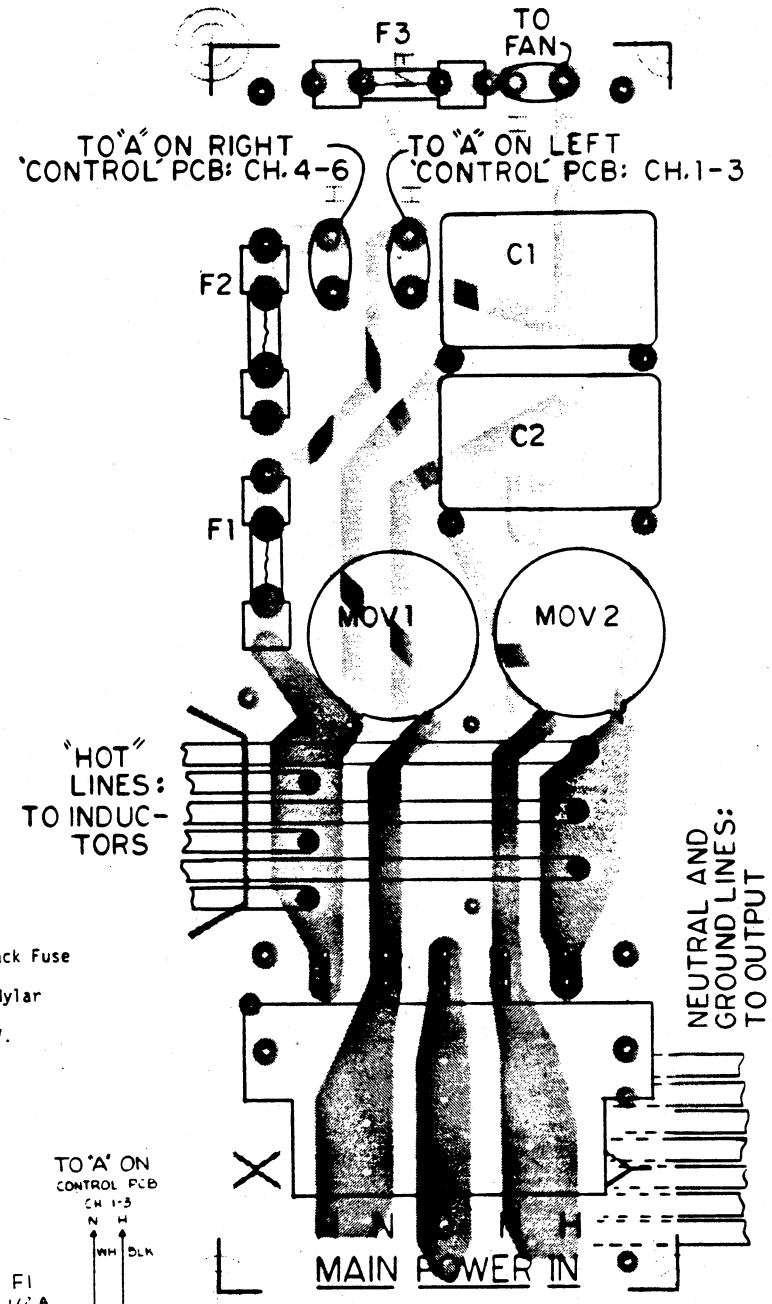


Note: LD-1200 has only two inductors; 2400 has six. Circled numbers refer to connector ref. #'s.

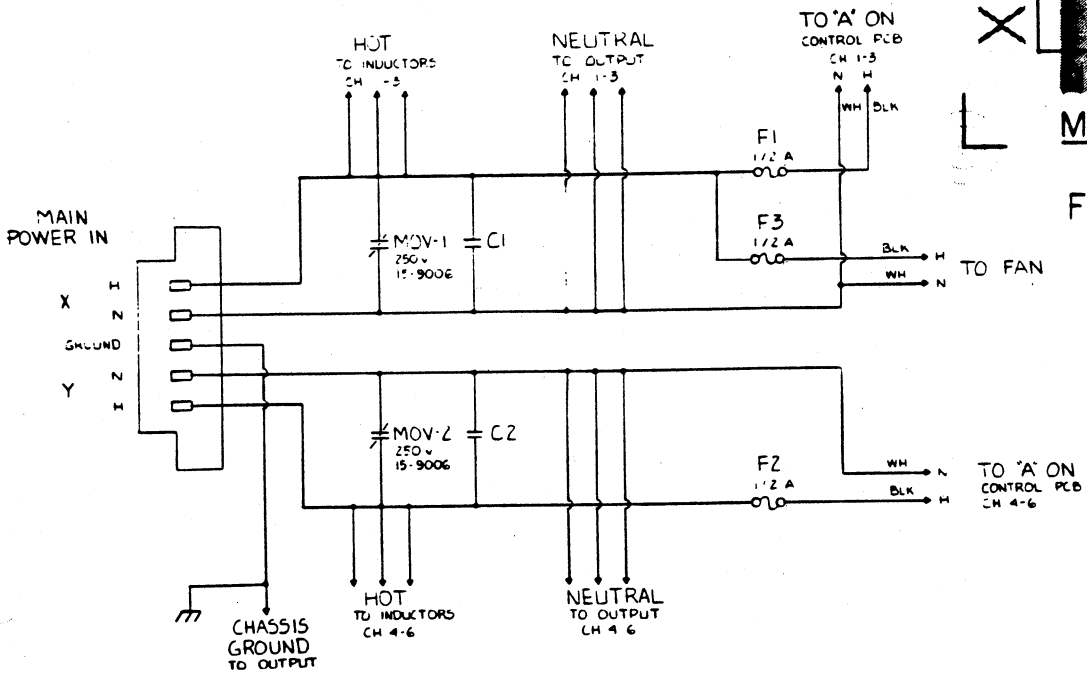
Power distr. board layout



FOIL SIDE VIEW

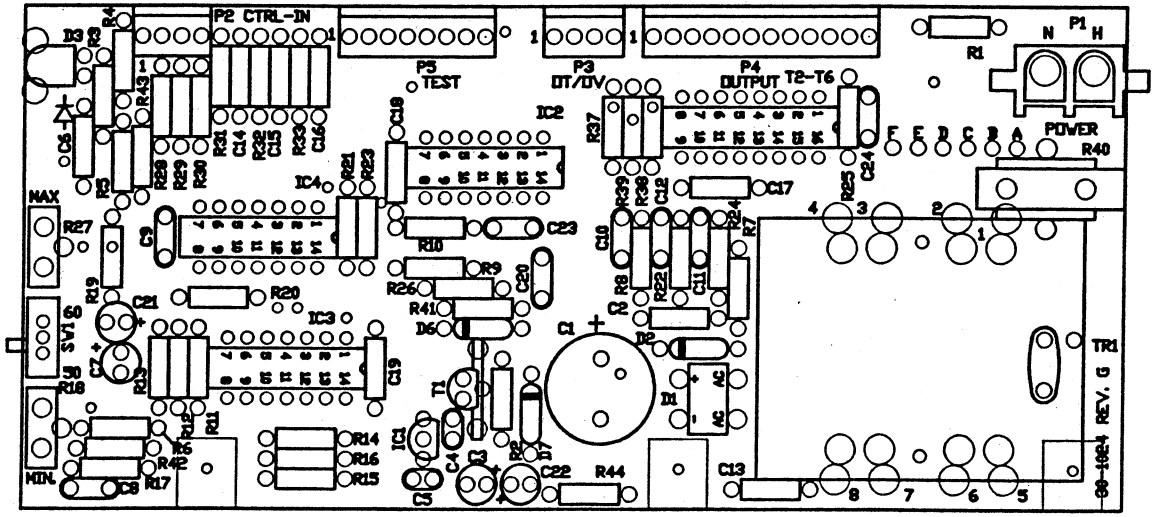
POWER DISTRIBUTION PCA
PARTS LIST

PARTS	PART NUMBER	DESCRIPTION
F1, 2, 3	15-4046	2A, 250V Flatpack Fuse
C1, 2	02-1019	.39/630 V Mylar
MOV1, 2	15-9006	250V M.O.V.



Power distr. board schematic

ASSEMBLY



#30-1024G

CONTROL PCA PARTS LIST

RESISTORS	PART NUMBER	DESCRIPTION
R1	01-0041	47
R2,4,8,10,26,37,38,39,43	01-0097	10K
R3	01-0065	470
R5,15,19,25	01-0083	2.7K
R6,16	01-0072	910
R7	01-0104	20K
R9	01-0129	220K
R11	01-0117	68K
R12,44	01-0121	100K
R13,17,42	01-0107	27K
R14,41	01-0093	6.8K
R18,27	08-1037	50K Trimpot
R20,22	01-2005	30.1K, 1%
R21,23	01-2010	475, 1%
R24	01-0113	47K
R28,29,30	01-2016	200K, 1%
R31,32,33	01-2015	66.5K, 1%
R40	15-9096	PTC Thermistor

CAPACITORS	PART NUMBER	DESCRIPTION
C1	02-2042	1000/35 LYTIC
C2,6,14-16,17-19	02-0008	.1/50 Disc
C3,21,22	02-2025	10/50 LYTIC
C4,5	02-2026	1/35 Tant
C7	02-2032	4.7/35 LYTIC
C8	02-1024	.033/100 MYLAR
C9,10	02-0003	.01/50 Disc
C11,12	02-1023	.1/50 FILM
C20	02-1006	.015 MYLAR

INTEGRATED CIRCUITS	PART NUMBER	DESCRIPTION
IC1	06-0029	78L05 Regulator
IC2,3	06-0021	LM339N
IC4	06-0001	LM324N

TRANSISTORS	PART NUMBER	DESCRIPTION
T1	04-0022	2N6725
T2-6	06-0106	CA3183E Array

DIODES	PART NUMBER	DESCRIPTION
D1	03-0013	1A,200V Bridge
D2	03-0002	IN4002
D3	03-1001	Green LED
D4,6,7	03-0004	IN4148

TRANSFORMER	PART NUMBER	DESCRIPTION
TR1	10-0026	DST-4-20

CONNECTORS	PART NUMBER	DESCRIPTION
P1	07-4007	2 Pin Mate-N-Lock
P2,3	07-0040	4 pin .1 ctr header
P4	07-0020	2 x 6 pin .1ctr header
P5	07-0020	6 pin .1 ctr header

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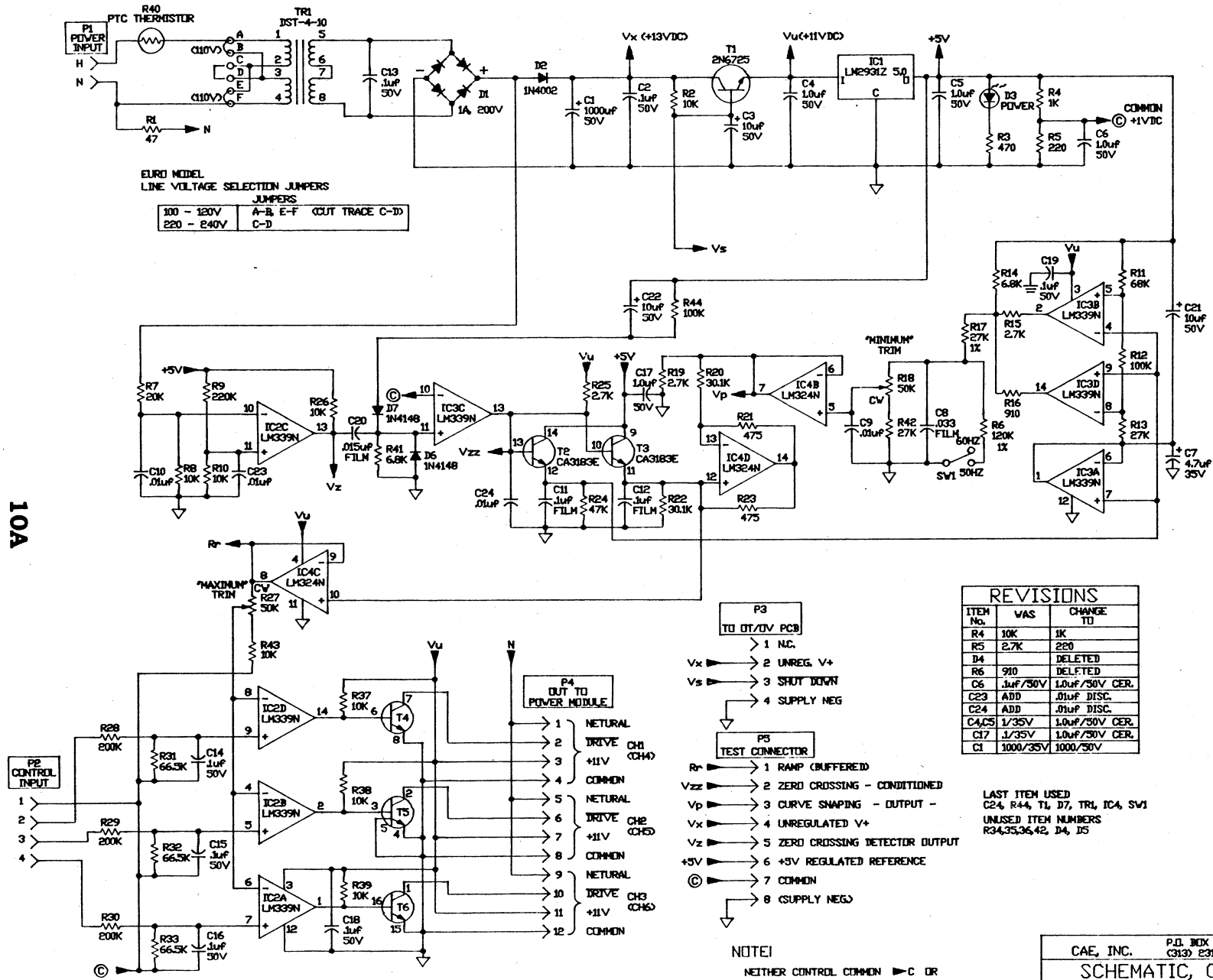
PARTS LAYOUT, CONTROL PCA

4/20/87 tmw | 30-1024G



10A

REVISIONS		
ITEM No.	WAS	CHANGE TO
R4	10K	1K
R5	2.7K	220
D4		DELETED
R6	910	DELETED
C6	.1uF/50V	1.0uF/50V CER.
C23	ADD	.01uF DISC.
C24	ADD	.01uF DISC.
C4,C5	1/35V	1.0uF/50V CER.
C17	.1/35V	1.0uF/50V CER.
C1	1000/35V	1000/50V

LAST ITEM USED
C24, R44, T1, D7, TR1, IC4, SW1

UNUSED ITEM NUMBERS
R34,35,36,42, D4, D5

CAD FILE: S049004

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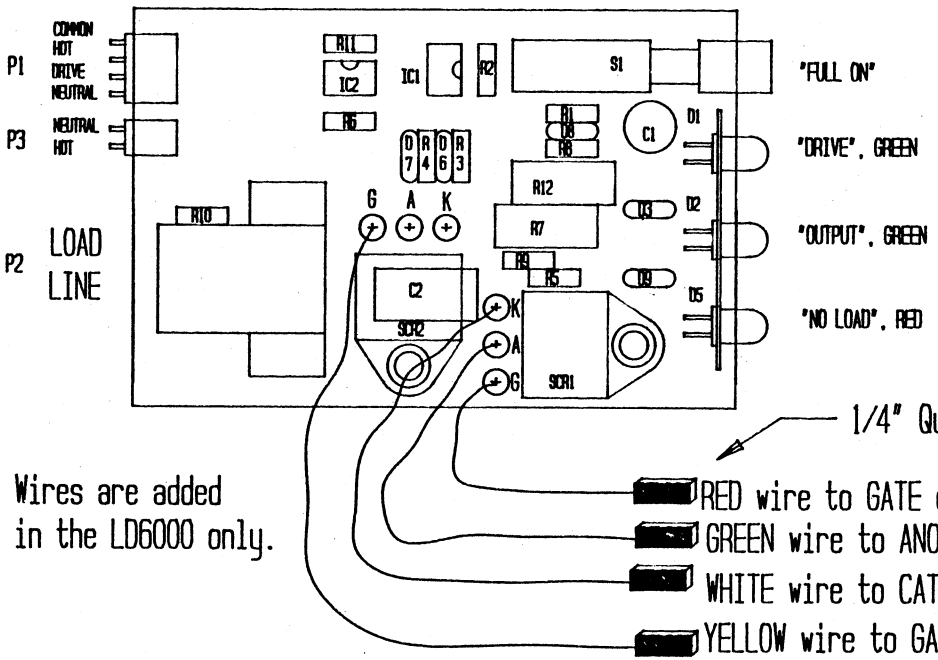
SCHEMATIC, CONTROL PCA

3/20/90 JF/DG 30-1024G

COMPONENT SIDE VIEW



Wires are added
in the LD6000 only.

1/4" Quick Connects

RED wire to GATE of SCR1
GREEN wire to ANODE SCR1 & CATHODE of SCR2
WHITE wire to CATHODE of SCR1 & ANODE of SCR2
YELLOW wire to GATE of SCR2

POWER MODULE PARTS LIST

RESISTORS	PART NUMBER	DESCRIPTION
R1	01-0079	1.8K
R2	01-0059	270
R3,4,9	01-0049	100
R5,6	01-0089	4.7K
R7	01-9019	24K,2W
R8	01-0069	680
R10	01-0121	100K
R11	01-0145	1MEG
R12	01-9018	15K,2W

CAPACITORS	PART NUMBER	DESCRIPTION
C1	02-2023	100/10 LYTIC
C2	02-1018	.1/40V MYLAR

DIODES	PART NUMBER	DESCRIPTION
D1,2	03-1001	Green LED
D3,6,7	03-0012	IN4005
D5	03-1003	Red LED
D8,9	03-0004	IN4148

INTEGRATED CIRCUIT & SCR'S	PART NUMBER	DESCRIPTION
IC1	03-3008	GE3020 400V Opto-triac
IC2	03-1007	4N27 Opto-coupler
SCR1,2	03-3009	65A, 400V SCR (LD-2400)
SCR1,2	03-3002	20A, 400V SCR (LD-1200)
SCR1,2	03-3010	90A, 400V SCR (LD-6000)

CONNECTORS	PART NUMBER	DESCRIPTION
P1	07-4001	4 Pin .1 Ctr header
P2	07-4010	2C Powerlock
P3	07-4035	2 Pin .1 Ctr header

SWITCHES	PART NUMBER	DESCRIPTION
S1	09-0010	Switch 2PDT Push-Push

NOTE: On the LD1200 and LD2400, both SCR's are on the foil side of the PCB.
On the LD6000 the SCRs are in a POWER-BLOCK and connected away from the PCB. The CATHODE of SCR1 is strapped together with the ANODE of SCR2 externally

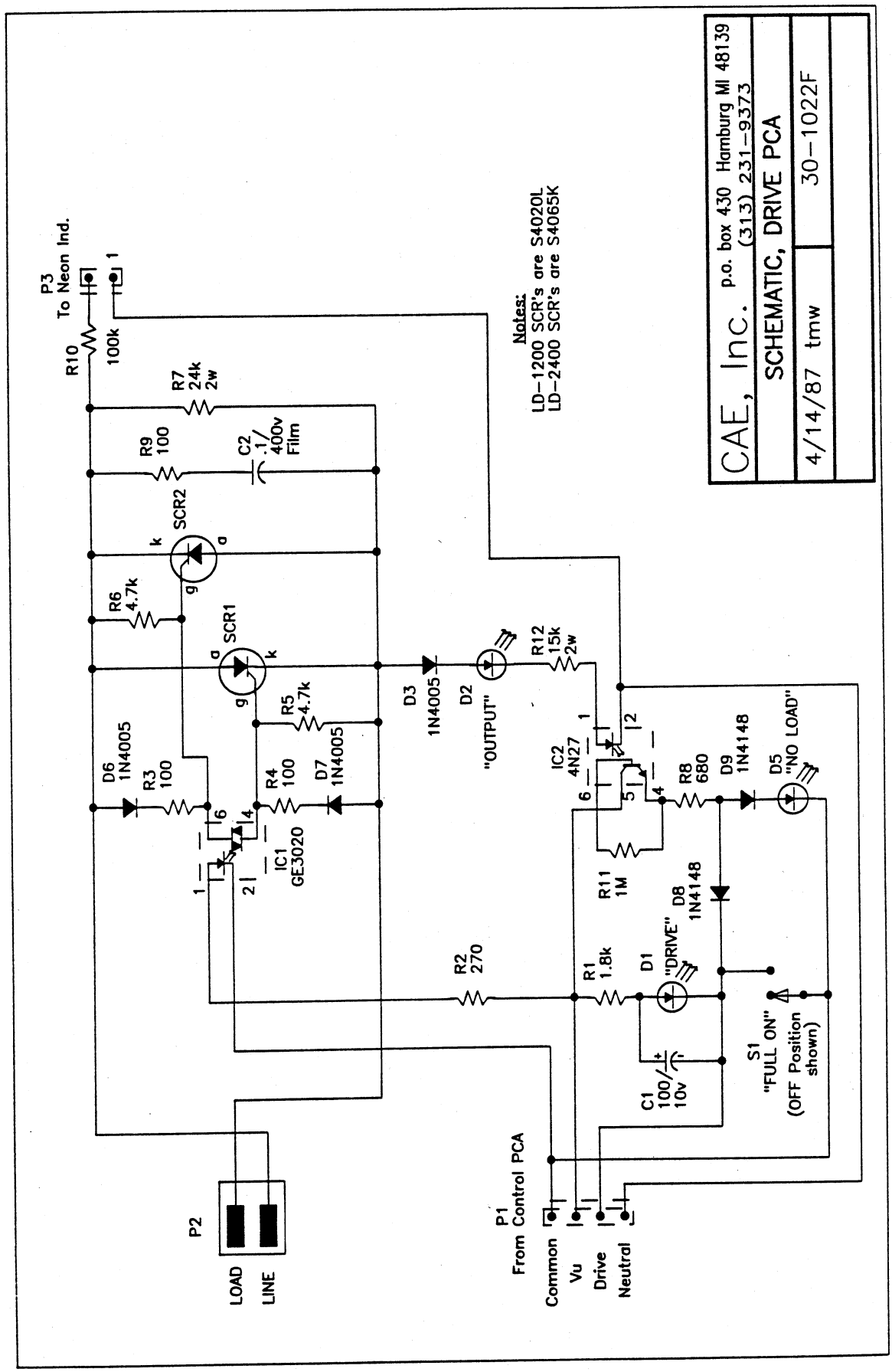
LD-2400 SCR's are Part Number 03-3009 in TO-218 pkg. (as shown)
LD-1200 SCR's are Part Number 03-3002 in TO-220 pkg.
LD-6000 SCR's are part #03-3010 in POWER-BLOC pkg.

CAE Inc. p.o. box 430 Hamburg, Mi. 48139 313-231-9373

LD-1200/2400/6000 Drive PCA Parts Layout

FILE NAME

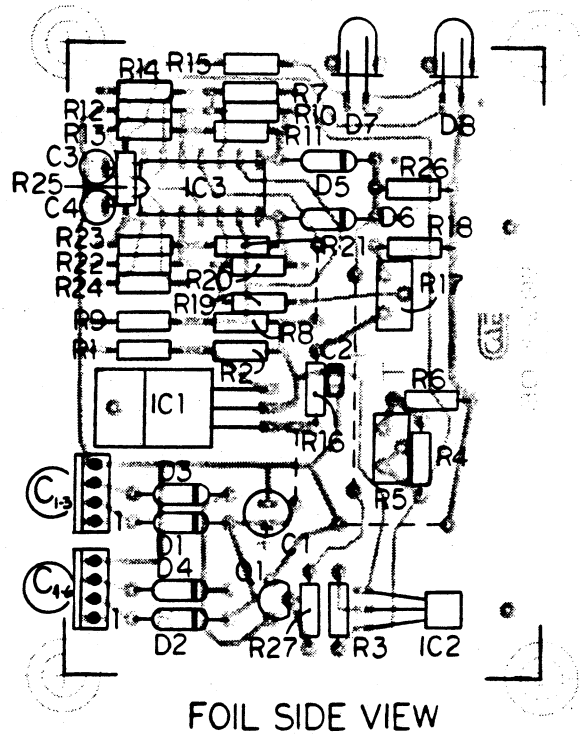
SIZE	DRAWN BY:	DWG NO.
A	TMW	30-1022F


CAE, Inc. p.o. box 430 Hamburg MI 48139 (313) 231-9373
SCHEMATIC, DRIVE PCA
4/14/87 tmw
30-1022F
Notes:
LD-1200 SCR's are S4020L
LD-2400 SCR's are S4065K
P3
To Neon Ind.
R10
100k
R7
24k
2w
R9
100
C2
.1/
400v
Film
SCR2
R6
4.7k
SCR1
R5
4.7k
D6
1N4005
R3
100
R4
100
D7
1N4005
IC1
GE3020
D3
1N4005
D2
"OUTPUT"
R12
15k
2w
IC2
4N27
R8
680
D9
1N4148
D5
"NO LOAD"
R11
1M
D8
1N4148
R2
270
R1
1.8k
D1
"DRIVE"
C1
100/
10v
S1
"FULL ON"
(OFF Position
shown)
P2
LOAD
LINE
P1
From Control PCA
Common
Vu
Drive
Neutral

11A

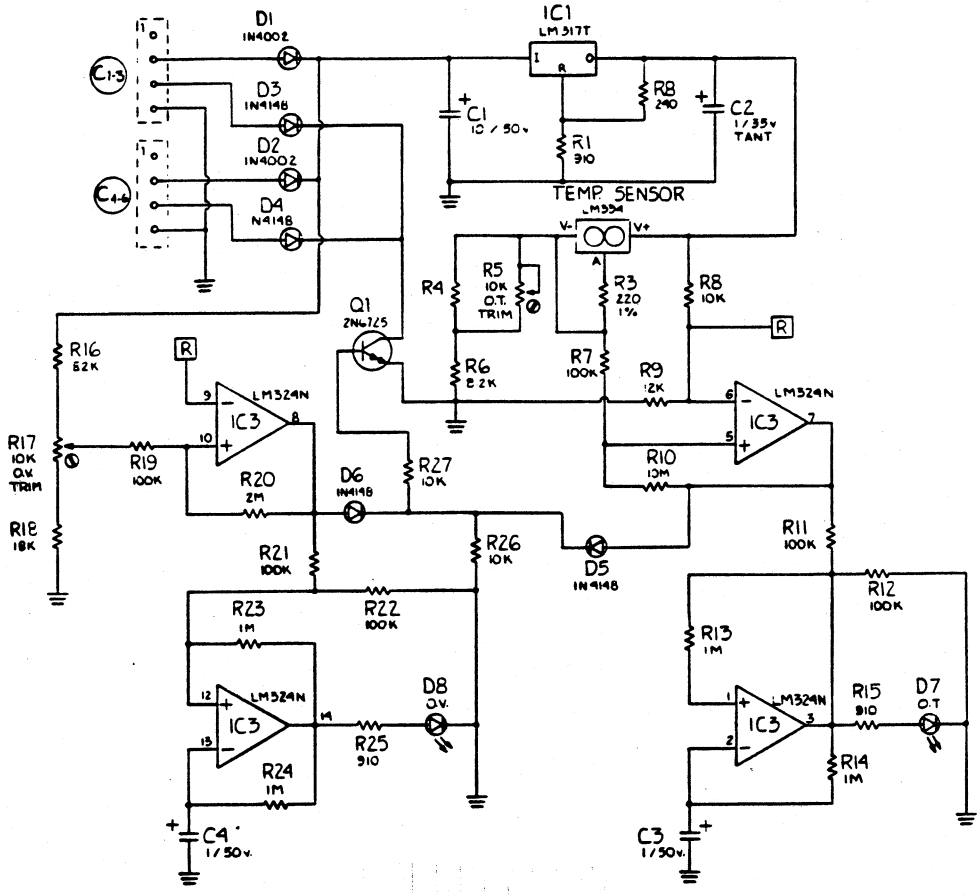
OT-OV PCB PARTS LIST

RESISTORS	PART NUMBER	DESCRIPTION
R1	01-0072	910
R2	01-0058	240
R3	01-2002	221, 1%
R4	01-0083	2.7K
R5	08-1019	10K Trimmer
R6	01-0095	8.2K
R7	01-0121	100K
R8	01-0097	10K
R9	01-0099	12K
R10	01-0169	10M
R11,12	01-0121	100K
R13,14	01-0145	1M
R15	01-0072	910
R16	01-0119	82K
R17	08-1019	10K Trimmer
R18	01-0103	18K
R19	01-0121	100K
R20	01-0152	2M
R21,22	01-0121	100K
R23,24	01-0145	1M
R25	01-0072	910
R26,27	01-0097	10K
DIODES		
D1,2	03-0002	IN4002
D3,4,5,6	03-0004	IN4148
D7,8	03-1003	LED RED
INTEGRATED CIRCUITS		
IC1	06-0057	LM317T
IC2	06-0061	LM334
IC3	06-0001	LM324
CAPACITORS		
C1	02-2025	10/50LY
C2	02-2026	1/35 TANT
C3,4	02-2003	1/50 LYTIC



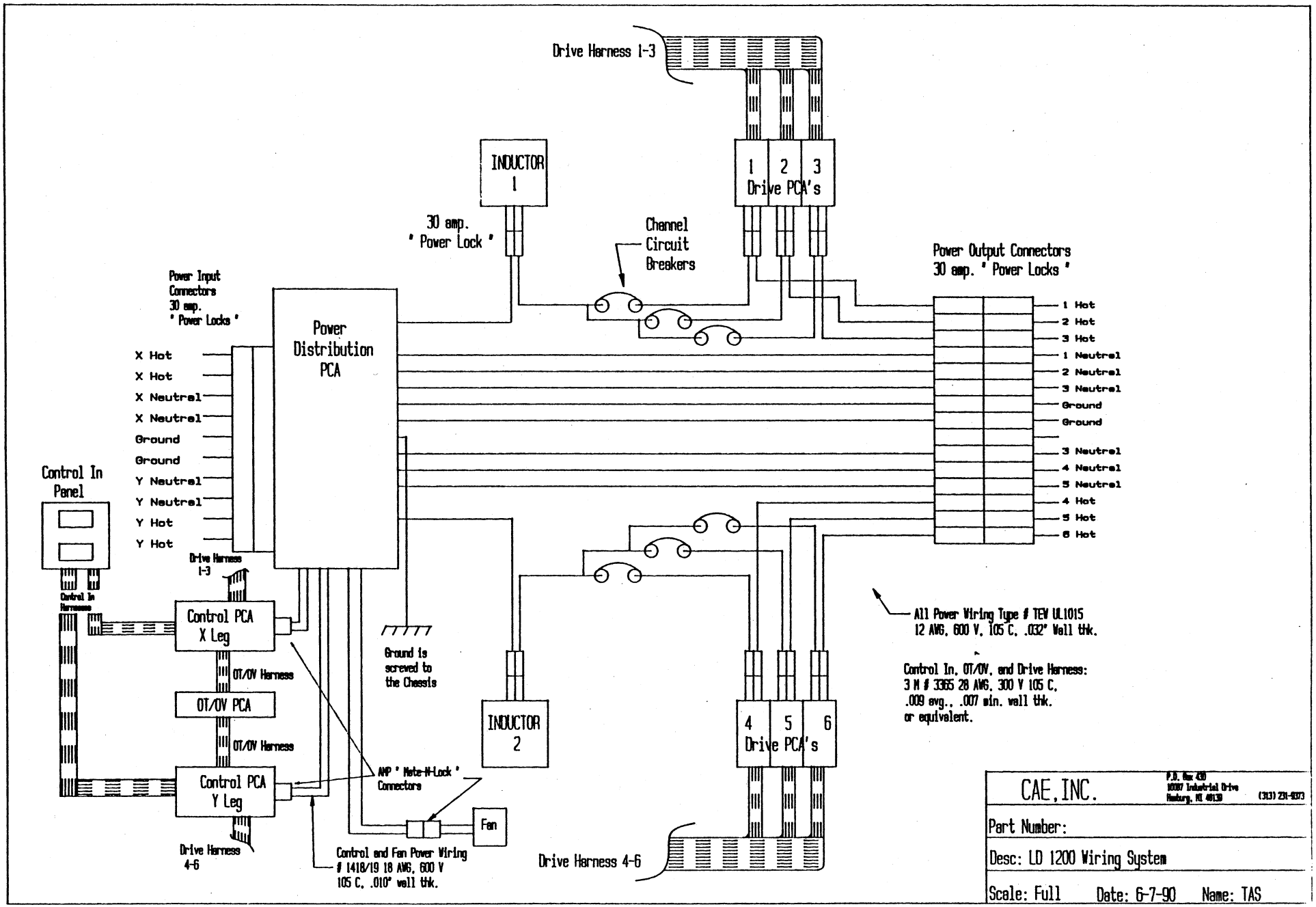
FOIL SIDE VIEW

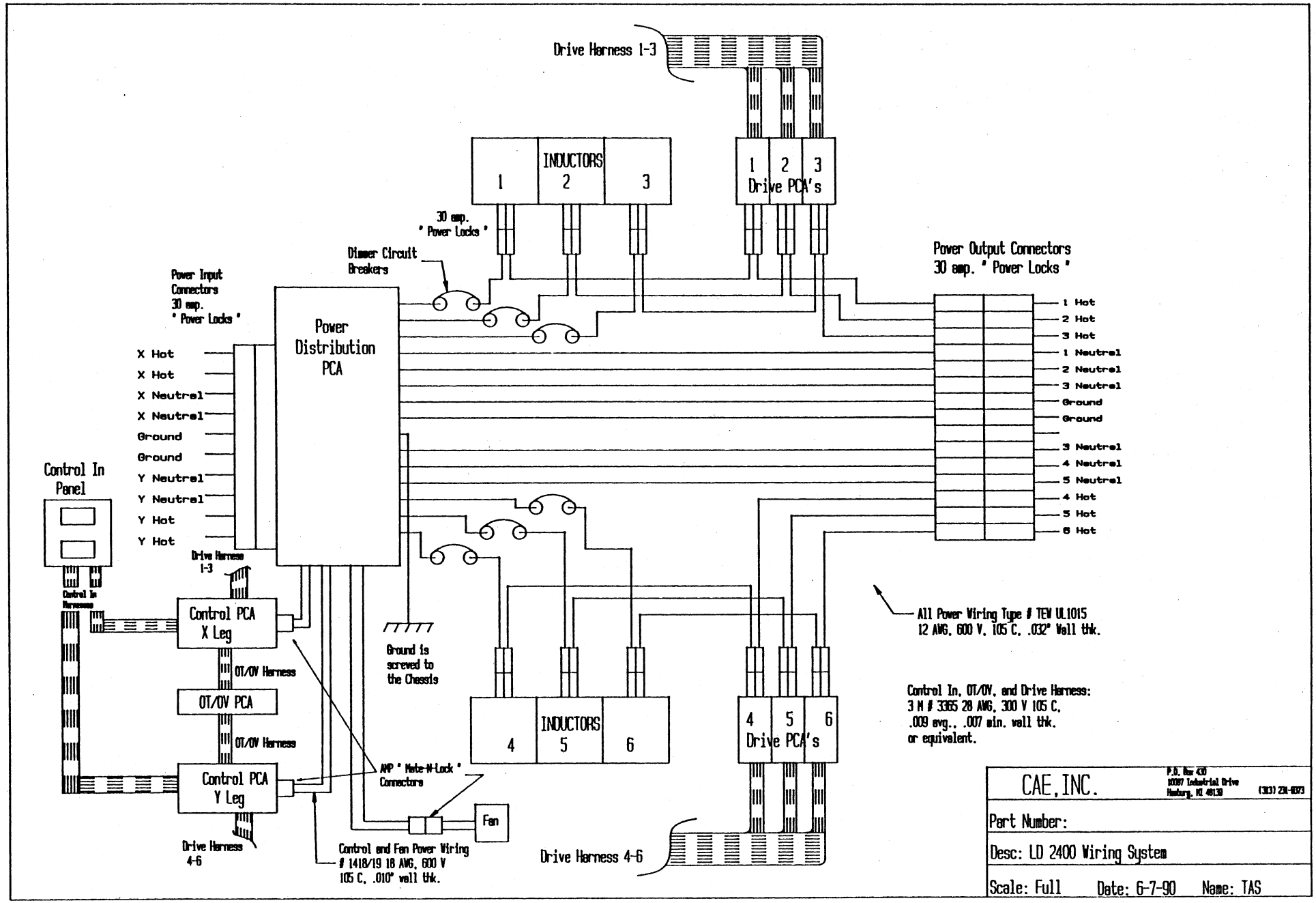
OT/OV PCA layout

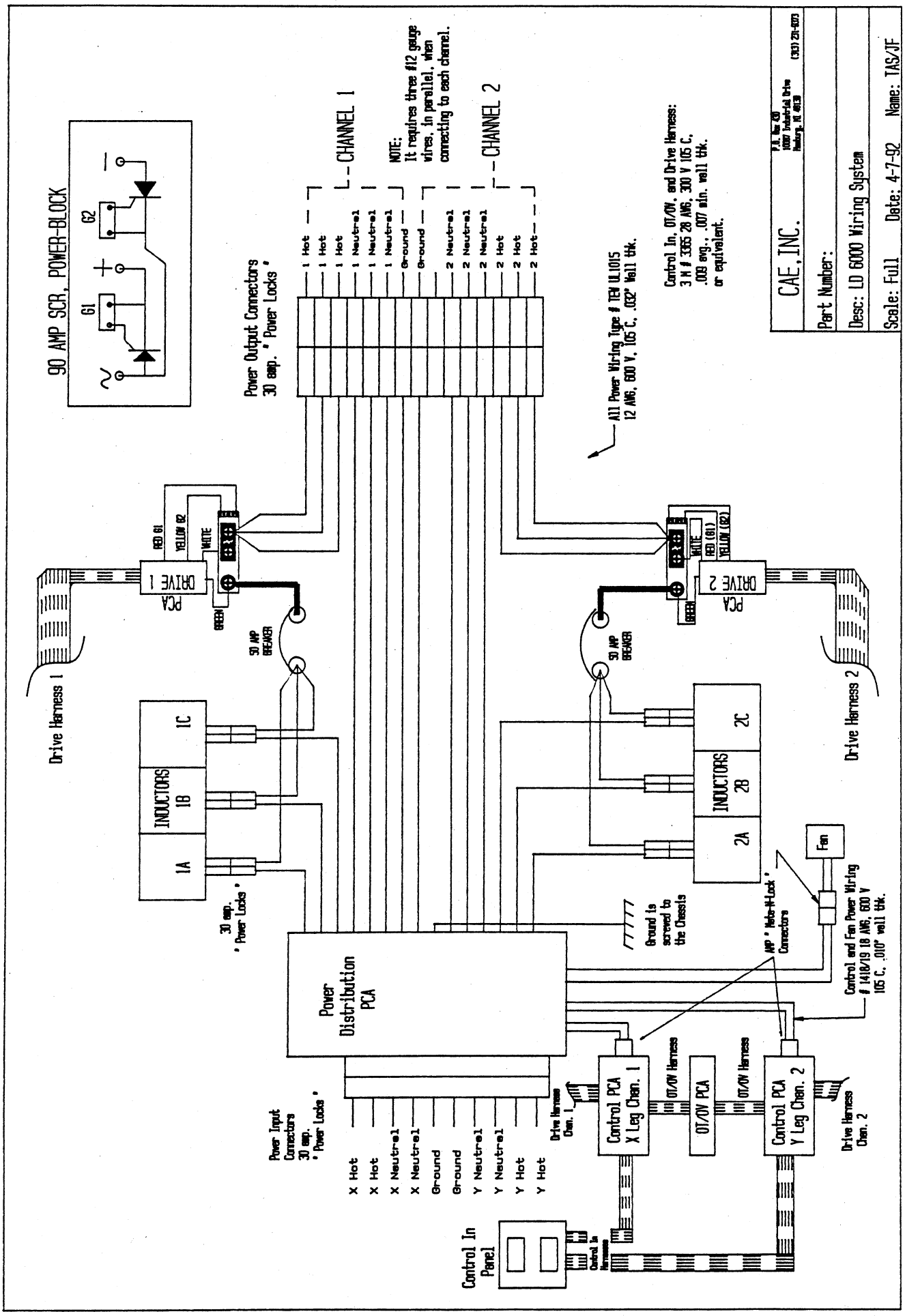


12 OT/OV schematic

6/8/83


Drive Harness 1-3
INDUCTOR 1
1 2 3 Drive PCA's
30 amp. ' Power Lock '
Channel Circuit Breakers
Power Output Connectors 30 amp. ' Power Locks '
Power Input Connectors 30 amp. ' Power Locks '
Power Distribution PCA
X Hot
X Hot
X Neutral
X Neutral
Ground
Ground
Y Neutral
Y Neutral
Y Hot
Y Hot
1 Hot
2 Hot
3 Hot
1 Neutral
2 Neutral
3 Neutral
Ground
Ground
3 Neutral
4 Neutral
5 Neutral
4 Hot
5 Hot
6 Hot
Control In Panel
Drive Harness 1-3
Control In Harnesses
Control PCA X Leg
OT/OV Harness
OT/OV PCA
OT/OV Harness
Control PCA Y Leg
Drive Harness 4-6
Ground is screwed to the Chassis
AMP ' Mate-N-Lock ' Connectors
Fan
Control and Fan Power Wiring # 1418/19 18 AWG, 600 V 105 C, .010" wall thk.
INDUCTOR 2
4 5 6 Drive PCA's
Drive Harness 4-6
All Power Wiring Type # TEW UL1015 12 AWG, 600 V, 105 C, .032" Wall thk.
Control In, OT/OV, and Drive Harness: 3 M # 3365 28 AWG, 300 V 105 C, .009 avg., .007 min. wall thk. or equivalent.
CAE, INC.
P.O. Box 230 10307 Industrial Drive Hamburg, MI 48139 (313) 231-9373
Part Number:
Desc: LD 1200 Wiring System
Scale: Full Date: 6-7-90 Name: TAS


Drive Harness 1-3
INDUCTORS
1
2
3
1 2 3
Drive PCA's
30 amp.
" Power Locks "
Dimmer Circuit
Breakers
Power Output Connectors
30 amp. " Power Locks "
Power Input
Connectors
30 amp.
" Power Locks "
Power
Distribution
PCA
X Hot
X Hot
X Neutral
X Neutral
Ground
Ground
Y Neutral
Y Neutral
Y Hot
Y Hot
1 Hot
2 Hot
3 Hot
1 Neutral
2 Neutral
3 Neutral
Ground
Ground
3 Neutral
4 Neutral
5 Neutral
4 Hot
5 Hot
6 Hot
Control In
Panel
Drive Harness
1-3
Control In
Harness
Control PCA
X Leg
OT/OV Harness
OT/OV PCA
OT/OV Harness
Control PCA
Y Leg
Drive Harness
4-6
Ground is
screwed to
the Chassis
AMP " Mate-N-Lock "
Connectors
Fan
Control and Fan Power Wiring
1418/19 18 AWG, 600 V
105 C, .010" wall thk.
INDUCTORS
4
5
6
4 5 6
Drive PCA's
Drive Harness 4-6
All Power Wiring Type # TEW UL1015
12 AWG, 600 V, 105 C, .032" Wall thk.
Control In, OT/OV, and Drive Harness:
3 M # 3365 28 AWG, 300 V 105 C,
.009 avg., .007 min. wall thk.
or equivalent.
CAE, INC.
P.O. Box XXX
10097 Industrial Drive
Hudson, MI 49138
(313) 231-8373
Part Number:
Desc: LD 2400 Wiring System
Scale: Full
Date: 6-7-90
Name: TAS


90 AMP SCR, POWER-BLOCK
G1
G2
CHANNEL 1
CHANNEL 2
NOTE:
It requires three #12 gauge wires, in parallel, when connecting to each channel.
Power Output Connectors
30 amp. ' Power Locks '
1 Hot
1 Neutral
Ground
2 Neutral
2 Hot
All Power Wiring Type # TEW UL1015
12 AWG, 600 V, 105 C, .032" Wall thk.
Control In, OT/OV, and Drive Harness:
3 M # 3365 28 AWG, 300 V 105 C,
.009 avg., .007 min. wall thk.
or equivalent.
CAE, INC.
P.O. Box 430
10000 Industrial Drive
Hamburg, NY 14075
(303) 214-6073
Part Number:
Desc: LD 6000 Wiring System
Scale: Full
Date: 4-7-92
Name: TAS/JF
DRIVE 1
DRIVE 2
PCA
RED (G1)
YELLOW (G2)
WHITE
GREEN
50 AMP BREAKER
Drive Harness 1
Drive Harness 2
INDUCTORS
1A
1B
1C
2A
2B
2C
30 amp. ' Power Locks '
Power Distribution PCA
Ground is screwed to the Chassis
Fan
AMP ' Mate-N-Lock ' Connectors
Control and Fan Power Wiring
1418/19 18 AWG, 600 V
105 C, .010" wall thk.
Power Input Connectors
30 amp. ' Power Locks '
X Hot
X Neutral
Ground
Y Neutral
Y Hot
Drive Harness Chan. 1
Control PCA X Leg Chan. 1
OT/OV Harness
OT/OV PCA
Control PCA Y Leg Chan. 2
Drive Harness Chan. 2
Control In Panel
Control In Harness